SOIL SURVEY

Carson Valley Area Nevada-California

Issued July 1971

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF NEVADA
and
UNIVERSITY OF CALIFORNIA
AGRICULTURAL EXPERIMENT STATIONS

Major fieldwork for this soil survey was done in the period 1958–60. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the area in 1965. This survey was made cooperatively by the Soil Conservation Service, and the University of Nevada and the University of California Agricultural Experiment Stations. It is part of the technical assistance furnished to the Carson Valley and Alpine Soil Conservation Districts.

This survey was partly financed by Douglas County and the Carson Valley Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased, on individual order, from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D. C. 20250.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

All of the soils in the Carson Valley Area are shown on the detailed map at the back of this survey. This map consists of many sheets 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 survey. This guide lists all of the soils of the area in alphabetic order by map symbol. It shows the page where each kind of soil is described and the page for the capability unit.

Interpretations not given in this publication 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 from the soil descriptions and from the discussions of the capability units and wildlife sites.

Game managers and sportsmen can find information about soils and wildlife in the section "Wildlife."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that give engineering descriptions of the soils in the area and that name soil features that affect engineering practices and structures.

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

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

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Contents

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SOIL SURVEY OF CARSON VALLEY AREA, NEVADA-CALIFORNIA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEVADA AND THE UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATIONS

THE CARSON VALLEY AREA consists of about 171 square miles in Douglas County and about 19 square miles in Alpine County (fig. 1). Nearly all the irrigated land in these counties is included in this survey area. Minden, the county seat of Douglas County, is in the center of the survey area.

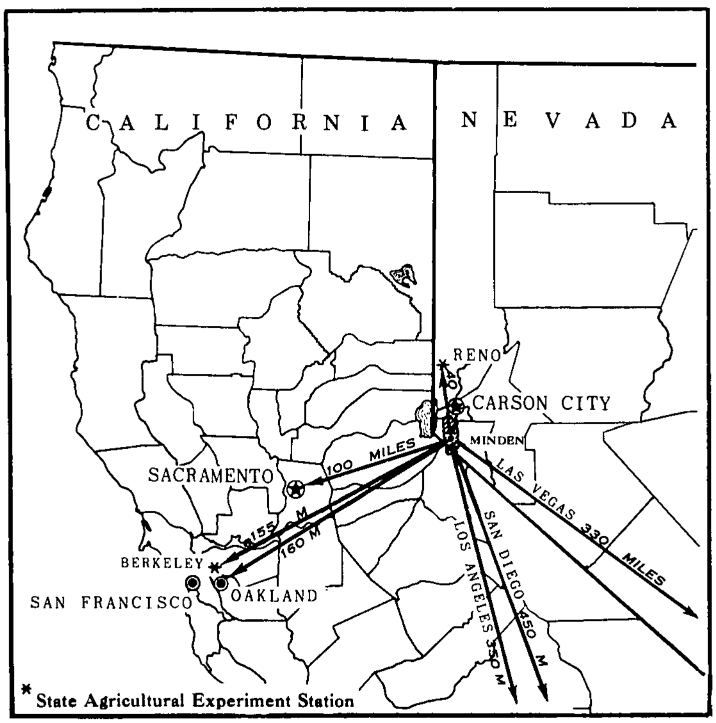

***Figure 1.*—Location of the Carson Valley Area in Nevada and California.**

The survey area consists of smooth, nearly level flood plains and low terraces along the Carson River and its forks, nearly level to sloping higher terraces and alluvial fans, rolling to very steep foothills, and very steep mountain slopes. The elevation ranges from about 4,625 feet at the northern end of Carson Valley to about 7,000 feet in the mountains along the western margin.

The Carson Valley Area has dry summers that are warm at the lower elevations and cool at the higher elevations and cold winters during which there are occasional spells of severe cold weather. The average annual precipitation, mostly in the form of snow, ranges from about 7 inches on the valley floor to about 30 inches in the mountains.

Farming has always been important in the Carson Valley Area. The raising of livestock, both cattle and sheep, and dairying are the most important enterprises. Alfalfa and grass-legume mixtures are the main forage crops. Irrigation is needed for all crop production. In 1960 there were 45,000 acres under water rights; of this acreage, about 26,000 acres was used for crops.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Carson Valley Area, where they are located, and how they can be used. They went into the area knowing they were likely to find many soils they had already seen and perhaps some they had not. As they worked in the county, they observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the 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 the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey *(6)*[1].

[1] Italic numbers in parentheses refer to Literature Cited, p. 128.

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. East Fork and Ophir, 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 undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Ophir gravelly sandy loam, 0 to 2 percent slopes, is one of several phases within the Ophir series, which in this area has two different textures in the surface layer and a slope range of 0 to 8 percent.

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

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. 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 phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of the Carson Valley Area; soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Franktown very stony and rocky complex, 45 to 80 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils. Aldax-Indiano very stony association, 16 to 45 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Cradlebaugh soils, poorly drained, slightly saline-alkali, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gullied land is a land type in the Carson Valley Area.

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

The soil scientists set up trial groups of soils on the basis of yield and practice tables and other data they have collected. 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 survey shows, in color, the soil associations in the Carson Valley 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 several minor soils, and it is named for 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 land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in the Carson Valley Area are discussed in the following pages. The textures in the descriptive legend are those of the surface layer.

1. Borda-Reno-Indian Creek association

Nearly level to steep, well-drained, gravelly and stony fine sandy loams and sandy loams on high terraces and foothills.

This association consists of nearly level to steep soils on high terraces and moderately steep to steep soils on foothills. It is in the northern part of the survey area and along the eastern and southern boundaries. It receives about 8 to 16 inches of precipitation a year.

This association makes up about 28 percent of the survey area. It is about 20 percent Borda soils, 17 percent Reno soils, and 15 percent Indian Creek soils. The rest consists of small areas of Aldax, Glenbrook, Indiano, Millich, Prey, Springmeyer, and Stodick soils, and the heavy subsoil variant of Prey soils.

Borda soils are deep to moderately deep, well drained, slowly permeable, and slightly acid to moderately alkaline. They have a fine-textured subsoil and are underlain by andesite or andesitic tuff-breccia.

Reno and Indian Creek soils are well drained, very slowly permeable, and slightly acid to moderately alkaline. They have a fine-textured subsoil. They formed in very gravelly alluvium derived from mixed rocks.

Most of this association has a cover of big sagebrush or low sagebrush and an understory of grasses. The rest has a cover of pinyon pine and an understory of big sagebrush and antelope bitterbrush. Livestock graze the available forage either during spring through fall or late in winter and early in spring. A few deer graze throughout the year, but many can be expected in winter when deep snow forces them from their high-altitude range.

A few pinyon pines are harvested as Christmas trees each year. In years of normal rainfall, the nuts are harvested for local consumption and for sale.

2. *Cradlebaugh-Fettic association*

Nearly level, somewhat poorly drained to poorly drained fine sandy loams and clay loams that have been affected by salts and alkali; on low terraces

This association consists of nearly level soils that have been affected by salts and alkali. It occurs on smooth low terraces in the central and north-central parts of the survey area. It receives about 8 to 12 inches of precipitation a year.

This association makes up about 10 percent of the survey area. It is about 55 percent Cradlebaugh soils and 12 percent Fettic soils. The rest consists of small areas of the thin solum variant of Dangberg soils, of Heidtman, Hussman, Job, Jubilee, and Ormsby soils, and of the gypsic variant of Puddle soils.

Cradlebaugh soils are somewhat poorly drained to poorly drained. They are generally moderately fine textured and contain alkali-soluble hardpan fragments. Permeability is slow, and the content of organic matter is moderately high.

Fettic soils are somewhat poorly drained. They have a fine-textured subsoil. Permeability is very slow, and the content of organic matter is moderate.

Much of this association is in native meadow or range. The rest is used for irrigated crops and pasture.

The quantity of vegetation varies widely, depending upon the content of salts and alkali. Sedges, baltic-rush, and saltgrass grow in the meadows, and greasewood and a sparse understory of saltgrass grow on the range. The meadows and some of the range areas are irrigated.

If drained, leveled, and leached, these soils are suited to alfalfa for hay, grass-legume pasture, and other crops. In their natural state, they are suitable only for native pasture. A fairly large area has been leveled and is used for crops and grass-legume pasture.

Because of the concentration of salts and alkali, reclamation of these soils is difficult and slow. Nevertheless, additional areas can be reclaimed if a stable supply of water becomes available and drainage is provided.

3. *Dressler-Hussman-East Fork association*

Nearly level, somewhat poorly drained sandy loams, clay loams, and clays on low terraces

This association consists of nearly level to gently sloping, moderately coarse textured, moderately fine textured, and fine textured soils on low smooth terraces along the East Fork and the West Fork of the Carson River. It is mainly in the south-central and southern parts of the survey area. It receives about 10 to 14 inches of precipitation each year.

This association makes up about 9 percent of the survey area. It is about 18 percent Dressler soils, 17 percent Hussman soils, and 16 percent East Fork soils. The rest consists of small areas of Brockliss, Draper, Henningsen, and Settlemeyer soils and the moderately deep variant of Henningsen soils.

Dressler soils have a moderately coarse textured surface layer and a coarse textured substratum. The upper part of the profile is noncalcareous. Permeability is rapid. The content of organic matter is moderate.

Hussman soils are fine textured. The upper part of the profile is noncalcareous. Permeability is slow, and the content of organic matter is moderately high.

East Fork soils are moderately fine textured. The upper part of the profile is noncalcareous. Permeability is moderately slow, and the content of organic matter is moderate.

Most of this association is irrigated and used for crops, pasture, or meadow. Good water rights are available in most areas, and there is an average supply of irrigation water. The principal crops are alfalfa or alfalfa-grass mixtures and small grain, commonly grown in rotation. Irrigated meadows are ordinarily used for grazing after a crop of hay has been harvested. Most meadows can be leveled and used for cultivated crops.

4. *Kimmerling-Voltaire-Dangberg association*

Nearly level, poorly drained loams, silty clays, and clays on flood plains and low alluvial terraces and in basins

This association consists of nearly level, dark-colored soils in smooth to slightly concave areas, mainly in the western half of the survey area. These areas receive about 8 to 14 inches of precipitation each year. The poor drainage is mainly a result of the release of ground water along the Sierra Nevada front.

This association makes up about 11 percent of the survey area. It is about 18 percent Kimmerling soils, 18 percent Voltaire soils, and 15 percent Dangberg soils. The rest consists of small areas of Bishop, Job, Jubilee, and Settlemeyer soils, and the sand substratum variant of Jubilee soils.

Kimmerling soils are very deep. They have a medium-textured surface layer and below that a moderately fine textured layer. Permeability is moderately slow, and the content of organic matter is high.

Voltaire soils are deep and fine textured. Permeability is slow, and the content of organic matter is high.

Dangberg soils are moderately deep and fine textured and have been affected by salts and alkali. They are underlain by a hardpan strongly cemented with silica. Permeability is very slow in the subsoil and the upper part of the substratum and very rapid in the lower part of the substratum.

Most of this association is meadow, but a small acreage is irrigated and used for crops. The meadows are used for grazing after a crop of hay has been cut. They have a fairly dense cover, either of sedges, juncus, and water-tolerant grasses and clover, or of saltgrass, creeping wildrye, and Great Basin wildrye. The meadow stands could be improved by irrigating less frequently in spring when the water table is high and the soils are cold, by planting improved water-tolerant varieties of grass and clover, and by using commercial fertilizer. Valley-wide improvements in drainage and irrigation would be needed to control the water table.

Molybdenum toxicity is a hazard to livestock where pasture has been seeded to clover and treated with commercial fertilizer. The adverse effects of this toxicity can be offset by supplying the livestock with salt that contains copper sulfate or giving injections of copper glycinate.

5. *Mottsville-Holbrook-Ophir association*

Nearly level to steep, excessively drained to poorly drained gravelly or stony fine sandy loams, sandy loams, or loamy coarse sands on alluvial fans

This association consists of nearly level to steep, dark-colored, micaceous soils on alluvial fans. It occurs as a strip of varying width along the eastern edge of the Carson Range. It receives about 10 to 15 inches of precipitation each year.

This association makes up about 15 percent of the survey area. It is about 35 percent Mottsville soils, 25 percent Holbrook soils, and 20 percent Ophir soils. The rest consists mainly of small areas of Cave Rock, Calpine, and James Canyon soils; the calcareous variant of the James Canyon soils; and the pan variant of Fettic soils.

Mottsville soils are very deep, excessively drained, and coarse textured. Permeability is very rapid, and the available water capacity is low. The reaction is neutral to slightly acid. The content of organic matter is moderate.

Holbrook soils are deep, well drained, moderately coarse textured, and very gravelly, cobbly, and stony. Permeability is moderately rapid, and the available water capacity is low. The reaction is neutral to slightly acid. The content of organic matter is moderate.

Ophir soils are very deep, poorly drained to somewhat poorly drained, and coarse textured. Permeability is rapid, and the available water capacity is low. Reaction is neutral to slightly acid. The content of organic matter is high.

Most of this association is range. The lower, more poorly drained parts are in meadow or are used for pasture, hay, and grain crops.

The range provides limited grazing for livestock and wildlife. The cover consists predominantly of big sagebrush, bitterbrush, and an understory of grasses. Jeffrey pine grows on the upper margins of alluvial fans and along some drainageways. If ground water can be developed for irrigation, areas now in native brush can be cleared, leveled, and seeded to alfalfa. The soils are droughty and require much water.

Some areas on the larger alluvial fans have been leveled and seeded to legume-grass pasture mixtures in rotation with small grain. Hay grown in these areas, particularly clover, may contain enough molybdenum to be toxic to livestock. Native plants generally take up less molybdenum than introduced plants.

The meadows provide considerable forage. The cover consists predominantly of sedges, juncus, and native grasses and clover. Water for irrigation comes mainly from local creeks, among which are James Canyon Creek, Daggett Creek, Sheridan Creek, Jobs Canyon Creek, Luther Creek, and Indian Creek. Additional water is pumped from ground-water sources.

Little timber is harvested from soils of this association.

6. *Toiyabe-Franktown association*

Steep to very steep, excessively drained to somewhat excessively drained stony sandy loams and stony loamy coarse sands on mountain slopes

This association consists of steep to very steep, dark-colored soils interspersed with rock outcrops on mountain slopes. It occurs as a strip of varying width along the western boundary of the survey area. It receives about 16 to 24 inches of precipitation each year.

This association makes up about 3 percent of the survey area. It is about 65 percent Toiyabe soils and 25 percent Franktown soils. The rest consists of small areas of Glenbrook and Mottsville soils.

Toiyabe soils are shallow, excessively drained, coarse textured, and very gravelly. They formed in residuum weathered from granite. Permeability is rapid, and the reaction is medium acid. The content of organic matter is high.

Franktown soils are very shallow, somewhat excessively drained, moderately coarse textured, and very gravelly. They formed in residuum weathered from gneiss and slate. Permeability is rapid, and the reaction is medium acid. The content of organic matter is high.

Most of this association is in timber, and the rest is in range. It is also used for recreation and water supply. A limited amount of timber could be harvested. The timbered areas have a relatively thin stand of Jeffrey pine and an understory of big sagebrush, bitterbrush, and grasses. Big sagebrush, bitterbrush, and grasses also make up the cover in burned-over areas that have no trees. These plants provide forage for wildlife. The slopes are so steep that livestock generally do not graze in these areas.

7. *Toll-Washoe-Turria association*

Nearly level to moderately sloping, well-drained and somewhat excessively drained sands, sandy loams, cobbly sandy loams, clay loams, and loams on alluvial fans and terraces

This association consists of nearly level to strongly sloping soils on generally smooth alluvial fans and terraces. It is mainly northeast of Minden, but there is also a large area south of Minden. It receives 8 to 14 inches of precipitation each year.

This association makes up about 24 percent of the survey area. It is about 20 percent Toll soils, 16 percent Washoe soils, and 14 percent Turria soils. The rest consists of small areas of Cashmere, Gardnerville, Godecke, Haybourne, McFaul, Ormsby, and Quincy soils.

Toll soils are very deep, somewhat excessively drained, and coarse textured. Permeability is rapid, and the reaction is slightly acid to neutral. The content of organic matter is low.

Washoe soils are very deep and well drained. They have a gravelly, moderately fine textured to moderately coarse textured subsoil. Permeability is moderately slow, and the reaction is slightly acid to neutral. The content of organic matter is moderate.

Turria soils are very deep and well drained. They have a moderately fine textured subsoil. There is some lime in the substratum. Permeability is moderately slow, and the content of organic matter is low.

Most of this association is either in range or in small tracts that are being homesteaded. About one quarter of the acreage is used for irrigated crops and pasture.

The vegetation on this association provides some grazing for livestock. It consists predominantly of big sagebrush but includes some Mormon-tea, rabbitbrush, and desert peach and an understory of cheatgrass and squirreltail. There are also spots of spiny hopsage, bud sagebrush, and saltbush.

Some homesteads were once cleared and seeded to cereal rye, but the crops were not irrigated and yields were poor.

Where water is available, the soils have been leveled and irrigated and used for crops or grass-legume pasture. The principal crops are alfalfa and small grain, commonly grown in rotation.

Some soils in other areas could be cleared, leveled, and irrigated if additional river water or ground water became available for irrigation. Low-lying soils may need to be drained so that irrigation does not raise the water table.

Descriptions of the Soils

This section describes the soil series and individual soils, or mapping units, of the Carson Valley Area. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The method is to describe the more easily observed features and geographic setting of each soil series, and then the soils, or mapping units, in the series. The first mapping unit following the soil series description is described in detail, and the other mapping units, mainly by referring to the first one. The first mapping unit has a short narrative description of a typical profile and a much more detailed description of the same profile, from which highly technical interpretations can be made.

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 it has been placed. The page on which a given capability unit is described can be found readily by referring to the "Guide to Mapping Units."

Many of the terms used in the soil descriptions and in other sections of the survey are defined in the Glossary. Unless otherwise indicated, the colors mentioned are for dry soils and the texture is generally that of the layer at depths between 10 to 40 inches.

Aldax Series

The Aldax series consists of well-drained, stony and very stony soils underlain at a depth of 9 to 20 inches by andesite. These soils are in the foothills in the southern and northeastern parts of the Carson Valley Area. They have slopes of 4 to 45 percent. The vegetation consists dominantly of sagebrush, bitterbrush, and grasses, but it covers only 10 to 15 percent of the surface. Elevations range from 5,000 to 6,000 feet. The annual precipitation ranges from 12 to 16 inches, and the frost-free season from 70 to 90 days. The average annual air temperature is between 43° and 45° F.

Aldax soils occur with Indiano, Springmeyer, Toll, Borda, and Millich soils.

Soils of the Aldax series are used mainly for grazing and wildlife habitat.

Aldax stony fine sandy loam, 16 to 45 percent slopes (AdE).—This soil occurs as scattered areas in the foothills along the Nevada-California boundary. The surface layer typically is 14 inches thick. It consists of grayish-brown stony fine sandy loam over brown, very stony fine sandy loam. It is underlain by andesite bedrock. Reaction is neutral.

Representative profile of Aldax stony fine sandy loam, 16 to 45 percent slopes, under native vegetation, south-southeast of Mud Lake, approximately 1,000 feet east and 1,000 feet south of the northwest corner of sec. 10, T. 11 N., R. 20 E.

A11—0 to 3 inches, grayish-brown (10YR 5/2) stony fine sandy loam, very dark brown (10YR 2/2) when moist; weak, medium and fine, granular structure; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine and fine interstitial pores; neutral (pH 6.6); clear, wavy boundary.

A12—3 to 14 inches, brown (10YR 5/3) very stony fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine and very fine granular structure; soft, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.6); abrupt, irregular boundary.

R—14 inches, extremely hard, undecomposed andesite bedrock.

The depth to bedrock ranges from 9 to 20 inches. Stones, cobblestones, and gravel make up 20 to 50 percent of the A11 horizon and 50 to 75 percent of the A12 horizon. The content of coarse fragments varies with proximity to rock

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

Soil	Area	Extent
	Acres	*Percent*
Aldax stony fine sandy loam, 16 to 45 percent slopes	599	0.5
Aldax very stony fine sandy loam, 4 to 45 percent slopes	1,134	.9
Aldax-Indiano very stony association, 16 to 45 percent slopes	1,706	1.4
Bishop loam, cool	440	.4
Bishop loam, cool, eroded	95	.1
Bishop loam, clay substratum, cool	216	.2
Bishop loam, poorly drained, cool	513	.4
Bishop loam, poorly drained, slightly saline-alkali, cool	139	.1
Borda stony sandy loam, 16 to 45 percent slopes	4,917	4.0
Borda gravelly sandy loam, 4 to 16 percent slopes	1,643	1.4
Brockliss stony loamy sand, 0 to 8 percent slopes	1,078	.9
Brockliss gravelly loamy sand, 0 to 2 percent slopes	116	.1
Brockliss stony loamy sand, water table, 0 to 4 percent slopes	283	.2
Calpine gravelly coarse sandy loam, 0 to 2 percent slopes	136	.1
Calpine stony coarse sandy loam, 2 to 8 percent slopes	121	.1
Cashmere fine sandy loam	498	.4
Cave Rock loamy sand, 2 to 8 percent slopes	283	.2
Cradlebaugh soils, slightly saline-alkali	1,659	1.4
Cradlebaugh clay loam	264	.2
Cradlebaugh clay loam, poorly drained, slightly saline, strongly alkali	205	.2
Cradlebaugh clay loam, poorly drained, strongly saline-alkali	386	.3
Cradlebaugh soils, poorly drained, slightly saline-alkali	2,212	1.8
Cradlebaugh soils, slightly saline, strongly alkali	265	.2
Cradelbaugh soils, strongly saline-alkali	1,657	1.4
Dangberg clay	514	.4
Dangberg clay, strongly alkali	308	.3
Dangberg clay, strongly saline-alkali	494	.4
Dangberg clay, water table	536	.4
Dangberg clay, water table, strongly alkali	207	.2
Dangberg clay, thin solum variant	628	.5
Draper loam	370	.3
Draper loam, overflow	545	.5
Dressler sandy loam, 0 to 2 percent slopes	866	.7
Dressler gravelly sandy loam, 0 to 2 percent slopes	154	.1
Dressler gravelly sandy loam, water table, 0 to 2 percent slopes	202	.2
Dressler sandy loam, water table, 0 to 2 percent slopes	306	.3
Dressler sandy loam, water table, 2 to 4 percent slopes	420	.4
East Fork clay loam	929	.8
East Fork loam	449	.4
Fettic very fine sandy loam	862	.7
Fettic clay, strongly saline	447	.4
Fettic clay loam	166	.1
Fettic very fine sandy loam, pan variant, 2 to 4 percent slopes	188	.2
Franktown very stony and rocky complex, 45 to 80 percent slopes	916	.8
Gardnerville clay loam	990	.8
Gardnerville clay	740	.6
Gardnerville clay, slightly saline-alkali	243	.2
Gardnerville clay loam, deep water table	891	.7
Gardnerville clay loam, gravel substratum	144	.1
Gardnerville clay loam, slightly saline-alkali	386	.3
Glenbrook sand, 8 to 30 percent slopes	1,414	1.2
Glenbrook rocky sand, 30 to 60 percent slopes	706	.6
Godecke clay loam	1,589	1.3
Gullied land	100	.1
Haybourne loam, 0 to 2 percent slopes	670	.6
Haybourne loam, 2 to 4 percent slopes	203	.2
Haybourne sand, 0 to 4 percent slopes	1,609	1.3
Heidtman clay loam	906	.7
Heidtman clay loam, clay substratum	374	.3
Heidtman loam, slightly saline-alkali	136	.1
Henningsen gravelly loam	785	.6
Henningsen clay loam, water table	240	.2
Henningsen gravelly loam, water table	406	.3
Henningsen loam	242	.2
Henningsen loam, water table	282	.2
Henningsen loam, moderately deep variant	314	.3
Henningsen clay loam, moderately deep variant	459	.4
Holbrook gravelly fine sandy loam, 2 to 4 percent slopes	266	.2
Holbrook gravelly fine sandy loam, 4 to 8 percent slopes	911	.8
Holbrook gravelly fine sandy loam, water table, 2 to 4 percent slopes	134	.1
Holbrook very stony fine sandy loam, 4 to 16 percent slopes	3,306	2.7
Hussman clay	1,188	1.0
Hussman clay, slightly saline-alkali	164	.1
Hussman clay loam, strongly saline-alkali	192	.2
Hussman silty clay loam, slightly saline-alkali, overflow	302	.3
Indian Creek very cobbly loam, 0 to 4 percent slopes	776	.6
Indian Creek gravelly fine sandy loam, 4 to 16 percent slopes	4,149	3.4
Indiano stony fine sandy loam, 30 to 45 percent slopes	521	.4
James Canyon loam, drained, 2 to 4 percent slopes	307	.3
James Canyon loam, 2 to 4 percent slopes	163	.1
James Canyon loam, 4 to 16 percent slopes	200	.2
James Canyon loam, drained, 4 to 8 percent slopes	396	.3
James Canyon peat, 2 to 8 percent slopes	227	.2
James Canyon loam, calcareous variant, 2 to 4 percent slopes	397	.3
James Canyon loam, calcareous variant, 4 to 8 percent slopes	220	.2
Job loam	168	.1
Job loam, clay substratum, water table, slightly saline-alkali	327	.3
Job loam, slightly saline-alkali	534	.4
Job loam, water table	344	.3
Jubilee loam	246	.2
Jubilee clay, slightly saline-alkali	189	.2
Jubilee loam, poorly drained	173	.1
Jubilee peat	368	.3
Jubilee loam, sand substratum variant	276	.2
Jubilee clay loam, sand substratum variant, deep	234	.2
Kimmerling loam	744	.6
Kimmerling clay loam	1,063	.9
Kimmerling clay loam, clay substratum	308	.3
Kimmerling clay loam, slightly saline-alkali	486	.4
McFaul sand, 2 to 8 percent slopes	2,453	2.0
McFaul sand, 0 to 2 percent slopes	586	.5
McFaul sand, moderately deep, 2 to 4 percent slopes	113	.1
Millich very stony sandy loam, 4 to 30 percent slopes	2,073	1.7
Millich very stony sandy loam, 30 to 60 percent slopes	470	.4
Mottsville loamy coarse sand, 4 to 16 percent slopes	4,674	3.8
Mottsville loamy coarse sand, 2 to 4 percent slopes	777	.6
Mottsville very bouldery loamy coarse sand, 2 to 16 percent slopes	743	.6
Mottsville very bouldery loamy coarse sand, 16 to 45 percent slopes	286	.2
Mottsville-Toiyabe association, 4 to 8 percent slopes	389	.3
Ophir gravelly sandy loam, 2 to 8 percent slopes	1,781	1.5
Ophir gravelly sandy loam, 0 to 2 percent slopes	863	.7
Ophir gravelly sandy loam, somewhat poorly drained, 2 to 8 percent slopes	509	.4
Ophir peat, 2 to 4 percent slopes	548	.4
Ormsby gravelly loamy sand	662	.6
Ormsby gravelly loamy sand, slightly saline-alkali	212	.2
Ormsby loamy sand	688	.6
Peat	281	.2
Prey gravelly loamy sand, 0 to 4 percent slopes	1,235	1.0

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

Soil	Area	Extent
	Acres	*Percent*
Prey loamy sand, 0 to 2 percent slopes	539	.4
Prey stony sandy loam, 4 to 16 percent slopes	268	.2
Prey stony loam, heavy subsoil variant, 2 to 16 percent slopes	943	.8
Puddle silt loam, gypsic variant	442	.4
Quincy fine sand, 2 to 30 percent slopes	2,119	1.7
Reno gravelly sandy loam, 2 to 8 percent slopes	5,321	4.4
Reno gravelly sandy loam, moderately deep, 2 to 8 percent slopes, eroded	130	.1
Reno stony sandy loam, 4 to 16 percent slopes	169	.1
Rock land	1,269	1.0
Rough broken land	110	.1
Sandy alluvial land	526	.4
Settlemeyer clay loam	434	.4
Settlemeyer clay loam, somewhat poorly drained	463	.4
Settlemeyer clay loam, slightly saline-alkali	283	.2
Settlemeyer clay loam, strongly saline-alkali	160	.1
Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes	1,802	1.5
Springmeyer loam, 2 to 4 percent slopes	108	.1
Springmeyer stony fine sandy loam, 16 to 45 percent slopes	1,213	1.0
Springmeyer stony fine sandy loam, moderately deep, 4 to 16 percent slopes	358	.3
Springmeyer very stony fine sandy loam, 30 to 45 percent slopes	459	.4
Stodick very stony fine sandy loam, 4 to 16 percent slopes	1,326	1.1
Toiyabe very rocky loamy coarse sand, 30 to 60 percent slopes	1,973	1.6
Toll sand, 0 to 4 percent slopes	3,081	2.5
Toll sand, 4 to 16 percent slopes	2,417	2.0
Toll sand, clay substratum, water table, 0 to 2 percent slopes	175	.1
Toll sandy loam, 0 to 4 percent slopes	174	.1
Turria loam	1,736	1.4
Turria clay loam	564	.5
Turria clay loam, water table	1,529	1.3
Turria loam, water table	280	.2
Voltaire clay, slightly saline-alkali	547	.4
Voltaire silty clay	287	.2
Voltaire silty clay, water table, slight saline-alkali	137	.1
Voltaire silty clay, water table, strongly saline-alkali	399	.3
Voltaire silty clay loam, strongly saline-alkali	1,085	.9
Voltaire clay loam, seeped variant	418	.3
Washoe cobbly sandy loam	2,779	2.3
Washoe gravelly sandy loam	1,949	1.6
Marsh	506	.4
Carson River	486	.4
Reservoirs and ponds	417	.3
Total	121,850	100.0

outcrops, with steepness, and with length of slope. In any given area stones or one of the other sizes of coarse fragments may make up 5 to 30 percent of the A11 horizon. The fragments are either angular or slightly rounded.

Included with this soil in mapping were small areas of exposed bedrock, which cover less than 10 percent of the acreage.

Permeability is moderately rapid, and the available water capacity is very low. Surface runoff is medium, and the erosion hazard is moderate to high. Fertility is low. The effective rooting depth is 9 to 20 inches, but some roots penetrate the bedrock along fracture planes.

The vegetation consists of big sagebrush, bitterbrush, cheatgrass, Sandberg bluegrass, and a small amount of pinyon pine, juniper, rabbitbrush, low sagebrush, and annual weeds. This soil is used for grazing and wildlife habitat. (Capability unit VIIe-1, nonirrigated)

Aldax very stony fine sandy loam, 4 to 45 percent slopes (AlE).—This soil contains less gravel than Aldax stony fine sandy loam, 16 to 45 percent slopes, but, in the uppermost 3 inches, nearly twice the amount of stones. The total content of stones, cobblestones, and gravel in the soil ranges from 50 to 75 percent.

Runoff is slow to rapid, and the erosion hazard is slight to moderate.

The vegetation is slightly less dense than that on Aldax stony fine sandy loam, 16 to 45 percent slopes, but the proportion of grasses is higher. Livestock use little of the forage, because the surface is so stony, but deer graze it heavily in winter. (Capability unit VIIs–8, nonirrigated)

Aldax-Indiano very stony association, 16 to 45 percent slopes (AnF).—This association consists of approximately 45 percent Aldax very stony fine sandy loam; 45 percent Indiano stony fine sandy loam, 30 to 45 percent slopes; and 10 percent of small areas of included soils and rock outcrops. The profiles of the major soils are essentially the same as the profiles described as representative of the Aldax and Indiano series.

This association is used for grazing and as wildlife habitat. (Aldax part in capability unit VIIs–8, nonirrigated; Indiano part in capability unit VIIe–1, nonirrigated)

Bishop Series

The Bishop series consists of very deep, nearly level, poorly drained and very poorly drained, micaceous, loamy soils that formed in alluvium derived from granite. These soils are on flood plains. The vegetation consists mainly of sedges, grasses, and clover, and the plants cover 40 to 60 percent of the surface. Elevations range from 4,700 to 5,000 feet. The annual precipitation ranges from 12 to 14 inches, and the frost-free season from 95 to 110 days. The average annual air temperature is between 49° and 51° F.

Bishop soils occur with Dressler and Ophir soils, which are also on flood plains.

Soils of the Bishop series are mostly in native meadow. Small areas are irrigated and planted to tame grasses and clover. These areas are used for hay.

The Bishop soils in the Carson Valley Area are mapped as cool phases because they are at the cool end of the range of temperature defined for the Bishop series.

Bishop loam, cool (Bc).—This soil is very poorly drained. The surface layer typically consists of an organic layer of dark-brown root sod 4 inches thick over 26 inches of loam that is gray in the upper part and dark gray in the lower part. The underlying material, to a depth of 38 inches, consists of light olive-gray loam over fine sandy loam variegated with light gray, pale yellow, and light brownish gray. Below this is light-gray cobbly sandy loam. The profile is micaceous throughout.

Representative profile of Bishop loam, cool, about 1½ miles north of the California-Nevada State line, approximately 50 feet south and 1,245 feet west of the north quarter corner of sec. 31, T. 12 N., R. 20 E.

O1—4 inches to 0, dark-brown (10YR 3/3) root sod, very dark brown (10YR 2/2) when moist; neutral (pH 6.6); clear, smooth boundary.

A11—0 to 13 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine and many very fine roots; common fine and many very fine tubular pores; abrupt, smooth boundary.

A12—13 to 26 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, coarse, prismatic structure breaking to weak, very coarse and coarse, subangular blocky; very hard, firm, slightly sticky and slightly plastic; common fine and many very fine roots; many very fine tubular pores; neutral (pH 7.0); clear, wavy boundary.

C1g—26 to 31 inches, light olive-gray (5Y 6/2) loam, olive (5Y 4/3) when moist; common, medium, faint, dark grayish-brown (2.5Y 4/2) iron stains; massive; hard, friable, slightly sticky and slightly plastic; few fine roots and common very fine roots; few fine tubular pores and common very fine interstitial pores; few thin clay films in some pores; neutral (pH 7.0); abrupt, wavy boundary.

C2g—31 to 38 inches, variegated light-gray (5Y 7/1), pale-yellow (5Y 7/3), and light brownish-gray (2.5Y 6/2) fine sandy loam; thin strata of gravelly light sandy clay loam that are greenish gray (5GY 4/1), olive (5Y 5/4), and dark grayish brown (2.5Y 4/2) when moist; common, medium, prominent mottles of dark reddish brown (5YR 3/2) and reddish brown (5YR 4/3) and many medium and coarse, distinct mottles of dark yellowish brown; all mottling is caused by iron content; common, coarse, prominent black stains caused by manganese; massive; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few very fine tubular pores and common very fine interstitial pores; slightly acid (pH 6.5); abrupt, wavy boundary.

C3g—38 to 60 inches, light-gray (5Y 7/1) cobbly sandy loam, dark greenish gray (5G 4/1) when moist; massive; hard, friable, slightly sticky and nonplastic; few very fine and fine roots; few very fine and fine interstitial pores, and few very fine and fine tubular pores; neutral (pH 6.8).

The organic mat on the surface ranges from 2 to 4 inches in thickness. The A horizon ranges from loam to clay loam in texture, but in most places it is loam or light sandy clay loam. It ranges from 16 to 26 inches in thickness. The content of organic matter ranges from 8 percent near the surface to 1 percent in the lower part. In most places the A1 horizon is calcareous; the lower part ranges from slightly effervescent to noneffervescent. The C horizon ranges from fine sandy loam to clay loam in texture, but the more common textures are loam to light sandy clay loam. The lower part of this horizon is stratified. The strata range from loamy sand to clay loam in texture but are dominantly sandy loam. Some strata are cobbly or gravelly. Ordinarily, the C horizon is prominently mottled, and in some places the mottles are greenish or bluish rather than reddish.

The water table is at a depth of less than 18 inches during most of the irrigation season and is frequently at the surface late in winter and early in spring. Permeability is moderately slow in the surface layer and subsoil and moderately rapid in the substratum. The available water capacity is high. Surface runoff is slow to very slow, and erosion is either not a hazard or only a slight hazard. Inherent fertility is high.

This soil supports meadows, which are grazed by livestock during the growing season or late in fall and in winter. Occasionally, the meadows are cut for hay. (Capability unit Vw–9, irrigated)

Bishop loam, cool, eroded (Bc2).—This soil is cut by several gullies 3 to 5 feet deep and is partly drained by them, but otherwise, it is similar to Bishop loam, cool. The water table fluctuates between depths of 3 and 5 feet.

This soil supports meadow grasses, which are grazed by livestock during the growing season or late in fall and in winter. Occasionally, the meadows are cut for hay. The erosion hazard is moderate to high. (Capability unit IIIw–9P, irrigated)

Bishop loam, clay substratum, cool (Bh).—This soil is similar to Bishop loam, cool, but it is underlain at a depth of about 4 feet by dense, slowly permeable clay. The clay substratum retards the downward and lateral movement of water, and as a result, the water table is perched.

The soil supports meadow grasses and is used for livestock grazing. (Capability unit Vw–9, irrigated)

Bishop loam, poorly drained, cool (Bm).—This soil is similar to Bishop loam, cool, except that the water table is between depths of 18 and 36 inches during most of the irrigation season. Its profile differs in that the surface layer is slightly thinner, or about 12 to 16 inches thick, and the organic-matter content of the upper part is about 4 percent.

Included with this soil in mapping were small areas of gravelly loam, in which the gravel content ranges from 15 to 35 percent. Also, in the included areas, the surface layer is somewhat thinner, or about 9 to 14 inches thick.

This soil supports meadow grasses and is used for grazing livestock. (Capability unit IIIw–9P, irrigated)

Bishop loam, poorly drained, slightly saline-alkali, cool (Bn).—This soil is similar to Bishop loam, cool, except that the surface layer is slightly affected by salts and alkali and the water table is between depths of 2 and 3 feet during the irrigation season. The organic-matter content of the surface layer is about 2 percent. The salts and alkali reduce the intake of water. The vegetation is saltgrass.

This soil is used for grazing and wildlife habitat. (Capability unit IIIw–6P, irrigated)

Borda Series

The Borda series consists of deep or moderately deep, moderately sloping to steep, well-drained soils that have a fine-textured subsoil. These soils formed in gravelly and stony alluvium and residuum derived from andesite and andesitic tuff. They are on foothills in the southern part of the survey area, and adjacent to Dutch

Valley, Bryant Creek, and the East Fork of the Carson River. The vegetation consists of pinyon pine and an understory of big sagebrush, bitterbrush, and grasses, but the plants cover only 5 to 15 percent of the surface. Elevations range from 5,200 to 5,800 feet. The annual precipitation ranges from 12 to 16 inches, and the frost-free season from 50 to 70 days. The average annual air temperature is between 43° and 45° F.

Borda soils are associated with Indian Creek, Millich, and Aldax soils.

Soils of the Borda series are used mainly for grazing.

Borda stony sandy loam, 16 to 45 percent slopes (BrF).—This soil is mostly in Alpine County, west of the East Fork of the Carson River and near Bryant Creek. The surface layer typically consists of grayish-brown gravelly sandy loam about 3 inches thick over brown gravelly loam about 7 inches thick. The subsoil is brown clay and extends to a depth of about 34 inches. The substratum is clay loam and variegated in color. Bedrock of andesite tuff begins at a depth of about 50 inches.

Representative profile of a Borda soil, about 1,500 feet south and 1,000 feet east of the northwest corner of sec. 21, T. 11 N., R. 20 E.

A11—0 to 3 inches, a pavement of gravel and stone covers 50 percent of the surface; grayish-brown (10YR 5/2) gravelly sandy loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; slightly acid (pH 6.3); clear, smooth boundary.

A12—3 to 10 inches, brown (7.5YR 5/3) gravelly loam, dark brown (7.5YR 4/3) when moist; weak, fine, granular structure; hard, friable, nonsticky and slightly plastic; few fine horizontal roots and many very fine vertical roots; many very fine interstitial and tubular pores; slightly acid (pH 6.3); abrupt, wavy boundary.

B2t—10 to 24 inches, brown (7.5YR 5/4) clay, brown (7.5YR 5/4) when moist; strong, medium, prismatic structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; common very fine tubular pores; thick continuous clay films in pores and as bridges; many slickensides; neutral (pH 7.0); clear, wavy boundary.

B3t—24 to 34 inches, brown (7.5YR 5/4) clay, brown (7.5YR 5/4) when moist; few to common, fine to medium, distinct mottles of reddish yellow (7.5YR 6/8); moderate, medium, subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots in the upper part; common very fine interstitial and tubular pores; many moderately thick clay films on ped faces; noneffervescent, but violently effervescent where lime occurs as common, fine and medium, distinct, white (10YR 8/2) mottles on ped faces and undecomposed rock fragments, or as fine soft concretions; moderately alkaline (pH 8.0); gradual, smooth boundary.

C—34 to 50 inches, variegated 40 percent very pale brown (10YR 7/3), 40 percent light yellowish-brown (10YR 6/4), and 20 percent strong-brown (7.5YR 5/8) clay loam; yellowish brown (10YR 5/4, 10YR 5/6, or 7.5YR 5/8) when moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores and many very fine interstitial pores; intermittently effervescent; few, fine, soft lime nodules in pockets and cracks; moderately alkaline (pH 8.0).

R—50 inches, andesite tuff bedrock.

The thickness of the solum ranges from 30 to 48 inches and the depth to bedrock from 40 to about 51 inches. Stones as much as 24 inches in diameter are common in the A horizon, and there are a few in the lower part of the B horizon and in the C horizon. The content of stones, cobblestones, and gravel in the A1 horizon ranges from 25 to 45 percent. The A horizon and the upper part of the B horizon are noncalcareous; in the lower part of the B horizon, mottling caused by lime content is common. Reaction ranges from slightly acid to neutral in the A horizon and upper part of the B horizon and from slightly acid to moderately alkaline in the lower part of the B horizon.

Permeability of the subsoil is slow, and roots penetrate to bedrock. The available water capacity is moderate. Surface runoff is medium to rapid, depending on the slope and the proportion of stones in the surface layer. The erosion hazard is moderate to high. Fertility is moderate.

The vegetation consists predominantly of pinyon pine, big sagebrush, and bitterbrush, but there is some low sagebrush, grasses, and weeds.

This soil is used for limited grazing and as wildlife habitat. Pinyon nuts are harvested, and a limited number of pinyon trees are harvested for Christmas trees. (Capability unit VIIe–1, nonirrigated)

Borda gravelly sandy loam, 4 to 16 percent slopes (BoC).—This soil occurs on the more gently sloping toe slopes of the foothills. It has a profile similar to that of Borda stony sandy loam, 16 to 45 percent slopes, except that there are no stones in the A1 horizon.

Surface runoff is slow to medium, because of the lesser slopes and the lack of stones. The erosion hazard is slight to moderate.

The vegetation is predominantly big sagebrush, but there are scattered trees. The soil is used mainly for grazing and as wildlife habitat, but small areas of included Borda-like soils are irrigated and used for meadow, which is of poor quality. (Capability unit VIc–K, nonirrigated)

Brockliss Series

The Brockliss series consists of somewhat poorly drained, nearly level to moderately sloping, coarse-textured, gravelly and stony soils that formed in poorly sorted sandy alluvium derived mainly from granite but partly from basalt, rhyolite, andesite, gneiss, and slate. These soils are on convex and concave terraces and former flood plains of the West Fork of the Carson River, mainly in Alpine County. The vegetation consists of dense stands of big sagebrush, rabbitbrush, bitterbrush, and grasses, and plants cover 20 to 30 percent of the surface. Elevations range from 4,000 to 5,000 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 46° and 48° F.

Brockliss soils are associated with Dressler soils.

Soils of the Brockliss series support good-quality meadows. The meadows are used for grazing livestock and occasionally are cut for hay. Most of the acreage is irrigated, and some areas have been smoothed and the surface stones removed.

Brockliss stony loamy sand, 0 to 8 percent slopes (BtA).—This soil is adjacent to the West Fork of the Carson River on both sides of the California State line. The surface layer typically is stony loamy sand, 15 inches thick, that is dark grayish brown in the upper part and dark brown in the lower part. Below this is a transitional layer of brown very stony loamy sand about 8 inches thick. The substratum is white, pale-brown, and light yellowish-brown very stony coarse sand to a depth of 60 inches.

Representative profile of Brockliss stony loamy sand, 0 to 8 percent slopes, in an irrigated area, about 50 feet east and 1,370 feet north of the southwest corner of sec. 32, T. 12 N., R. 20 E.

A11—0 to 9 inches, dark grayish-brown (10YR 4/2) stony loamy sand, very dark brown (10YR 2/2) when moist; weak, medium to fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine interstitial pores; slightly acid (pH 6.4); gradual, smooth boundary.

A12—9 to 15 inches, dark-brown (10YR 4/3) stony loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, medium to fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine and few fine tubular pores; slightly acid (pH 6.4); gradual, smooth boundary.

AC—15 to 23 inches, brown (10YR 5/3) very stony loamy sand, dark brown (10YR 3/3) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine tubular pores; slightly acid (pH 6.4); gradual, irregular boundary.

C1—23 to 46 inches, colors are dominated by color of the individual sand grains and pebbles; white (10YR 8/2), pale-brown (10YR 6/3), and light yellowish-brown (10YR 6/4) very stony coarse sand; dark grayish brown (10YR 4/2), light brown (10YR 5/4), and olive brown (2.5Y 4/4) when moist; single grain; loose when dry and moist; very porous; few very fine roots; slightly acid (pH 6.4); diffuse, smooth boundary.

C2—46 to 60 inches, colors are dominated by color of the individual sand grains and pebbles; white (10YR 8/2), pale-brown (10YR 6/3), and light yellowish-brown (10YR 6/4) very stony coarse sand; dark grayish brown (10YR 4/2), light brown (10YR 5/4), and olive brown (2.5Y 4/4) when moist; single grain; loose when dry and moist; very few very fine roots; slightly acid (pH 6.4).

The content of stones, cobblestones, and gravel varies considerably throughout the profile and may range from 30 to 70 percent. Stones or one of the other sizes of coarse fragments may predominate in any one stratum within a profile. Stones increase in size and amount with distance to the south, or on the higher slopes, with distance upstream. In the C horizon at varying depths in some areas are mottles that range from few to common in abundance and from fine to coarse in size.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow or very slow, and the erosion hazard is slight. Natural fertility is low.

The native vegetation consisted of big sagebrush, bitterbrush, rabbitbrush, and grasses. Irrigated areas produce good-quality meadow grasses.

Most of this soil is irrigated and is in meadows consisting of native grasses and clovers. The meadows are used for grazing most of the year. (Capability unit Vw–7; irrigated)

Brockliss gravelly loamy sand, 0 to 2 percent slopes (BsA).—This soil is similar to Brockliss stony loamy sand, 0 to 8 percent slopes, except that most of the stones have been picked from the plow layer.

This soil is in meadow and is used for grazing livestock. (Capability unit Vw–7, irrigated)

Brockliss stony loamy sand, water table, 0 to 4 percent slopes (BwA).—This soil is in concave swales. It is similar to Brockliss stony loamy sand, 0 to 8 percent slopes, except that the water table fluctuates between depths of 18 and 30 inches during most of the irrigation season. This high water table is caused by excessive irrigation of soils in higher areas, and as a result, the meadow vegetation consists of coarse sedges and juncus. Accumulations of organic matter, 2 to 4 inches thick, are common on the surface. The surface layer is generally somewhat darker colored. Coarse yellowish mottles occur at a depth below 36 inches in some areas.

Shallow ditches should be constructed to remove the excess waste water and thus improve the quality of the meadow. Otherwise, the use of this soil is similar to that of Brockliss stony loamy sand, 0 to 8 percent slopes. (Capability unit Vw–7, irrigated)

Calpine Series

The Calpine series consists of very deep, well-drained, moderately coarse-textured soils that formed in alluvium derived predominantly from granite. These soils are on nearly level, gently convex and slightly concave alluvial fans and terraces and gently sloping to moderately sloping terrace breaks in Diamond Valley, at the southern edge of the Carson Valley Area. The vegetation consists predominantly of big sagebrush, bitterbrush, and grasses. The plants are vigorous and cover approximately 15 to 20 percent of the surface. Elevations range from 5,000 to 6,000 feet. The annual precipitation ranges from 12 to 20 inches, and the frost-free season from 70 to 90 days. The average annual temperature is between 43° and 45° F.

Calpine soils are associated with Cave Rock, Ophir, Mottsville, and Borda soils.

Soils of the Calpine series are generally cultivated and used for locally suitable forage crops.

Calpine gravelly coarse sandy loam, 0 to 2 percent slopes (CaA.)—This soil occurs only in Diamond Valley, Alpine County. The surface layer typically is about 19 inches thick. It consists of brown gravelly coarse sandy loam over coarse sandy loam. The subsoil is brown coarse sandy loam to a depth of about 60 inches. Reaction is slightly acid.

Representative profile of Calpine gravelly coarse sandy loam, 0 to 2 percent slopes, about 1,000 feet east and 250 feet south of the west quarter corner, sec. 31, T. 11 N., R. 20 E.

Ap—0 to 9 inches, brown (7.5YR 5/3) gravelly light coarse sandy loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores; about 20 percent fine gravel; slightly acid (pH 6.4); abrupt, smooth boundary.

A1—9 to 19 inches, brown (7.5YR 5/3) light coarse sandy loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular and interstitial pores; slightly acid (pH 6.4); gradual, smooth boundary.

B1—19 to 24 inches, brown (7.5YR 5/3) coarse sandy loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine tubular and interstitial pores; common thin clay bridges between sand grains and clay coatings on sand grains; slightly acid (pH 6.3); gradual, smooth boundary.

B2—24 to 42 inches, brown (7.5YR 5/4) coarse sandy loam or heavy coarse sandy loam, dark brown (7.5YR 3/3) when moist; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular and interstitial pores; many thin clay bridges between sand grains and coatings on sand grains; slightly acid (pH 6.3); diffuse, irregular boundary.

B3—42 to 60 inches, brown (7.5YR 5/5) coarse sandy loam, brown (7.5YR 3/3) when moist; some strongly weathered stones about 18 inches in diameter, massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; many very fine tubular pores and interstitial pores; many very thin clay bridges between sand grains and common very thin clay coatings on sand grains; slightly acid (pH 6.3).

The solum ranges from 54 to more than 72 inches in thickness. In places large, strongly weathered stones occur in the B horizon. The C horizon, where present, is loamy coarse sand.

Permeability is moderately rapid, and the available water capacity is moderate. Surface runoff is very slow to slow, and erosion is only a slight hazard. Fertility is high. The root zone is very deep.

This soil is cultivated and is seeded to grass-legume pasture. (Capability unit IIIs–4, irrigated)

Calpine stony coarse sandy loam, 2 to 8 percent slopes (CcB).—This soil is on gently sloping to moderately sloping, concave terrace breaks and on the more strongly sloping parts of alluvial fans. It is similar to Calpine gravelly coarse sandy loam, 0 to 2 percent slopes, except that there are stones and boulders as much as 5 feet in diameter on the surface.

Surface runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil can be used in much the same way as Calpine gravelly coarse sandy loam, 0 to 2 percent slopes, except that cultivation should be kept to a minimum because the plow layer is stony. (Capability unit IVe–4, irrigated)

Cashmere Series

The Cashmere series consists of nearly level, well-drained, moderately coarse textured soils that formed in loamy alluvium derived from mixed rocks. These soils are on smooth local flood plains or in wash areas in the eastern part of the Carson Valley Area. The vegetation consists mainly of big sagebrush, spiny hopsage, annual weeds, rabbitbrush, and squirreltail, but the plants cover only 10 to 20 percent of the surface. Elevations range from 4,700 to 5,100 feet. The annual precipitation ranges from 8 to 12 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Cashmere soils are associated with Reno and Turria soils.

Soils of the Cashmere series provide some grazing for livestock. Other areas, below the present irrigation ditches, are cultivated. All the crops grown locally are suitable.

Cashmere fine sandy loam (Cf).—Areas of this soil occur near Buckeye Creek in the eastern part of the survey area. The slope range is 0 to 2 percent. The surface layer typically is grayish-brown fine sandy loam about 20 inches thick. Below this, to a depth of about 40 inches, is grayish-brown loamy fine sand over fine sandy loam. This material is underlain by very gravelly and cobbly fine sand over very gravelly and cobbly sand. The undersides of the pebbles and cobblestones have white lime coatings. Reaction is neutral to a depth of 40 inches, but it is moderately to mildly alkaline below that depth.

Representative profile of Cashmere fine sandy loam, about 1,000 feet south and 600 feet east of the north quarter corner of sec. 2, T. 12 N., R. 20 E.

A11—0 to 6 inches, grayish-brown (10YR 5/2) light fine sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; neutral (pH 6.6); clear, smooth boundary.

A12—6 to 20 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; neutral (pH 6.8); clear, smooth boundary.

C1—20 to 26 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; generally noneffervescent, but slightly effervescent in spots; neutral (pH 6.8); clear, smooth boundary.

C2ca—26 to 40 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; few, fine, faint, light brownish-gray (10YR 6/2) lime seams; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine tubular pores; matrix is noneffervescent; neutral (pH 7.0); abrupt, wavy boundary.

IIC3ca—40 to 45 inches, grayish-brown (10YR 5/2) very gravelly and cobbly fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; many very fine, fine, and medium interstitial pores; strongly effervescent; white lime coatings on undersides of cobblestones and pebbles; moderately alkaline (pH 8.4); gradual, wavy boundary.

IIC4—45 to 62 inches, grayish-brown (10YR 5/2) very gravelly and cobbly sand, dark brown (10YR 3/3) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; many very fine, fine, and medium interstitial pores; slightly effervescent; mildly alkaline (pH 7.6).

The gravel-free part of the soil profile ranges from noneffervescent to slightly effervescent. The depth to gravelly material ranges from about 36 inches to 60 inches. The shallower part of the depth range is in the higher lying wash areas. Strata of loamy fine sand or fine sand are common in the areas that are deeper over gravel.

Permeability is moderately rapid above the gravelly material but very rapid within the gravelly layer. The available water capacity is moderate. Surface runoff is very slow, and the erosion hazard is slight. Soil deposition may occur during high-intensity storms in summer as a result of runoff from higher areas. Natural fertility is moderate.

The vegetation consists mainly of big sagebrush, spiny hopsage, annual weeds, rabbitbrush, cheatgrass, and squirreltail.

Most of the soil is in range and provides a fair amount of winter forage for livestock. Areas below the irrigation ditches are cultivated and used chiefly for alfalfa and small grain. Much of the acreage now in brush is above the irrigation ditches and consequently is not likely to be used for irrigated crops. (Capability unit IIs–4, irrigated)

Cave Rock Series

The Cave Rock series consists of very deep, gently sloping to moderately sloping, somewhat excessively drained, coarse-textured soils that formed in alluvium derived from granite. These soils occupy convex alluvial fans in Jacks Valley and Diamond Valley in the northwestern and southern parts of the Carson Valley Area. The vegetation is relatively dense and consists mainly of big sagebrush, bitterbrush, Indian ricegrass, and needlegrass. Some Jeffrey pines are scattered near the margin of higher areas. The elevation is about 5,100 feet. The annual precipitation ranges from 12 to 16 inches, and the frost-free season from 90 to 100 days. The average annual air temperature is about 46° F.

Cave Rock soils are associated with Glenbrook, Toiyabe, and Mottsville soils.

Soils of the Cave Rock series, in most areas, are used for range that is grazed by livestock in summer and fall and by deer in winter. When water is available, a small acreage in Diamond Valley is irrigated and used for meadow.

Cave Rock loamy sand, 2 to 8 percent slopes (CkC).—Most of this soil is in Jacks Valley in the northwestern part of the survey area or in Diamond Valley in the southern part. The surface layer typically is dark grayish brown and about 23 inches thick. It consists of loamy coarse sand over loamy sand. Below this is a transitional layer of brown loamy sand about 8 inches thick. This layer is underlain, to a depth of 70 inches, by loamy sand that is brown in the upper part and strongly mottled in the lower part. This mottling is caused by the weathering of iron-bearing minerals. Reaction is generally slightly acid.

Representative profile of Cave Rock loamy sand, 2 to 8 percent slopes, about 1,600 feet north and 800 feet east of the southwest corner of sec. 11, T. 14 N., R. 19 E.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; many very fine roots; many very fine and fine interstitial pores; highly micaceous; slightly acid (pH 6.4); abrupt, smooth boundary.

A12—3 to 11 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, medium to fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; highly micaceous; slightly acid (pH 6.4); gradual, smooth boundary.

A13—11 to 23 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; very weak, medium to fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many very fine tubular pores; highly micaceous; slightly acid (pH 6.5); gradual, smooth boundary.

AC—23 to 31 inches, brown (7.5YR 4/2) loamy sand, dark brown (7.5YR 3/2) when moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; few thin clay coatings on sand grains; highly micaceous; slightly acid (pH 6.5); abrupt, wavy boundary.

C1—31 to 46 inches, brown (7.5YR 5/4) loamy sand, dark brown (7.5YR 4/4) when moist; many, medium to large, prominent mottles of yellowish red (5YR 4/6) and dark reddish brown (5YR 3/4) caused by iron; massive; hard, friable, nonsticky and nonplastic; few very fine roots; many very fine tubular pores; common thin clay coatings on sand grains; highly micaceous; slightly acid (pH 6.5); diffuse, smooth boundary.

C2—46 to 62 inches, brown (7.5YR 5/4) loamy sand, brown (7.5YR 4/4) when moist; many, medium, prominent mottles of yellowish red (5YR 4/6) and dark reddish brown (5YR 3/4), and common, medium to large, prominent stains and mottles of dark reddish-gray (5YR 4/2) caused by iron and manganese content; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; common thin clay coatings on sand grains; highly micaceous; slightly acid (pH 6.5); diffuse, smooth boundary.

C3—62 to 70 inches, loamy sand, strongly mottled about equally with brown (7.5YR 5/4) and yellowish red (5YR 5/6); yellowish brown (7.5YR 5/4) and dark reddish brown (5YR 3/4) when moist; massive; slightly hard, friable, nonsticky and nonplastic; few thin clay coatings on sand grains; very few very fine roots; few very fine tubular pores; slightly acid (pH 6.5).

The A horizon ranges from 24 to 36 inches in thickness, and the uppermost 1 inch to 3 inches is loose sand, coarse sand, loamy sand, or loamy coarse sand. The C horizon ranges from loamy sand or loamy coarse sand to sand or coarse sand in texture and, in some places, has no mottles in the lower part.

Included in mapping was a small area, in Diamond Valley, where scattered stones 1 foot to 5 feet in diameter are on the surface and in the upper part of the A horizon.

Permeability is very rapid, and the available water capacity is moderate. Surface runoff is very slow, and the hazard of erosion, especially of wind erosion, is moderate. Natural fertility is moderate, and the content of organic matter is moderately high.

The vegetation consists mainly of big sagebrush, bitterbrush, cheatgrass, Indian ricegrass, and needlegrass, but there is scattered rabbitbrush. These plants cover 15 to 25 percent of the surface. A few scattered Jeffrey pine are invading at the higher elevations.

The soil is mostly in brush that provides forage for livestock in summer and fall and winter forage for deer. A small, gently sloping area in Diamond Valley is irrigated when spring runoff provides surplus water. This area supports a sedge meadow. (Capability unit VIIs–L, nonirrigated)

Cradlebaugh Series

The Cradlebaugh series consists of very deep, nearly level, somewhat poorly drained to poorly drained, moderately fine textured soils that formed in stream-deposited material derived mainly from granite but partly from gneiss, slate, andesite, basalt, and volcanic ash. These soils occur as scattered areas on smooth flood plains and low-lying terraces along the Carson River. They occur throughout the central and north-central parts of the survey area, adjacent to the river. They are occasionally flooded and are slightly to strongly affected by salts and alkali. The vegetation consists mainly of sedges and grass in the poorly drained areas; big sagebrush, greasewood, and grasses in the somewhat poorly drained areas; and sparse to moderate stands of greasewood and saltgrass in the areas more affected by salts and alkali. Elevations range from 4,500 to 4,800 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Cradlebaugh soils are associated with Heidtman and Hussman soils and the thin solum variant of Dangberg soils.

Most areas of Cradlebaugh soils are irrigated, and locally suitable crops are grown. The rest is in brush and used for grazing. The suitability of the soils for crops varies with the content of salts and alkali.

Cradlebaugh soils, slightly saline-alkali (Cs).—The soils of this mapping unit are Cradlebaugh clay loam and Cradlebaugh clay. They occur as large areas adjacent to the Carson River in the central part of the survey area, south and west of Gardnerville. The surface layer typically is gray clay loam about 9 inches thick. Below this is a transitional layer of gray sandy clay loam about 8 inches thick. The substratum consists of light-gray fine sandy loam over grayish-brown silty clay loam to a depth of about 32 inches. Below this is grayish-brown sandy clay loam over light olive-gray fine sandy loam to a depth of about 65 inches.

Representative profile of Cradlebaugh clay loam, slightly saline-alkali, about 1,000 feet north and 25 feet east of the center of sec. 2, T. 12 N., R. 19 E.

Ap—0 to 4 inches, gray (10YR 5/1) clay loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure in the uppermost 2 inches and massive below; very hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

A1—4 to 9 inches, gray (10YR 5/1) clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine, and few medium tubular pores; strongly effervescent; strongly alkaline (pH 8.8); clear, wavy boundary.

AC—9 to 17 inches, gray (2.5Y 5/1) sandy clay loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, faint mottles of dark gray (10YR 4/1); common, fine and medium, prominent, white (10YR 8/2) lime flecks and filaments in root channels; weak, coarse, prismatic structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores and many very fine and fine interstitial pores; few thin clay films on ped faces and in pores; strongly effervescent; strongly alkaline (pH 8.8); clear, wavy boundary.

C1si—17 to 27 inches, light-gray (2.5Y 6/1) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; common, fine and medium, faint, very dark grayish-brown (2.5Y 3/2) organic stains; common, fine, prominent, white (10YR 8/2) lime flecks; massive; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular pores; discontinuous weak silica cementation; strongly effervescent; strongly alkaline (pH 8.8); clear, wavy boundary.

C2—27 to 32 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, fine, angular blocky and subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; noneffervescent; strongly alkaline (pH 8.6); clear, smooth boundary.

C3g—32 to 39 inches, grayish-brown (2.5Y 5/2) sandy clay loam, olive gray (5Y 4/2) when moist; massive; hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine pores, and few coarse tubular pores; noneffervescent; moderately alkaline (pH 8.4); clear, wavy boundary.

C4g—39 to 55 inches, light olive-gray (5Y 6/2) fine sandy loam, olive gray (5Y 4/2) when moist; massive; slightly plastic; common very fine and fine roots; common very fine and fine tubular pores; noneffervescent; moderately alkaline (pH 8.4); clear, wavy boundary.

C5gsi—55 to 65 inches, light olive-gray (5Y 6/2) fine sandy loam, variegated dark gray (N 4/0), olive gray (5Y 4/2), and olive (5Y 4/3) when moist; common, medium and coarse, prominent mottles of dark reddish brown (5Y 3/4) caused by iron content; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine and fine tubular pores; about 10 to 15 percent brittle, various shaped, alkali-soluble fragments that range from ¼ to about 1 inch in diameter; noneffervescent; moderately alkaline (pH 8.4).

The content of silica-cemented fragments in the C horizon ranges from about 20 to 90 percent but is not more than 40 percent in most places. Generally, these fragments are at depths between 18 and 30 inches, but they are at a depth of only 12 or 13 inches where leveling cuts have been made. Lime, either disseminated or segregated, occurs above the water table, but it does not occur below the water table. Mottles caused by iron occur at a depth below 30 inches. Strata of gravel or sand occur at a depth below 48 inches in places. The A horizon is slightly affected by salts and alkali, and generally the C horizon is moderately affected.

The water table fluctuates between depths of 3 and 4 feet. Permeability is slow. The root zone is deep, but the silica-cemented fragments restrict the growth of roots and the movement of water. The available water capacity and natural fertility are high. Surface runoff is slow, and erosion is not a hazard. Some nondetrimental deposition may result from flooding.

These soils are irrigated and used for alfalfa or an alfalfa-alta fescue mixture grown in rotation with small grain or pasture. Application of gypsum or sulfur followed by leaching helps to remove excess alkali and thus improves the permeability to water and roots. Drainage is needed to lower the water table and to carry away the excess water used in leaching, but deep drainage may be difficult because of the low position of the soils and the lack of grade to an outlet. Without drainage, further improvement of the soil by removing salts and alkali is almost impossible. A few small areas have been reclaimed. (Capability unit IIIw–36, irrigated)

Cradlebaugh clay loam (Cm).—This soil has characteristics that are almost identical to those of the Cradlebaugh soils, slightly saline-alkali, but most of the soluble salts and alkali have been removed from the profile. About two-thirds of the acreage has a plow layer of clay loam, and the other third a plow layer of loam. Consequently, the soil takes in water more rapidly.

This soil is used in essentially the same way as Cradlebaugh soils, slightly saline-alkali, but it is better suited to crops. Occasionally, the application of a large amount of irrigation water may be needed to leach out accumulated salts and thus maintain a favorable salt balance. (Capability unit IIw–3, irrigated)

Cradlebaugh clay loam, poorly drained, slightly saline, strongly alkali (Cn).—This soil is adjacent to the Carson River. It occurs on smooth, slightly lower terraces than those on which Cradlebaugh soils, slightly saline-alkali, occur. It differs from those soils in being poorly drained and in being strongly affected by alkali in the plow layer. The water table fluctuates between depths of 2 and 3 feet during most of the irrigation season. As a result, the surface layer is slightly darker colored than that of the typical profile. It also has about half again as much organic matter.

The vegetation consists of an almost solid stand of saltgrass, but there is some alkali sacaton. The soil is either used for grazing livestock or for hay. It is doubtful whether the soil could be improved by using gypsum because the water table is too high to obtain the necessary leaching, but this could be done if deep drains could be provided. (Capability unit VIw–6, irrigated)

Cradlebaugh clay loam, poorly drained, strongly saline-alkali (Co).—This soil is on terraces that have irregular relief and are slightly lower than those on which Cradlebaugh soils, slightly saline-alkali, occur. It differs from those soils in being poorly drained and strongly affected by salts and alkali. The water table fluctuates between depths of 1 foot and 3 feet during most of the irrigation season. As a result, the surface layer is slightly darker colored than that of the typical profile. It also has about half again as much organic matter.

The vegetation consists mainly of saltgrass and alkali sacaton, and in the high areas, scattered greasewood. Because of the irregular surface, the soil has to be watered by flooding. Under natural conditions improvement by reducing the content of salts and alkali cannot be expected. (Capability unit VIw–6, irrigated)

Cradlebaugh soils, poorly drained, slightly saline-alkali (Cr).—These soils are generally adjacent to the Carson River. They occur on slightly lower terraces than those on which Cradlebaugh soils, slightly saline-alkali, occur. They differ from those soils in having a water table that fluctuates between depths of 2 and 3 feet during most of the irrigation season. The surface layer is slightly darker colored than that of the typical profile. It also has about half again as much organic matter.

The vegetation consists of sedges, grasses, and clover. The meadow is used mostly for grazing livestock. Some areas have been seeded to grass-legume mixtures that are suitable for pasture. Ordinarily, the meadow is cut for hay and the stubble is grazed. (Capability unit IVw–36P, irrigated)

Cradlebaugh soils, slightly saline, strongly alkali (Ct).—These soils occur as 2- to 20-acre areas isolated within cultivated fields. They are similar to Cradlebaugh soils, slightly saline-alkali, except that they are strongly alkali. As a result of irrigation, most of the soluble salts have been removed from the uppermost 6 to 10 inches of the soil, but below this depth the soil is generally moderately to strongly affected by salts. The strong alkali content nearly stops the intake of water.

The vegetation consists almost entirely of saltgrass or stunted Bassia. Large amounts of gypsum are required to reduce the alkali content of the surface layer and thus increase the intake of water and improve permeability. Other than the special practices used to remove the alkali, these soils are used in much the same way as Cradlebaugh soils, slightly saline-alkali. (Capability unit VIw–6, irrigated)

Cradlebaugh soils, strongly saline-alkali (Cu.)—These soils are on low ridges beyond the reach of irrigation water. They are similar to Cradlebaugh soils, slightly saline-alkali, except that the uppermost 6 to 8 inches is strongly affected by salts and alkali.

The vegetation consists of greasewood, a sparse understory of saltgrass, and a few alkali sacaton plants. These soils are used for limited grazing in areas where adjacent soils are grazed. In other areas they are used for stackyards or farmsteads or are idle. (Capability unit VIIw–6, nonirrigated)

Dangberg Series

The Dangberg series consists of moderately deep, nearly level, poorly drained, clayey soils that formed in alluvium derived largely from granitic rocks but partly from other igneous and sedimentary rocks. These soils are calcareous. They have a strongly cemented hardpan and are affected by excess soluble salts and alkali. They are on low-lying alluvial terraces above the river channel, in the north-central part of the survey area, north of Minden. The relief is slightly concave in many places. The vegetation consists of sedges, saltgrass, alkali bluegrass, Carex, and assorted weeds. The elevation is about 4,600 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 100 days. The average annual temperature is between 49° and 51° F.

Dangberg soils are associated with Ormsby and Voltaire soils and the thin solum variant of Dangberg soils.

Soils of the Dangberg series are irrigated and used for meadow. Some areas that are not regularly irrigated support greasewood and an understory of alkali sacaton and saltgrass. The forage provides grazing for livestock during most of the year.

Dangberg clay (Da).—This soil occurs in the north-central part of Carson Valley, about 2 miles north of Minden. The surface layer typically is gray clay about 3 inches thick. The subsoil is light brownish gray. It consists of clay over sandy clay to a depth of about 25 inches. The substratum has a light brownish-gray hardpan at depths between 25 and 43 inches. The hardpan is strongly cemented with silica. Below this is pale-brown coarse sand.

Representative profile of Dangberg clay, about 600 feet south and 800 feet east of the north quarter corner of sec. 19, T. 13 N., R. 20 E.

A1—0 to 3 inches, gray (10YR 5/1) clay, very dark brown (10YR 2/2) when moist; moderate, medium and coarse, subangular blocky structure; extremely hard, firm, very sticky and very plastic; many very fine and few fine roots; common very fine and fine interstitial pores; noneffervescent; strongly alkaline (pH 8.6); abrupt, wavy boundary.

B21t—3 to 15 inches, light brownish-gray (10YR 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, very coarse, prismatic structure; very hard, friable, very sticky and very plastic; common very fine and few fine roots; clay films on peds and in root channels, and clay bridges between sand grains; generally slightly effervescent, but strongly effervescent where there are common, fine, distinct mottles of light gray (10YR 7/2) and white (10 YR 8/2) caused by lime content; strongly alkaline (pH 8.8); abrupt, wavy boundary.

B22t—15 to 25 inches, light brownish-gray (10YR 6/2) sandy clay, dark brown (10YR 3/3) when moist; few fine and medium mottles of dark brown (7.5YR 3/2) caused by iron content and common, fine and medium, prominent mottles of light gray (10YR 7/2) caused by lime content; massive; very hard, friable, very sticky and very plastic; few very fine roots; few very fine tubular pores and many micro interstitial pores; thin continuous clay films in pores and common thin clay films on ped faces; generally slightly effervescent, but violently effervescent where lime is visible; strongly alkaline (pH 8.7); gradual, wavy boundary.

C1sim—25 to 43 inches, light brownish-gray (10YR 6/2) hardpan strongly cemented with silica, dark brown (10YR 3/3) when moist; common, medium, faint mottles of dark brown (7.5YR 3/3) caused by iron content; few, fine, horizontal roots between plates; generally slightly effervescent but violently effervescent where lime is visible as common, fine, medium and coarse mottles of light gray (10YR 7/2); few fine lime nodules; moderately alkaline (pH 8.4); abrupt, smooth boundary.

IIC2—43 to 60 inches, pale-brown (10YR 6/3) coarse sand, brown (10YR 4/3) when moist; dark-gray, yellowish-red, and reddish-brown mottles caused by iron content; single grain; loose when dry and moist, nonsticky and nonplastic; no plant roots; many very fine and fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.2).

The thickness of the solum and the depth to the strongly cemented pan range from 24 to 36 inches. The ground water is held under pressure below the hardpan, and the water table is believed to result from the release of ground water caused by the blocking of the aquifer by flood-plain sediments. Irrigation water also perches above the hardpan, and the water table fluctuates between depths of 2 and 3 feet where the pan is broken. The A horizon is slightly affected by salts and alkali, and the B horizon is strongly affected.

Included with this soil in mapping were small areas in which the A1 horizon is clay loam.

Permeability is very slow in the surface layer and subsoil but rapid in the sandy substratum. The root zone is restricted by the hardpan, which is strongly cemented with silica. The available water capacity is moderate. Surface runoff is slow, and there is no erosion hazard. Natural fertility is moderate.

The vegetation consists of sedges, juncus, bluegrass, and clover. This soil is in meadow that provides grazing for livestock, mainly in spring, summer, and fall. (Capability unit IVw–36P, irrigated)

Dangberg clay, strongly alkali (Db).—This soil is similar to Dangberg clay, except that the surface layer is strongly affected by alkali. Consequently, the soil particles in the surface layer have dispersed and the intake of water is reduced. Included in mapping were small areas of soils that have a surface layer of clay loam.

The vegetation consists of nearly pure stands of saltgrass and baltic-rush. The use of this soil is similar to that of Dangberg clay. It is doubtful that much can be done to reduce the alkali content of the surface layer, because of the very slow permeability and the lack of drainage. Some improvement in productivity can be made with more careful control of irrigation water. (Capability unit VIw–6, irrigated)

Dangberg clay, strongly saline-alkali (Dc).—This soil is in raised areas where irrigation is difficult if not impossible. It is similar to Dangberg clay, except that the surface layer is strongly affected by salts and alkali. Included in mapping were small areas of soils that have a surface layer of clay loam.

The vegetation consists of saltgrass, alkali sacaton, and some stunted greasewood. The use of this soil is similar to that of Dangberg clay. Some reduction in the salt content of the surface layer can be obtained by smoothing the high areas and thus increasing the water coverage. (Capability unit VIw–6, irrigated)

Dangberg clay, water table (De).—This soil is in depressions where irrigation water ponds. It is similar to Dangberg clay, except that the water table fluctuates between depths of 1 foot and 2 feet during most of the irrigation season.

The vegetation consists mainly of coarse sedges and scattered sour dock plants. Irrigation water should be more carefully controlled to prevent the ponding. If the excess water were removed, the quality of the vegetation would improve and the soil could be used in much the same way as Dangberg clay. (Capability unit Vw–3, irrigated)

Dangberg clay, water table, strongly alkali (Dg).—This soil is in depressions where the irrigation water from adjacent soils ponds. It is similar to Dangberg clay, except that the water table fluctuates between depths of 1 foot and 2 feet. The water table is the combined result of irrigation water that has perched on the pan, and of the release of ground water from beneath the pan where the pan is broken. The surface layer is strongly affected by alkali.

Where there is vegetation, it consists of sparse stands of coarse sedges and scattered patches of saltgrass. This soil is used in the same way as Dangberg clay. (Capability unit VIw–6, irrigated)

Dangberg Series, Thin Solum Variant

The Dangberg series, thin solum variant, consists of shallow to moderately deep, nearly level, somewhat poorly drained soils that have a fine-textured subsoil. These soils formed in alluvium derived from mixed rocks, mainly from granitic formations. The soils are occasionally flooded, and they are strongly affected by salts and alkali. They are on slightly concave to nearly level stream terraces of valley plains, in the north-central part of Carson Valley, near Minden. The vegetation consists principally of saltgrass, greasewood, and rabbitbrush in fairly dense stands. The elevation is about 4,600 feet. The average annual precipitation is between 8 to 10 inches, and the average annual temper-

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ature between 49° and 51° F. The frost-free season ranges from 95 to 110 days.

The thin solum variant of Dangberg soils is associated with Cradlebaugh, Settlemeyer, and typical Dangberg soils.

Dangberg soils, thin solum variant, produce forage that provides grazing for livestock late in spring, in summer, and early in fall. Small low areas are irrigated by flooding. Cultivation of these soils has not been attempted, because of the salts and alkali and because of their high-lying positions in relationship to available irrigation ditches.

Dangberg clay, thin solum variant (Dk).—This soil occurs essentially as one area in the center of the valley, about 1 mile northwest of Minden. The surface layer typically is light clay or heavy clay loam, about 4 inches thick, that is gray in the uppermost few inches and light gray in the lower inch. The subsoil is about 24 inches thick. It consists of dark-gray clay over light brownish-gray silty clay loam and, below this, light brownish-gray clay loam. The substratum has a light-gray hardpan between depths of 28 to 54 inches. The hardpan is strongly cemented with silica. Below this is light-gray silty clay or silty clay loam. This soil is calcareous.

Representative profile of a Dangberg clay, thin solum variant, about 1,200 feet west and 300 feet north of the southeast corner of sec. 24, T. 13 N., R. 19 E.

A1—0 to 3 inches, gray (10YR 5/1) light clay, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, friable, sticky and plastic; many fine and medium rhizomes of saltgrass; many, fine, interstitial pores; effervescent; strongly alkaline (pH 8.5); abrupt, smooth boundary.

A2—3 to 4 inches, light-gray (2.5Y 7/2) light clay loam, dark grayish-brown (2.5Y 4/2) moist; moderate, thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine tubular pores; strongly effervescent; strongly alkaline (pH 8.8); abrupt, wavy boundary.

B2t—4 to 9 inches, dark-gray (10YR 4/1) clay, dark grayish brown (10YR 4/2) when moist; moderate, fine, columnar structure; hard, friable, sticky and plastic; many very fine and common fine roots, principally between peds; few very fine tubular pores and few very fine and fine interstitial pores; continuous thin clay films on ped faces and in pores; strongly effervescent; very strongly alkaline (pH 9.6); clear, wavy boundary.

B31t—9 to 15 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (2.5YR 4/2) when moist; weak, fine, prismatic structure; hard, friable, sticky and plastic; many very fine and few fine roots; many very fine and fine tubular pores; common thin clay films on peds and continuous thin clay films in pores; slightly effervescent; very strongly alkaline (pH 9.6); clear, wavy boundary.

B32t—15 to 28 inches, light brownish-gray (2.5Y 6/2) heavy clay loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, sticky and plastic; few fine roots; few very fine interstitial pores and tubular pores; few thin clay films in pores; effervescent; very strongly alkaline (pH 9.6); gradual, wavy boundary.

C1sim—28 to 54 inches, light-gray (2.5Y 7/2) strongly silica-cemented hardpan, dark grayish brown (2.5Y 4/2) when moist; few fine roots between plates; strongly effervescent; very strongly alkaline (pH 9.2); abrupt wavy boundary.

C2—54 to 60 inches, light-gray (2.5Y 7/2) silty clay or silty clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; very hard, very firm, very sticky and very plastic; no plant roots; many very fine interstitial pores; noneffervescent; moderately alkaline (pH 8.3).

The depth to the strongly cemented hardpan ranges from about 18 to 36 inches. The depth to the water table ranges from 48 to more than 72 inches. The pH values are not higher than 8.5 in the A1 horizon and not less than 9.2 in the B horizon and the C1sim horizon. The content of mica in all layers generally ranges from 1 to 3 percent.

Permeability is very slow, and the available water capacity is low. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is moderate.

The forage grown on this soil along with that in adjacent pastures is used for limited grazing of livestock. (Capability unit VIIw–6, nonirrigated)

Draper Series

The Draper series consists of deep, nearly level, somewhat poorly drained, medium-textured soils that formed in alluvium derived mainly from granite but partly from other igneous and sedimentary rocks. These soils are on smooth terraces in the central part of the survey area, south of Gardnerville. The vegetation consists of moderately dense stands of big sagebrush and an understory of grasses. Elevations range from 4,600 to 4,800 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 90 to 110 days. The average annual temperature is between 48° and 51° F.

Draper soils are associated with Hussman, East Fork, and Henningsen soils.

Soils of the Draper series are farmed intensively. Alfalfa, small grain, and pasture are the principal crops.

Draper loam (Dl).—This soil occurs on relatively low terraces along the East Fork of the Carson River, in the central part of the survey area. The surface layer typically is grayish-brown loam about 38 inches thick. The substratum consists of brown, mottled fine sandy loam over brown, mottled very gravelly sand. Reaction is neutral to slightly acid.

Representative profile of Draper loam, 150 feet south and 500 feet west of the north quarter corner of sec. 4, T. 12 N., R. 20 E.

Ap—0 to 8 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 3/2) when moist; weak, thick platy structure breaking to moderate, fine, subangular blocky and weak, medium and fine, granular; hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine interstitial pores; neutral (pH 6.7); clear, smooth boundary.

A11—8 to 15 inches, grayish-brown (10YR 5/2) loam, very dark grayish-brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; common very fine and fine, tubular pores; neutral (pH 6.7); clear, smooth boundary.

A12—15 to 38 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots;

few very fine and fine tubular pores; slightly acid (pH 6.4); clear, wavy boundary.

C1—38 to 48 inches, brown (10YR 5/3) heavy fine sandy loam, dark grayish brown (10YR 4/2) when moist; many, fine and medium to coarse, faint mottles of very dark grayish brown (10YR 3/2) caused by manganese content; massive; slightly hard, friable, sticky and slightly plastic; common very fine and fine roots; few very fine and fine interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

IIC2—48 to 60 inches, brown (10YR 5/3) very gravelly sand, dark brown (10YR 3/3) when moist; common to many, fine to medium, distinct to prominent mottles of reddish yellow (7.5YR 6/6) and yellowish red (5YR 5/6) caused by iron content; single grain; loose when dry and moist, nonsticky and nonplastic; very few fine roots; many interstitial pores; neutral (pH 6.6).

Mottles in the C horizon, caused by iron content, range from few to many in abundance and from fine to coarse in size. Stratification is common, and unconformable strata of very gravelly sand or coarse sand occur at a depth below 4 feet. The soil is normally noncalcareous throughout the profile, but there may be a few fine lime segregations in the strata of finer textured material because of the normally slow downward movement of water.

The water table fluctuates between depths of 4 and 6 feet during most of the irrigation season. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is high.

This soil is irrigated and used either for alfalfa grown in rotation with small grain or for grass-legume pasture grown in long-term rotation with small grain. The alfalfa is harvested as hay and the aftermath grazed. The grass-legume pasture is grazed by livestock. (Capability unit IIw-2, irrigated)

Draper loam, overflow (Do).—This soil is in slightly lower terrace positions that Draper loam, and it is occasionally flooded by the East Fork of the Carson River. Some of the soil material, deposited during floods, fills irrigation ditches and corrugations. Except for the flooding, this soil is similar to Draper loam. Included in mapping were several small areas that have a sandy plow layer.

The use of this soil is like that of Draper loam. In areas adjacent to the Carson River and especially where the river floods, the terrace escarpments should be riprapped with stones to prevent cutting. (Capability unit IIw-2, irrigated.)

Dressler Series

The Dressler series consists of very deep, nearly level to gently sloping, somewhat poorly drained and poorly drained, moderately coarse textured soils that formed in mixed alluvium derived mainly from granitic rocks but partly from small amounts of other igneous rocks. These soils are on alluvial terraces of the West Fork of the Carson River at the south end of the Carson Valley Area, about 2 miles north of the California State line. The vegetation consists of fairly dense stands of big sagebrush and bitterbrush and an understory of grasses and annual weeds. Elevations range from 4,700 to 5,000 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Dressler soils occur immediately below areas of Brockliss soils.

In some areas soils of the Dressler series are used for alfalfa grown in rotation with small grain or for grass-legume pasture. These areas are cut for hay, and the aftermath is grazed. The other areas are irrigated and are in meadow of native grasses and clovers. These areas are either grazed or are cut once for hay and the aftermath grazed.

Dressler sandy loam, 0 to 2 percent slopes (DtA).—This soil is in the southern part of the Carson Valley Area adjacent to the West Fork of the Carson River, about 2 miles north of the California State line. The surface layer typically is dark grayish-brown sandy loam about 20 inches thick. Below this, to a depth of about 37 inches, is a transitional layer of yellowish-brown loamy coarse sand. The substratum, to a depth of 60 inches, consists of mottled cobbly and stony coarse sandy loam over mottled loamy sand. This soil is noncalcareous and is slightly acid to neutral.

Representative profile of Dressler sandy loam, 0 to 2 percent slopes, about 100 feet south and 1,500 feet west of the center of sec. 29, T. 12 N., R. 20 E.

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) sandy loam (about 10 percent fine gravel); very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; very porous; slightly acid (pH 6.4); abrupt, smooth boundary.

A1—6 to 20 inches, dark grayish-brown (10YR 4/2) coarse sandy loam (10 percent fine gravel); very dark grayish brown (10YR 3/2) when moist; very weak, medium and fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; very porous; neutral (pH 6.6); gradual, smooth boundary.

AC—20 to 37 inches, yellowish-brown (10YR 5/4) loamy coarse sand, dark yellowish brown (10YR 3/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; very porous; few very fine tubular pores; neutral (pH 6.6); abrupt, wavy boundary.

IIC1—37 to 49 inches, cobbly and stony coarse sandy loam (about 25 percent cobblestones and stones), about equally mottled with strong brown (7.5YR 5/6) and brown (10YR 5/3); brown (10YR 4/3) when moist; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; very porous; slightly acid (pH 6.5); abrupt, irregular boundary.

IIIC2—49 to 60 inches, loamy sand, about 60 percent pale-brown (10YR 6/3) and 40 percent strong-brown (7.5YR 5/5) mottles; brown (7.5YR 5/5) when moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; very porous; slightly acid (pH 6.4)

The content of gravel, mostly fine gravel, in the Ap horizon ranges from 5 to 15 percent. At the southern limit of areas of these soils, thin stony and cobbly strata are common, but at the northern limit, they are rare. The mottles in the C horizon range from many in abundance and medium in size to the abundance and size sufficient to make up almost 50 percent of the soil color. This soil ranges from slightly acid in the coarser textured strata to neutral in the somewhat finer textured strata.

Permeability is rapid, and the available water capacity is low. The root zone is very deep. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is moderate.

Most of this soil is cultivated and used either for alfalfa grown in rotation with small grain or for grass-legume pasture grown in a long-term rotation with small grain. These crops are cut twice each year for hay, and the aftermath grazed. The rest of the soil is irrigated and used as meadow consisting of native grasses and clover. These crops are cut only once a year and then grazed. (Capability unit IIIw–4, irrigated)

Dressler gravelly sandy loam, 0 to 2 percent slopes (DrA).—The profile of this soil is similar to that of Dressler sandy loam, 0 to 2 percent slopes, except that the content of gravel in the surface layer is 20 to 50 percent. Consequently, the available water capacity is slightly lower. This soil occurs near the transition between Dressler and Brockliss soils. Consequently, the content of gravel, cobblestones, and stones throughout the profile is greater.

Most of this soil is used for meadow. Some areas can be improved and used for alfalfa or suitable clover-grass mixtures. (Capability unit IIIw–4, irrigated)

Dressler gravelly sandy loam, water table, 0 to 2 percent slopes (DsA).—This soil occupies slightly concave positions where irrigation water from higher areas accumulates. Its profile is essentially the same as that of Dressler gravelly sandy loam, 0 to 2 percent slopes, except that the uppermost 4 inches is a dense root mat. The water table fluctuates between depths of 2 and 3 feet during most of the irrigation season. Drainage is poor. A very high proportion of sedges makes up the meadow vegetation.

This soil is used in much the same way as Dressler gravelly sandy loam, 0 to 2 percent slopes, except that it is in cropland. Careful use of irrigation water on higher lying soils would do much to alleviate the conditions caused by the water table. Shallow ditches that divert the water away from this soil would help to lower the water table and keep it at a fairly constant level. Drainage would improve the quality of the meadow grass. (Capability unit IIIw–4P, irrigated)

Dressler sandy loam, water table, 0 to 2 percent slopes (DwA).—The profile of this soil is similar to that of Dressler sandy loam, 0 to 2 percent slopes, except that the uppermost 3 to 4 inches is a dense mat of roots. The water table fluctuates at depths between 2 and 3 feet. Drainage is poor.

The meadow vegetation consists predominantly of coarse sedges and water-tolerant grasses. This soil is used in much the same way as Dressler sandy loam, 0 to 2 percent slopes, except that it is in cropland. Careful use of irrigation water in higher areas and the construction of shallow drainage ditches would help to lower the water table and thus improve the quality of forage. (Capability unit IIIw–4P, irrigated)

Dressler sandy loam, water table, 2 to 4 percent slopes (DwB).—This soil occurs as narrow areas in concave swales. Its profile is similar to that of Dressler sandy loam, 0 to 2 percent slopes, except that the uppermost 3 to 4 inches is a dense mat of roots. The water table fluctuates between depths of 2 and 3 feet. Drainage is poor.

Sedges make up a higher proportion of the meadow than they do on better drained soils. This soil is used in much the same way as Dressler sandy loam, 0 to 2 percent slopes, except that it is not cultivated. Leveling the soil to make irrigation easier should not be attempted because of the relief and the narrowness of the soil areas. (Capability unit IIIw–14P, irrigated)

East Fork Series

The East Fork series consists of very deep, nearly level, somewhat poorly drained, moderately fine textured soils that formed in alluvium derived from sedimentary rocks and from granite and other igneous rocks. These soils are on smooth terraces in the central part of the survey area, south of Gardnerville. The vegetation consists of moderately dense stands of big sagebrush and an understory of grasses. Elevations range from 4,600 to 4,800 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 100 to 110 days. The average annual temperature is between 48° and 51° F.

East Fork soils are associated with Hussman, Gardnerville, Turria, Draper, and Henningsen soils.

Soils of the East Fork series are cultivated and used principally for alfalfa, small grain, and pasture.

East Fork clay loam (Ea).—This soil occurs in the central part of the survey area along the East Fork of the Carson River, near Gardnerville. The surface layer typically is grayish-brown clay loam about 11 inches thick. The substratum consists of grayish-brown sandy clay loam over brown, calcareous loamy sand, and below this, brown clay loam. This soil is noncalcareous in the uppermost 30 inches and is neutral in reaction.

Representative profile of East Fork clay loam, about 750 feet south and 400 feet east of the north quarter corner of sec. 3, T. 12 N., R. 20 E.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, subangular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; common very fine and fine tubular pores and many very fine and fine interstitial pores; numerous wormholes; neutral (pH 6.6); clear, smooth boundary.

A1—6 to 11 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; strong, medium to fine, subangular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; few very fine and fine tubular pores and many very fine and fine interstitial pores; neutral (pH 6.6); gradual, smooth boundary.

C1—11 to 30 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; few very fine tubular pores and many very fine interstitial pores; neutral (pH 6.6); clear, smooth boundary.

IIC2—30 to 45 inches, brown (10YR 5/3) loamy sand, dark grayish brown (10YR 4/2) when moist; few, fine and medium, distinct mottles of reddish brown (5YR 4/3) caused by iron content; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; matrix is generally noneffervescent, but it is slightly effervescent in spots; neutral (pH 6.8); abrupt, smooth boundary.

IIIC3—45 to 63 inches, brown (10YR 5/3) heavy clay loam; dark grayish brown (10YR 4/2) when moist; few to common, fine to medium, distinct mottles of reddish brown (5YR 4/3) caused by iron content;

massive; very hard, friable, very sticky and plastic; no roots; few very fine tubular pores; matrix is generally noneffervescent but strongly effervescent where there are a few, medium, distinct, white (10YR 8/2) lime veins; neutral (pH 7.2).

Stratification is common in the C horizon. The strata are predominantly moderately fine textured, but there are strata of sand, loamy sand, sandy loam, or loam in some places. Some areas near the river are underlain by gravel at a depth of about 4 feet. The mottles, which are generally at a depth of more than 30 inches, range from few to many in abundance and from fine to coarse in size. The soil is noneffervescent to a depth of 30 to 36 inches, but it may be effervescent below this depth. A few fine and medium lime segregations that slightly impede the downward movement of water occur in the denser materials.

Included in mapping were several small areas of soils that are affected by salts and alkali. In these areas the pH values range from 7.6 to 8.8, the soil particles in the plow layer are dispersed, and the intake of water is slow.

Permeability is moderately slow, and the available water capacity is high. The water table fluctuates between depths of 4 and 6 feet during most of the irrigation season. Surface runoff is very slow. Erosion is either not a hazard or only a slight hazard.

This soil is cultivated, irrigated, and used either for alfalfa grown in rotation with small grain or for grass-legume pasture grown in long-term rotation with small grain. The alfalfa is harvested for hay and the aftermath grazed. The grass-legume pasture provides grazing, mostly for livestock. Some included areas that are affected by salts and alkali can readily be reclaimed by the use of gypsum followed by leaching. (Capability unit IIw-2, irrigated)

East Fork loam (Ef).—This soil is generally closer to the river than East Fork clay loam. Its profile is similar to that of East Fork clay loam, except that the uppermost 8 to 10 inches is loam.

Included in mapping were some areas that are on slightly lower terraces and are flooded occasionally. Also included were areas that are underlain by gravel at depths of more than 48 inches. The hazard of erosion is not increased as a result of the flooding, but the soil material and debris deposited by floodwaters can fill irrigation ditches and corrugations.

This soil is used in essentially the same way as East Fork clay loam, but it is more easily tilled. It is well suited to potatoes and other row crops. Areas that are flooded should have a grass-legume buffer strip along the river edge to keep clean-up work to a minimum. Where there is a steep escarpment adjacent to the river, the bank should be riprapped with stones to keep the river from cutting into it during floods. (Capability unit IIw-2, irrigated)

Fettic Series

The Fettic series consists of very deep, nearly level, somewhat poorly drained soils that have a fine-textured layer in the subsoil. These soils formed in stratified loamy alluvium derived from granite, basalt, rhyolite, and metamorphic and sedimentary rocks. They are strongly affected by salts. They are on smooth alluvial terraces in the northern part of the survey area, and are occasionally flooded by the Carson River. The vegetation consists dominantly of greasewood, big sagebrush, and rabbitbrush and an understory of saltgrass. Elevations range from 4,500 to 4,600 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Fettic soils are associated with Ormsby, Godecke, Heidtman, and Job soils.

Soils of the Fettic series are mostly in brush that provides limited grazing. One small area has been leveled and seeded to tall wheatgrass, alta fescue, and sweetclover.

Fettic very fine sandy loam (Ff).—This soil is in the northern part of Carson Valley, about 1 mile northwest of Cradlebaugh Bridge. The surface layer typically is gray very fine sandy loam about 4 inches thick. The subsoil is about 25 inches thick. It consists of grayish-brown clay over light brownish-gray clay loam. The substratum consists of grayish-brown fine sandy loam over pale-brown loamy fine sand and pale-brown loamy sand. This soil is calcareous above the water table.

Representative profile of Fettic very fine sandy loam, about 700 feet north and 300 feet east of the southwest corner of sec. 19, T. 14 N., R. 20 E.

A1—0 to 4 inches, gray (10YR 5/1) very fine sandy loam, dark gray (10YR 3/1) when moist; massive; soft, friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine vesicular pores; effervescent; moderately alkaline (pH 8.4); abrupt, wavy boundary.

B21t—4 to 9 inches, grayish-brown (10YR 5/2) light clay, very dark grayish brown (10YR 3/2) when moist; strong, medium, prismatic structure; hard, friable, very sticky and very plastic; many very fine and fine roots, mainly along the prisms; common very fine tubular pores; continuous moderately thick clay films on ped faces and in pores; effervescent but violently effervescent where there are few, medium, faint mottles of light gray (10YR 7/2) caused by lime content; very strongly alkaline (pH 9.6); clear, wavy boundary.

B22t—9 to 21 inches, light brownish-gray (2.5Y 6/2) heavy clay loam, dark grayish brown (2.5Y 4/2) when moist; strong, medium, prismatic structure; hard, firm, sticky and very plastic; many very fine and fine roots; many very fine and fine tubular pores; thin continuous clay films on peds and in pores; few, medium, prominent, black (10YR 2/1) organic stains on ped faces; effervescent, but violently effervescent where there are a few, medium, faint, light-gray (10YR 7/2) lime flecks; very strongly alkaline (pH 9.2;) gradual, smooth boundary.

B3t—21 to 29 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, prominent mottles of dark reddish brown (2.5YR 3/3) caused by iron content; moderate, medium, prismatic structure; hard, firm, sticky and plastic; many thin clay films on ped faces and in pores; common very fine and fine roots; common very fine and fine tubular pores; violently effervescent; common, medium, faint, grayish-brown (10YR 5/2) lime flecks; very strongly alkaline (pH 9.2); clear, smooth boundary.

C1—29 to 36 inches, grayish-brown (2.5Y 6/2) heavy fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, distinct mottles of dark brown (7.5YR 3/2) caused by iron content; massive; hard, friable, slightly sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; few thin clay films in pores; effervescent; moderately alkaline (pH 8.4); clear, smooth boundary.

C2—36 to 41 inches, grayish-brown (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; massive; soft, friable, slightly sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; effervescent; moderately alkaline (pH 8.4); gradual, smooth boundary.

C3—41 to 54 inches, pale-brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) when moist; many, medium and large, distinct mottles of very dark gray (10YR 3/1) and many, fine, distinct mottles of dark brown (7.5YR 3/2); all mottles caused by iron and manganese content; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine tubular pores; noneffervescent; moderately alkaline (pH 8.2); gradual, smooth boundary.

IIIC4—54 to 64 inches, pale-brown (10YR 6/3) loamy sand, dark gray (10YR 4/1) when moist; many, large, distinct mottles of very dark grayish brown (10YR 3/2) caused by iron and manganese content; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many micro, very fine and fine, interstitial pores; noneffervescent; moderately alkaline (pH 8.2).

The C horizon is highly stratified with materials ranging from medium to coarse in texture. Very gravelly or very coarse sandy material occurs at a depth of more than 54 inches in some areas. Mottles caused by iron content are only 20 inches from the surface in places. Mottles caused by manganese content generally occur at depths of more than 36 inches, but they do not occur in all places. Flakes of mica occur throughout the profile. The A horizon is slightly affected by salts, and the subsoil is strongly affected.

Permeability is very slow, and the available water capacity is moderate to high. The water table is between depths of 42 and 66 inches during most of the irrigation season. Surface runoff is very slow. Erosion is either not a hazard or only a slight hazard. Natural fertility is moderate. Deposition can result from the flooding.

The available forage provides grazing for livestock during most of the year. Cultivating and irrigating a small area has been attempted. This area was leveled and seeded to tall wheatgrass, alta fescue, and sweetclover, but the stand was poor. Further cultivation is questionable, unless there is an adequate supply of water available. (Capability unit VIIw-6, nonirrigated)

Fettic clay, strongly saline (Fc).—The profile of this soil is similar to that of Fettic very fine sandy loam, except that the uppermost 3 to 5 inches is clay. The surface layer is strongly affected by salts. Because of the high salt content, the subsoil has weak prismatic structure that breaks to strong subangular blocky and angular blocky.

The vegetation consists predominantly of greasewood but little, if any, big sagebrush or rabbitbrush. The available forage provides grazing for livestock in spring, summer, and fall. (Capability unit VIIw-6, nonirrigated)

Fettic clay loam (Fe).—The profile of this soil is similar to that of Fettic very fine sandy loam, except that the uppermost 2 to 6 inches is clay loam. The soil particles in the surface layer are dispersed, and the intake of water is very slow as a result of the high sodium content.

The vegetation consists of greasewood and saltgrass. The limited amount of forage is grazed by livestock in spring, summer, and fall. (Capability unit VIIw-6, nonirrigated)

Fettic Series, Pan Variant

The Fettic series, pan variant, consists of very deep, nearly level to gently sloping, moderately well drained soils that have a moderately fine textured subsoil. These soils formed in alluvium derived mainly from granite, gneiss, and schist. They are on slightly convex alluvial fans in the northwestern part of the survey area, near Hobo Hot Spring. They have been affected by the salts and alkali that have been precipitated from the adjacent hot springs. The vegetation consists mainly of greasewood, rabbitbrush, and big sagebrush, and an understory of saltgrass. Elevations range from 4,700 to 4,900 feet. The average annual precipitation is between 10 and 12 inches, and the average annual temperature between 48° and 51° F. The frost-free season ranges from 90 to 105 days.

Fettic soils, pan variant, are associated with James Canyon, Voltaire, and Holbrook soils.

Soils of the Fettic series, pan variant, are in brush that provides limited grazing for livestock.

Fettic very fine sandy loam, pan variant, 2 to 4 percent slopes (FpB).—This soil is in the northwestern part of the Carson Valley Area, adjacent to Hobo Hot Spring. It has been affected by the salt and alkali content of the thermal water. The surface layer typically is grayish-brown very fine sandy loam about 5 inches thick. The subsoil is light olive-brown clay loam to a depth of about 10 inches. The substratum consists of light olive-gray very fine sandy loam over sandy clay loam that is light olive gray in the upper part and brown in the lower part. The surface layer and subsoil are noncalcareous, and the substratum is calcareous.

Representative profile of Fettic very fine sandy loam, pan variant, 2 to 4 percent slopes, about 50 feet north and 25 feet west of the east quarter corner of sec. 26, T. 14 N., R. 19 E.

A11—0 to 2 inches, grayish-brown (2.5Y 5/2) very fine sandy loam, very dark grayish-brown (2.5Y 3/2) when moist; moderate, thick, platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many fine and medium vesicular pores; moderately alkaline (pH 8.4); abrupt, smooth boundary.

A12—2 to 5 inches, grayish-brown (2.5Y 5/2) very fine sandy loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, thin, platy structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; moderately alkaline (pH 8.4); abrupt, wavy boundary.

B2t—5 to 10 inches, light olive-brown (2.5YR 5/3) clay loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, medium, prismatic structure; very hard, friable, sticky and plastic; common very fine and fine roots; many very fine and fine tubular pores; common thin clay films on peds and in pores; few to common, medium, distinct, black (10YR 2/1) organic stains on ped faces; moderately alkaline (pH 8.4); abrupt, smooth boundary.

C1—10 to 19 inches, light olive-gray (5Y 6/2) very fine sandy loam, olive gray (5Y 4/2) when moist; common, medium, prominent mottles of strong brown (7.5YR 5/6) caused by iron content; massive; hard, friable, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine tubular pores; strongly alkaline (pH 8.6); abrupt, smooth boundary.

C2ca—19 to 28 inches, light olive-gray (5Y 6/2) sandy clay loam, olive gray (5Y 4/2) when moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; few, very fine and fine roots; common very fine and few fine tubular pores; strongly effervescent; common, medium to fine, distinct mottles of light gray (10YR 7/2) caused by lime content; strongly alkaline (pH 8.8); abrupt, smooth boundary.

C3si—28 to 36 inches, brown (10YR 5/3) light sandy clay loam that is weakly cemented with silica, brown (10YR 4/3) when moist; many medium and coarse mottles of light brownish gray (2.5YR 2/6) caused by iron content; massive; very hard and hard, firm, brittle, sticky and plastic; few very fine and fine roots; common very fine and few fine tubular pores; effervescent; strongly alkaline (pH 9.0); abrupt, smooth boundary.

C4sica—36 to 60 inches, brown light sandy clay loam that is weakly cemented with silica, brown when moist; few silica-and-lime cemented nodules; few and common, medium, distinct mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) caused by iron content; massive; very hard and hard, firm and friable, sticky and plastic; few very fine and fine roots; few very fine and fine tubular pores; effervescent in matrix, but violently effervescent in nodules; strongly alkaline (pH 9.0).

The A horizon ranges from 4 to 9 inches in thickness. The structure of the A horizon ranges from weak to moderate, and that of the B horizon from moderate to strong in grade and from medium to fine in size. Below the B horizon the content of mica is commonly between 3 and 5 percent. The Csi horizon, when moist, ranges from firm to very firm in consistence because of the silica cementation. The cementation is nodular in some parts of the Csi horizon, but the soil material is generally massive. In places hard and firm, silica-cemented, fine, subangular aggregates occur at a depth below 36 inches.

The drainage of this soil is affected by the upward and lateral movement of water from hot springs. The parent material, apparently, has somewhat poor drainage, but pumping and the recent impoundment of water from the hot springs and creeks have lowered the water table and thus improved the drainage. The depth to the water table is more than 6 feet. Permeability is slow, and the available water capacity is high. Surface runoff is slow, and the erosion hazard is slight to moderate. Natural fertility is moderate.

The available forage provides grazing for livestock in spring, summer, and fall. Areas of this soil are also used as stackyards for hay cut on adjacent soils. (Capability unit VIIw-6, nonirrigated)

Franktown Series

The Franktown series consists of steep to extremely steep, somewhat excessively drained very stony and very gravelly, moderately coarse textured soils that formed in residuum weathered from the underlying gneiss and slate. These soils are on mountains in the northwestern part of the survey area. The vegetation consists of Jeffrey pine in small groves or as scattered trees, big sagebrush, bitterbrush, mountain-mahogany, phlox, bluegrass, and needlegrass. Elevations range from 4,900 to 7,500 feet. The annual precipitation ranges from 16 to 24 inches, and the frost-free season from 70 to 95 days. The average annual temperature is between 41° and 45° F.

Franktown soils are associated with Toiyabe and Holbrook soils.

The soils of the Franktown series are used mainly for water supply, wildlife habitat, and recreation. They are too steep for grazing by livestock. A limited amount of timber has been harvested in the past, but logging is restricted by the very steep slopes.

Franktown very stony and rocky complex, 45 to 80 percent slopes (FrG).—This mapping unit consists of Franktown very stony sandy loam, which makes up about 40 percent of this complex; rubble land, which makes up 30 percent; rock outcrops of gneiss and slate, which make up almost 20 percent; and a very deep gravelly loam, which makes up about 10 percent. The Franktown soil is between and above the rock outcrops; the rubble land is adjacent to or between the areas of rock outcrops; and the gravelly loam is along the toe slopes of the mountain, below the north-south fault scarp that traverses this complex.

The Franktown soil has an organic layer consisting of pine-needle litter about half an inch thick. The surface layer typically is olive-gray very stony sandy loam about 5 inches thick. Below this is a transitional layer of light olive-gray very gravelly sandy loam. Bedrock of gray slate begins at a depth of about 10 inches.

Representative profile of a Franktown very stony sandy loam, about 1,000 feet east and 700 feet south of the northwest corner of sec. 4, T. 13 N., R. 19 E.

O1—½ inch to 0, litter of pine needles.

A1—0 to 5 inches, olive-gray (5Y 5/2) very stony sandy loam, dark olive gray (5Y 3/2) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores; medium acid (pH 6.0); clear, smooth boundary.

AC—5 to 10 inches, light olive-gray (5Y 6/2) very gravelly sandy loam (60 percent gravel), olive gray (5Y 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine and few medium roots; many very fine interstitial pores; medium acid (pH 6.0); abrupt, irregular boundary.

R—10 inches, gray (N 5/0) unweathered slate bedrock; very dark gray (N 3/0) when moist.

The depth to bedrock ranges from 6 to 20 inches. Generally, the A1 horizon is slightly darker colored. It is thicker on the north- and east-facing slopes. The content of gravel, cobblestones, and stones, which varies considerably within short distances, ranges from 50 to 80 percent in the A1 horizon and from 60 to 95 percent in the AC or C horizon. There is an O1 horizon of pine needles in areas under Jeffrey pine, but not in areas under brush. In many places the bedrock is shattered to a depth of 6 feet or more.

Permeability is rapid, and the available water capacity is very low. Surface runoff is very rapid, and the erosion hazard is very high. Natural fertility is very low.

This soil is used mainly for water supply, wildlife habitat, and recreation. It is too steep for grazing by livestock. A limited amount of Jeffrey pine has been harvested in the past, but none is harvested at present. Timber harvesting should be kept to a minimum. (Franktown part in capability unit VIIs-1, nonirrigated; inclusions of rubble land and rock outcrops in capability unit VIIIs-8, nonirrigated)

Gardnerville Series

The Gardnerville series consists of very deep, nearly level, somewhat poorly drained to moderately well drained soils that have a fine-textured layer in the subsoil. These soils formed in alluvium derived from mixed rocks, mainly granite but partly andesite, basalt, sandstone, and rhyolite, and from volcanic ash. They are on smooth alluvial terraces in the north-central part of the survey area, just north of Minden. The vegetation consists of big sagebrush, rabbitbrush, and a small amount of grass. The elevation is about 4,600 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Gardnerville soils are associated with Ormsby, Turria, and Godecke soils.

Soils of the Gardnerville series, in most areas, are cultivated and used for locally suitable crops. Some areas that are not irrigated are now in brush, but these areas could be easily cultivated if water were available.

Gardnerville clay loam (Gd).—This soil is on nearly level toe slopes of alluvial fans in the north-central part of the survey area, near Minden. It is somewhat poorly drained. The surface layer typically is gray fine sandy loam about 2 inches thick. The subsoil consists of mainly brown clay in the upper 6 inches and grayish-brown sandy clay loam in the lower 8 inches. The substratum extends to a depth of more than 5 feet. It consists of brown coarse sandy loam that is weakly cemented with silica over brown and pale-brown loamy coarse sand that is weakly cemented with silica. Below this is yellow coarse sand. The soil is generally noncalcareous and neutral in the upper part and calcareous and mildly alkaline in the lower part.

Representative profile of Gardnerville clay loam, about 900 feet south and 300 feet east of the center of sec. 8, T. 13 N., R. 20 E.

A2—0 to 2 inches, gray (10YR 6/1) fine sandy loam, dark gray (10YR 4/1) when moist; weak, thick, platy structure; slightly hard, friable, very slightly sticky and very slightly plastic; common very fine and fine roots; many fine and medium vesicular pores; slightly acid (pH 6.4); abrupt, wavy boundary.

B1t—2 to 2½ inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, platy structure; very hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few very fine interstitial pores and many very fine tubular pores; few thin clay films in pores and on ped faces; neutral (pH 6.8); abrupt, broken boundary.

B21t—2½ to 5½ inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure breaking to strong, very fine, subangular blocky; hard, friable, very sticky and very plastic; common very fine and fine roots; many very fine interstitial pores and few very fine tubular pores; thin continuous clay films on ped faces and in pores; neutral (pH 6.9); abrupt, smooth boundary.

B22t—5½ to 8 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, firm, very sticky and very plastic; common very fine and fine roots; few very fine tubular pores and common, very fine and fine interstitial pores; neutral (pH 7.1); clear, wavy boundary.

B3t—8 to 16 inches, grayish-brown (10YR 5/2) sandy clay loam, dark brown (10YR 4/3) when moist; massive; hard, friable, sticky and plastic; few very fine and fine roots; few very fine and fine interstitial and tubular pores; common thin clay bridges between sand grains, and common thin clay films in pores; generally effervescent but violently effervescent where there are common, fine and very fine, distinct mottles of white (10YR 8/2) caused by lime content; mildly alkaline (pH 7.7); clear, wavy boundary.

C1si—16 to 35 inches, brown (10YR 5/3) weakly silica-cemented coarse sandy loam, dark brown (10YR 4/3) when moist; few, fine, distinct mottles of dark brown (7.5YR 3/2) caused by iron content; massive; brittle, hard, firm, nonsticky and nonplastic; few very fine roots; few fine and very fine interstitial pores; few thin silica bridges between sand grains; generally noneffervescent but strongly effervescent where there are a few, fine and very fine, distinct mottles of white (10YR 8/2) caused by lime content; mildly alkaline (pH 7.8); clear, smooth boundary.

C2si—35 to 58 inches, brown and pale-brown (10YR 5/3 and 6/3) weakly silica-cemented loamy coarse sand, dark brown and brown (10YR 3/3 and 4/3) when moist; common, medium and coarse, distinct mottles of dark brown (7.5YR 3/2) caused by iron content; massive; brittle, slightly hard, friable, nonsticky and nonplastic; few very fine roots; few fine and very fine interstitial pores; mildly alkaline (pH 7.6); clear, smooth boundary.

IIC5—58 to 67 inches, yellow (10YR 7/6) coarse sand, yellowish-brown (10YR 5/8) when moist; common, coarse, prominent mottles of black (5YR 2/1) caused by manganese content and common, coarse, distinct mottles of brown (7.5YR 4/3) caused by iron content; single grain; loose when dry or moist; no roots; many fine interstitial pores; mildly alkaline (pH 7.7).

The solum ranges from 15 to 22 inches in thickness. The silica-cemented fragments in the Csi horizon range from few to many (15 to 80 percent) in number and, when moist, from firm to very firm in durability in the upper part of this horizon and from friable to firm in the lower part. In places, this soil has a substratum of gravel at moderate depth, has a high water table, or is slightly affected by salts and alkali. In most places the lower part of the B horizon and the upper part of the C horizon are slightly calcareous, but in some places the entire profile is noncalcareous.

Permeability is slow, and the available water capacity is moderate. The water table fluctuates between depths of 4 and 5 feet as a result of the releases of ground water, seepage from ditches, and excessive losses of irrigation water. Surface runoff is slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is high.

This soil is irrigated and used either for alfalfa grown in rotation with small grain or for grass-legume pasture grown in long-term rotation with small grain. The alfalfa is harvested twice a year for hay and the aftermath grazed. The pasture is grazed by livestock. (Capability unit IIw–3, irrigated)

Gardnerville clay (Ga).—The profile of this soil is similar to that of Gardnerville clay loam, except that the uppermost 6 to 8 inches is clay. The clay texture is the result of removing 2 to 6 inches of the surface layer when leveling and then mixing the surface layer with the upper part of the subsoil when plowing.

The water intake rate is slower than that of Gardnerville clay loam. This soil is used in much the same way as that soil. (Capability unit IIw–35, irrigated)

Gardnerville clay, slightly saline-alkali (Gc).—This soil is similar to Gardnerville clay loam, except that the uppermost 5 to 8 inches is slightly affected by salts and alkali. The salts and alkali precipitated as the capillary water rose to the surface and evaporated. The water table is high because of seepage from canals and excessive losses of irrigation water.

This soil is used in much the same way as Gardnerville clay loam. (Capability unit IIIw–356, irrigated)

Gardnerville clay loam, deep water table (Ge).—The profile of this soil is similar to that of Gardnerville clay loam, except that the surface layer contains less organic matter and has slightly lighter colors. This soil is moderately well drained. The water table is at a depth of more than 6 feet. Mottles caused by iron content occur at a depth of more than 36 inches.

This soil is in range that provides limited grazing for livestock, but should water become available for irrigation, it could be used for all crops that are suited to the climate. (Capability unit IIw–3, irrigated)

Gardnerville clay loam, gravel substratum (Gg).—The profile of this soil is similar to that of Gardnerville clay loam, except that it is underlain by gravel. It has lower available water capacity. The depth to the gravel substratum ranges from 24 to 36 inches.

This soil is used in much the same way as Gardnerville clay loam. (Capability unit IIw–3, irrigated)

Gardnerville clay loam, slightly saline-alkali (Gh).—This soil is similar to Gardnerville clay loam, except that the surface layer is slightly affected by salts and alkali. Much of it is in range that provides limited grazing for livestock. The acreage below the irrigation canals is cultivated and used for alfalfa-alta fescue mixtures. (Capability unit IIIw–36, irrigated)

Glenbrook Series

The Glenbrook series consists of shallow, strongly sloping to very steep, somewhat excessively drained soils that formed in residuum weathered from granite. These soils are on foothills in the northwestern and southern parts of the survey area. Rocks crop out in places. The vegetation consists of a relatively dense cover of bitterbrush and big sagebrush and an understory of needlegrass, squirreltail, and annual weeds. Elevations range from 5,000 to 5,500 feet. The annual precipitation ranges from 12 to 16 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 45° and 47° F.

Glenbrook soils are associated with Mottsville soils.

Soils of the Glenbrook series provide limited grazing for livestock and wildlife.

Glenbrook sand, 8 to 30 percent slopes (GlE).—This soil is on low rolling foothills, east of Jacks Valley and immediately south of Dressler Bench. The surface layer typically is grayish-brown sand about 9 inches thick. The substratum consists of grayish-brown gravelly loamy coarse sand to a depth of about 15 inches, and below this it is decomposing granite rock that is gray and white and contains dark-brown to black ferromagnesian minerals. This soil is noncalcareous and ranges from medium acid to neutral in reaction.

Representative profile of Glenbrook sand, 8 to 30 percent slopes, about 650 feet south and 200 feet west of the center of sec. 12, T. 14 N., R. 19 E.

A11—0 to 4 inches, grayish-brown (10YR 5/2) sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; common very fine and fine and few medium and coarse roots; many fine interstitial pores; medium acid (pH 6.0); abrupt, wavy boundary.

A12—4 to 9 inches, grayish-brown (10YR 5/2) sand or loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine and few medium and coarse roots; many medium interstitial pores; slightly acid (pH 6.3); clear, smooth boundary.

C1—9 to 15 inches, grayish-brown (10YR 5/2) gravelly loamy coarse sand, brown (10YR 4/3) when moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and few medium and coarse roots; common fine and medium interstitial pores; few thin clay bridges between sand grains; neutral (pH 6.8); clear, smooth boundary.

C2—15 to 20 inches, decomposing granite rock that is gray and white and contains dark-brown to black ferromagnesian minerals; original rock structure is visible.

R—20 inches, unweathered granite rock.

The depth to weathered bedrock ranges from 8 to 20 inches, depending on the slope, but the depth to unweathered bedrock ranges from 20 to 48 inches. The shallower areas are steep. The less shallow areas are more gently sloping, and in these areas some colluvial material has accumulated. Some gravel, cobblestones, stones, or boulders can occur in any part of the profile, especially in areas near granite outcrops.

Included in mapping were outcrops of granite rock, which make up about 5 percent of the acreage.

Permeability is rapid, and the available water capacity is very low. Surface runoff is slow to medium, depending on the slope, and the erosion hazard is slight to moderate. Natural fertility is very low.

The available forage is grazed by livestock late in spring, in summer, and in fall. Large amounts are consumed by wildlife in winter, when deerherds from the Sierra Nevada migrate into this area. (Capability unit VIIs–L, nonirrigated)

Glenbrook rocky sand, 30 to 60 percent slopes (GkF).—This soil is similar to Glenbrook sand, except that it is steeper. The erosion hazard is very severe.

Included in mapping were outcrops of granite rock that make up about 10 percent of the acreage.

This soil is used in the same way as Glenbrook sand, 8 to 30 percent slopes, but because of the steepness, there is less forage available for grazing livestock. More bitterbrush and less big sagebrush make up the plant cover. A few scattered Jeffrey pines grow at the higher elevations. (Capability unit VIIs–1, nonirrigated)

Godecke Series

The Godecke series consists of very deep, nearly level, somewhat poorly drained, moderately fine textured soils that formed in loamy alluvium derived from granite, basalt, rhyolite, and mixed metamorphic and sedimentary rocks. These soils are strongly affected by salts and alkali. They are on smooth terraces or slightly concave, basinlike parts of the terraces, in the northeastern part of the survey area. The vegetation consists mainly of greasewood and rabbitbrush, but there are lesser amounts of spiny hopsage, saltbush, Great Basin wildrye, saltgrass, and big sagebrush. Elevations range from 4,600 to 5,000 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Godecke soils are associated with Gardnerville, Ormsby, and Toll soils.

Soils of the Godecke series are used for grazing. Much of the acreage is in brush that provides limited grazing for livestock; the rest has been seeded to grasses that are tolerant of salts and alkali. The suitability of the soil for pasture crops depends on the content of salts and alkali and the suitability of the plants.

Godecke clay loam (Go).—This soil is in the northeastern part of the survey area, near Cradlebaugh Bridge. It is strongly affected by salts and alkali. The surface layer typically is 8 inches thick. It consists of light brownish-gray clay loam over pale-brown fine sandy loam. The subsoil is pale-brown clay loam to a depth of about 18 inches. The substratum consists of pale-brown coarse sandy loam over pale-brown fine sandy loam. Below this is pale-yellow loamy fine sand that is weakly cemented with silica. This layer overlies pale-yellow very fine sandy loam. This soil is generally calcareous.

Representative profile of Godecke clay loam, about 600 feet east and 50 feet south of the north quarter corner of sec. 32, T. 14 N., R. 20 E.

A11—0 to 2 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard, very friable, sticky and plastic; common very fine roots; many very fine and fine vesicular pores; noneffervescent; strongly alkaline (pH 8.8); abrupt, wavy boundary.

A12—2 to 8 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) when moist; massive; hard, friable, nonsticky and nonplastic; common very fine, fine, and medium roots; many very fine tubular pores; noneffervescent; strongly alkaline (pH 8.8); clear, smooth boundary.

B2t—8 to 18 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure; hard, friable, sticky and plastic; common very fine and few medium horizontal roots; many very fine tubular pores; common thin clay films as bridges between sand grains; generally effervescent but violently effervescent where lime has precipitated as filaments in root channels; strongly alkaline (pH 9.0); abrupt, smooth boundary.

C1—18 to 24 inches, pale-brown (10YR 6/3) coarse sandy loam, brown (10YR 5/3) when moist; massive; very hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores and many very fine and fine interstitial pores; violently effervescent; common, coarse, distinct mottles of very pale brown (10YR 8/3) caused by lime content; strongly alkaline (pH 9.0); gradual, smooth boundary.

C2sica—24 to 36 inches, pale-brown (10YR 6/3) fine sandy loam; common, coarse, extremely hard and very firm, silica-and-lime-cemented, pale-brown (10YR 7/2) nodules that range from ⅛ inch to 1½ inches in diameter, grayish brown (10YR 5/2) when moist; massive; slightly hard, friable, nonsticky and slightly plastic; few very fine roots; common very fine and few fine tubular pores; strongly effervescent; strongly alkaline (pH 9.0); abrupt, wavy boundary.

C3sica—36 to 55 inches, pale-yellow (5Y 8/3) heavy loamy fine sand that is weakly cemented with slicia, olive (5Y 5/3) when moist; few, fine and medium, prominent, black (10YR 2/1) manganese flecks; moderate, thick and medium, platy structure; very hard, firm and very firm, nonsticky and nonplastic; no plant roots; few fine tubular pores; strongly effervescent; common, medium and coarse, faint mottles and soft nodules of light olive gray (5Y 6/2) caused by lime content; strongly alkaline (pH 8.8); abrupt, wavy boundary.

C4g—55 to 60 inches, pale-yellow (5Y 7/3) very fine sandy loam; when moist, the color consists of 80 percent olive (5Y 5/3) and 20 percent black (2.5Y 2/1) mottles and flecks caused by manganese content; strong, thin, platy structure; hard, firm, nonsticky and nonplastic; no plant roots; few fine tubular pores; noneffervescent; moderately alkaline (pH 8.4).

The solum ranges from 14 to 20 inches in thickness. The B horizon ranges from prismatic to subangular blocky in structure, depending on the salt content. Where the salt content is very high, the structure is subangular blocky. Considerable stratification occurs in the C horizon. Silica cementation is generally weak, but in some places there are thin, discontinuous, strongly cemented or indurated strata.

Permeability is slow, and the available water capacity is moderate. The water table is at depths ranging from 4 to 7 feet during most of the year. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is moderate.

About half the acreage is in range that provides limited grazing for livestock, and about half has been leveled and irrigated and is used for alta fescue and alfalfa pasture or for tall wheatgrass. (Capability unit VIw-6, irrigated)

Gullied Land

Gullied land (Gu) is near the lower end of Dutch Valley, the lower end of Diamond Valley, and along Indian Creek in Alpine County. It consists of a branching network of gullies, 3 to 15 feet deep, 15 to 50 feet wide, and bounded by vertical banks. These gullies are the result of erosion on Kimmerling and Ophir soils during flash floods. They effectively drain the surrounding areas.

Meadow grows on the gully bottoms. It is grazed by livestock throughout the growing season. Rock gully plugs should be constructed in the Indian Creek channel to control further headcutting into the upstream meadows and to stablilize the channel grade. (Capability unit VIIe-1, nonirrigated)

Haybourne Series

The Haybourne series consists of very deep, nearly level to gently sloping, somewhat excessively drained soils that have a moderately coarse textured subsoil. These soils formed in sandy alluvium derived mainly from granite but partly from rhyolite, basalt, andesite, gneiss, and sandstone. They are on smooth to gently convex alluvial fans in the northeastern part of the survey area, near Hot Springs Mountain. The vegetation is dominantly big sagebrush, but there are small amounts of rabbitbrush, grasses, and weeds. The elevation is about 4,700 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Haybourne soils are associated with Toll, Stodick, and McFaul soils. Soils of the Haybourne series produce mainly forage for grazing livestock late in fall, in winter, and early in spring.

Haybourne loam, 0 to 2 percent slopes (HaA).—This soil is in the northeastern part of the survey area, south of Hot Springs Mountain. The surface layer typically is loam, about 6 inches thick, that is pale brown in the upper part and brown in the lower part. The subsoil is brown sandy loam to a depth of about 25 inches. The substratum consists of brown loamy sand over pale-brown loamy sand. Below this is light brownish-gray coarse sand. This soil is noncalcareous and is neutral in reaction.

Representative profile of Haybourne loam, 0 to 2 percent slopes, about 1,400 feet west of the north quarter corner of sec. 33, T. 14 N., R. 20 E.

A11—0 to 3 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 3/3) when moist; moderate, medium to thick, platy structure; soft, very friable, nonsticky and nonplastic; no plant roots; many medium and fine vesicular pores; neutral (pH 6.6); abrupt, smooth boundary.

A12—3 to 6 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak, medium, platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine and fine vesicular pores; neutral (pH 6.7); abrupt, smooth boundary.

B21—6 to 15 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; few fine tubular pores and many very fine and fine interstitial pores; neutral (pH 6.7); clear, smooth boundary.

B22—15 to 25 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; massive; hard, friable, nonsticky and nonplastic; common very fine and fine roots; many fine and very fine interstitial pores; few thin clay bridges between sand grains; neutral (pH 6.7); clear, smooth boundary.

C1—25 to 34 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; many very fine and fine interstitial pores; neutral (pH 7.0); clear, smooth boundary.

IIC2—34 to 42 inches, pale-brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) when moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; neutral (pH 7.0); clear, smooth boundary.

IIIC3—42 to 60 inches, light brownish-gray (10YR 6/2) coarse sand, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many fine and very fine interstitial pores; generally noneffervescent, but a few spots are effervescent; neutral (pH 7.2).

This soil is stratified. In some places the uppermost ½ to 1 inch of the A horizon consists of winnowed sandy material. The B horizon ranges from coarse sandy loam to fine sandy loam in texture, and the C horizon from light sandy loam to loamy sand that grades either to sand or to coarse sand at depths between 42 and 60 inches.

Permeability is moderately rapid, and the available water capacity is moderate. Surface runoff is slow, and erosion is either not a hazard or only a slight hazard. Soil deposition may occur during summer rainstorms as a result of runoff from higher areas. Inherent fertility is moderate.

This soil is used principally for limited grazing of livestock in winter and spring. Some of the areas have been subdivided for small homesites. If water becomes available, the soil can be cultivated safely and used for most crops that are suited to the climate. (Capability unit IIs–4, irrigated)

Haybourne loam, 2 to 4 percent slopes (HaB).—This soil is in higher positions on alluvial fans than Haybourne loam, 0 to 2 percent slopes. It is similar to that soil, except that it is gently sloping. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used or can be used in the same way as Haybourne loam, 0 to 2 percent slopes. (Capability unit IIIe–4, irrigated)

Haybourne sand, 0 to 4 percent slopes (HbB).—The profile of this soil is similar to that of Haybourne loam, 0 to 2 percent slopes, except that the uppermost 9 to 12 inches is sand. Because the texture is sand, the intake of water is considerably more rapid and the available water capacity is low. The hazard of erosion is slight to moderate. Inherent fertility is low.

This soil can be used in the same way as Haybourne loam, 0 to 2 percent slopes. (Capability unit IIIe–4, irrigated)

Heidtman Series

The Heidtman series consists of very deep, nearly level, somewhat poorly drained, somewhat stratified soils that formed in alluvium derived largely from granitic rocks but partly from a wide variety of other rocks. These soils are occasionally flooded. They are on smooth flood plains in the north-central part of the survey area. The vegetation consists dominantly of big sagebrush, but there are smaller amounts of saltgrass, Great Basin wildrye, rabbitbrush, cheatgrass, and povertyweed. Elevations range from 4,600 to 4,700 feet. The annual precipitation ranges from 10 to 21 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Heidtman soils are associated with Job, Voltaire, and Cradlebaugh soils.

Most of the soils of the Heidtman series are irrigated and used either for alfalfa grown in rotation with small grain or for grass-legume pasture. The rest are in range or irrigated meadow that provides grazing for livestock.

Heidtman clay loam (Hc).—This soil is in the west-central part of the survey area, adjacent to the Carson River near Genoa and to the West Fork of the Carson River near Centerville. The surface layer typically is gray clay loam about 7 inches thick. The substratum consists of grayish-brown clay loam over grayish-brown loam, and below this is light brownish-gray sand.

Representative profile of Heidtman clay loam, about 1,200 feet north and 2,000 feet east of the southwest corner of sec. 11, T. 13 N., R. 19 E.

Ap—0 to 7 inches, gray (10YR 5/1) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores; mildly alkaline (pH 7.6); abrupt, smooth boundary.

C1—7 to 16 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, prismatic structure; hard, friable, sticky and plastic; many very fine roots; common very fine and fine tubular pores; moderately alkaline (pH 8.0); clear, smooth boundary.

C2—16 to 25 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 3/3) when moist; massive; slightly hard, friable, sticky and plastic; common very fine and fine roots; common fine tubular pores; effervescent; moderately alkaline (pH 8.4); clear, smooth boundary.

C3g—25 to 47 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; few, fine, faint mottles of yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) caused by iron content; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common fine tubular pores; effervescent; moderately alkaline (pH 8.4); abrupt, smooth boundary.

IIC4—47 to 60 inches, light brownish-gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) when moist; common, very coarse, distinct mottles of strong brown (7.5YR 5/6) and many, fine, prominent mottles of yellowish red (5YR 5/8); all mottles caused by iron content; loose when dry and moist; few very fine and fine roots; many fine interstitial pores; noneffervescent; mildly alkaline (pH 7.8).

The A horizon ranges from 6 to 14 inches in thickness in virgin areas, but it may have a thickness of as much as 18 inches in cultivated areas that have been leveled. The C1 and C2 horizons are commonly stratified and have a dominant texture of clay loam or sandy clay loam, but there are strata of loam, fine sandy loam, sandy loam, loamy sand, or sand. Gravel may occur below a depth of 48 inches. Mottles caused by iron content occur at a depth of more than 20 inches. They range from few to many in abundance. The soil is generally noncalcareous in the uppermost 16 inches, but it may be effervescent to violently effervescent below this depth. Few to common, fine to medium lime segregations can occur between depths of 28 and 40 inches. Reaction ranges from mildly alkaline to, at depths of more than 20 inches, strongly alkaline.

Permeability is moderately slow, and the available water capacity is high. The water table fluctuates between depths of 3 and 5 feet during most of the irrigation season. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Some nondetrimental deposition occurs as a result of flooding on the Carson River. The natural fertility is high.

Most of this soil is irrigated and used for alfalfa or alfalfa-alta fescue mixtures grown in rotation with small grain or for grass-legume pasture grown in long-term rotation with small grain. The alfalfa or alfalfa-alta fescue mixture is harvested for hay and the aftermath grazed. The pasture and the nonirrigated areas, which are in range, are used for grazing by livestock. (Capability unit IIw–2, irrigated)

Heidtman clay loam, clay substratum (Hd).—The profile of this soil is similar to that of Heidtman clay loam, except that the substratum is dense, slowly permeable clay. The depth to the clay substratum ranges from 40 to 48 inches. A perched water table is an adverse feature resulting from the clay substratum.

Included in mapping, about a mile east of Genoa, was a small area of soil that is strongly affected by salts and alkali.

This soil is used in much the same way as Heidtman clay loam. The included soil either is idle or is used as a place for stacking hay. (Capability unit IIw–2, irrigated)

Heidtman loam, slightly saline-alkali (He).—The profile of this soil is similar to that of Heidtman clay loam, except that the uppermost 4 to 8 inches is loam. The surface layer is slightly affected by salts and alkali, and the intake of water is reduced because the excess sodium has dispersed the soil particles.

This soil is used in much the same way as Heidtman clay loam. (Capability unit IIw–6, irrigated)

Henningsen Series

The Henningsen series consists of very deep, nearly level, somewhat poorly drained, very gravelly, coarse-textured soils that formed in alluvium derived mainly from granite but partly from basalt, andesite, rhyolite, and some gneiss and slate. They are on smooth flood plains and low terraces in the the central part of the survey area adjacent to the East Fork of the Carson River and its sloughs, about 1 mile south of Gardnerville. The vegetation consists of big sagebrush and grasses. The elevation is about 4,700 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Henningsen soils are associated with East Fork, Draper, and Hussman soils.

About half the acreage of these soils has been leveled and is used principally for irrigated alfalfa-grass pasture. The rest is in native vegetation that is grazed by livestock. There is considerable use of these soils as a source of gravel for concrete aggregate.

Henningsen gravelly loam (Hg).—This soil is in the central part of the survey area, adjacent to Rocky Slough, about 1 mile south of Gardnerville. It is occasionally flooded. The surface layer typically is about 13 inches thick. It consists of grayish-brown gravelly loam over grayish-brown, faintly mottled gravelly very fine sandy loam. The substratum consists of grayish-brown very gravelly loamy coarse sand over grayish-brown very gravelly coarse sand. This soil is noncalcareous and is neutral in reaction.

Representative profile of Henningsen gravelly loam, about 2,500 feet north and 1,400 feet east of the southwest corner of sec. 9, T. 12 N., R. 20 E.

Ap—0 to 7 inches, grayish-brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard, friable, nonsticky and slightly plastic; many very fine and fine and few medium roots; many fine and medium interstitial pores; neutral (pH 6.8); clear, smooth boundary.

A1—7 to 13 inches, grayish-brown (10YR 5/2) gravelly very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; few, fine and medium, faint mottles of dark brown (10YR 4/3) caused by iron content; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores and common, medium, tubular pores; neutral (pH 7.0); clear, smooth boundary.

IIC1—13 to 20 inches, grayish-brown (2.5Y 5/2) very gravelly loamy coarse sand, dark grayish brown (2.5Y 4/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 50 to 60 percent gravel; neutral (pH 6.8); clear, smooth boundary.

IIC2—20 to 60 inches, grayish-brown (2.5Y 5/2) very gravelly coarse sand, dark grayish brown (2.5Y 4/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; few very fine and fine roots; many very fine and medium interstitial pores; 60 to 80 percent gravel; neutral (pH 6.6).

The thickness of the A horizon and the depth to the very gravelly material range from 3 to 16 inches. The variations in depth are related to undulations of gravelly and cobbly material during deposition, but in places, they are the result of leveling. Small spots of material from the C horizon are exposed in many fields. Mottles caused by iron content are common, but in places there are none in the A horizon.

The water table is commonly at a depth of 3 to 5 feet during most of the irrigation season, depending on the level of water in the river or slough. Permeability is very rapid in the subsoil. The available water capacity is low. Surface runoff is very slow, and the erosion hazard is slight. Fertility is low.

Many areas have been leveled and are used for irrigated alfalfa-grass pasture. Small grain, commonly oats, is sometimes grown for 1 year, when the stand is reestablished. A permanent buffer strip of grass should be maintained between the cultivated fields and the river or slough, so that the risk of river cutting during periods of flooding is lessened. Uncultivated areas are in range that provides limited grazing for livestock.

This soil can be used as a source of gravel and sand for construction purposes, but the soil material must be excavated carefully because the course of the river can be altered if the pit is too deep. Alteration of the channel may result in water for irrigation bypassing the existing diversion dams. (Capability unit Vw–4, irrigated)

Henningsen clay loam, water table (Hf).—This soil is on terraces adjacent to the river or sloughs and is frequently flooded. Its profile is similar to that of Henningsen gravelly loam, except that the uppermost 6 to 10 inches is clay loam. Consequently, this soil takes in water at a slightly slower rate. The water table fluctuates between depths of 2 and 3 feet during most of the spring or early in summer. The height of the water table depends on the level of water in the river. When the river is high, the water table is high; when the river flow decreases, the water table is lower.

Included in mapping, on the flood plain of the slough just north of Minden, was a small area of poorly drained soil that has a mottled surface layer. In this area the water table fluctuates between depths of 12 and 30 inches during most of the irrigation season.

This soil is used in the same way as Henningsen gravelly loam. It is more desirable for pasture because of the high water table, which makes enough water available to plants and permits longer periods between irrigations. (Capability unit Vw–4, irrigated)

Henningsen gravelly loam, water table (Hh).—This soil is on low-lying terraces and is frequently flooded. It is similar to Henningsen gravelly loam, except that the water table fluctuates between depths of 2 and 3 feet. The height of the water table depends upon the level of the water in the river.

This soil is used in much the same way as Henningsen gravelly loam. It is more desirable for pasture because the higher water table makes enough water available to plants and permits less frequent irrigation. (Capability unit Vw–4, irrigated)

Henningsen loam (Hk).—The profile of this soil is similar to that of Henningsen gravelly loam, except that the uppermost 4 to 8 inches is essentially gravel free. This soil has slightly greater available water capacity than that soil. The content of gravel in the plow layer is less than 15 percent, but gravel content increases with depth.

This soil is used in much the same way as Henningsen gravelly loam. (Capability unit Vw–4, irrigated)

Henningsen loam, water table (Hl).—This soil is on low-lying terraces and is frequently flooded. Its profile is similar to that of Henningsen gravelly loam, except that the content of gravel in the uppermost 5 to 8 inches is less than 15 percent. It has slightly higher available water capacity than that soil. The water table fluctuates between depths of 2 and 3 feet, and its height depends on the level of water in the river or slough.

This soil is used in much the same way as Henningsen gravelly loam, but because of the high water table, it is more desirable for pasture and it does not need to be irrigated so often. (Capability unit Vw–4, irrigated)

Henningsen Series, Moderately Deep Variant

The Henningsen series, moderately deep variant, consists of moderately deep, nearly level, somewhat poorly drained soils that formed in alluvium derived mainly from granite but partly from basalt, andesite, rhyolite, and some gneiss and slate. These soils are on smooth, low terraces in the central and southern parts of the survey area, adjacent to the East Fork of the Carson River and its sloughs, about 5 miles south of Gardnerville. The vegetation consists of big sagebrush and grasses. The elevation is about 4,700 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Henningsen soils, moderately deep variant, are associated with East Fork, Draper, and typical Henningsen soils.

Soils of the Henningsen series, moderately deep variant, have been leveled and irrigated. They are used principally for alfalfa and orchardgrass grown in rotation with small grain and legume-grass pasture.

Henningsen loam, moderately deep variant (Hn).—This soil is in the central and southern parts of the survey area adjacent to the East Fork of the Carson River, about 5 miles south of Gardnerville. A small area near the southern end of the survey area is subject to flooding. The surface layer typically is loam, about 9 inches thick, that is grayish brown in the upper part and dark grayish brown in the lower part. Below this is a substratum of grayish-brown fine sandy loam to a depth of 28 inches. This material overlies grayish-brown very gravelly loamy coarse sand to a depth of 60 inches. This soil is noncalcareous.

Representative profile of Henningsen loam, moderately deep variant, on an Indian Reservation, about 25 feet north and 50 feet east of the southwest corner of sec. 24, T. 12 N., R. 20 E.

Ap—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

A1—3 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and few fine tubular pores; neutral (pH 6.8); clear, smooth boundary.

C1—9 to 28 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine and fine tubular pores; 3 to 5 percent fine rounded gravel; neutral (pH 6.8); abrupt, wavy boundary.

IIC2—28 to 60 inches, grayish-brown (10YR 5/2) very gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; many fine interstitial pores; neutral (pH 6.8).

The A horizon ranges from 7 to 14 inches in thickness. The C horizon is dominantly fine sandy loam or loam, but in places, these materials are stratified with material of other textures. The depth to the IIC horizon ranges from 20 to 36 inches, but in most places it is 24 to 48 inches. Mottles, caused by iron content, that have high chromas occur at a depth of more than 20 inches. They range from a few to common in abundance and from fine to coarse in size. Reaction ranges from neutral to mildly alkaline.

The water table is commonly between depths of 3 and 5 feet during most of the irrigation season. Permeability and the available water capacity are moderate. Surface runoff is very slow. Inherent fertility is moderate.

Most of this soil is cultivated and irrigated. Alfalfa or alfalfa-orchardgrass mixtures are grown in rotation with small grain. (Capability unit IIIw–4, irrigated)

Henningsen clay loam, moderately deep variant (Hm).—This soil is on low terraces adjacent to the East Fork of the Carson River and is occasionally flooded. Its profile is similar to that of Henningsen loam, moderately deep variant, except that the uppermost 4 to 10 inches is dominantly clay loam. The C horizon is dominantly clay loam or loam, but it may have thin strata of moderately coarse textured soil material. The erosion hazard is not increased by the flooding, but the debris deposited can fill ditches and corrugations.

Included in mapping, in the western part of the survey area, were small areas of poorly drained soils that have a mottled surface layer in places. In these areas the water table fluctuates between depths of 18 and 30 inches during most of the growing season.

This soil is used in the same way as Henningsen loam, moderately deep variant. A buffer strip of grasses and legumes should be used to control erosion and to minimize damage from debris where the soil grades to the river. Steep escarpments along the river should be riprapped with stones to prevent river cutting during floods or periods of high flow. (Capability unit IIIw–4, irrigated)

Holbrook Series

The Holbrook series consists of deep, gently sloping to rolling, well-drained, gravelly, cobbly, and very stony, moderately coarse textured soils that formed in alluvium derived mainly from slate and gneiss. These soils are on slightly convex to convex alluvial fans in the western part of the survey areas, along the base of the very steep Sierra Nevada. The vegetation consists mainly of big sagebrush and bitterbrush and an understory of squirreltail and Sandberg bluegrass. Elevations range from 4,800 to 5,200 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 90 to 110 days. The average annual temperature is between 47° and 50° F.

Holbrook soils are associated with Franktown, James Canyon, and Mottsville soils.

Soils of the Holbrook series provide limited grazing for both wildlife and livestock. In the small, more gently sloping areas, they are used principally for alfalfa, small grain, and pasture.

Holbrook gravelly fine sandy loam, 2 to 4 percent slopes (HoB).—This soil is in the western part of the survey area, near Genoa. It lies between areas of James Canyon soil and areas of the steeper phases of Holbrook soils. The surface layer typically is about 15 inches thick. It consists of gray gravelly fine sandy loam over gray gravelly and cobbly loam. Below this, to a depth of 60 inches, is a substratum of light brownish-gray, very gravelly, cobbly, and stony sandy loam. This soil is noncalcareous and is neutral in reaction.

Representative profile of Holbrook gravelly fine sandy loam, 2 to 4 percent slopes, about 1,000 feet west and 520 feet south of the northeast corner of sec. 26, T. 14 N., R. 19 E.

A11—0 to 4 inches, gray (10YR 5/1) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure breaking to weak, very fine, granular; soft, very friable, nonsticky and nonplastic; many very fine and fine and a few medium roots; many very fine and fine tubular pores; 20 percent gravel; highly micaceous; neutral (pH 7.0); clear, smooth boundary.

A12—4 to 15 inches, gray (10YR 5/1) gravelly and cobbly loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine and fine tubular pores; 15 percent gravel and 15 percent cobblestones; highly micaceous; neutral (pH 7.1); clear, wavy boundary.

C1—15 to 60 inches, light brownish-gray (10YR 6/2) very gravelly, cobbly, and stony sandy loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots in the uppermost part, grading to very few fine roots in the lower part; many very fine and fine tubular pores; 50 percent gravel, 10 percent cobblestones, and 15 percent stones; highly micaceous; neutral (pH 6.6).

The A horizon ranges from 10 to 20 inches in thickness. Slight stratification of loam, fine sandy loam, and sandy loam is common throughout the profile. These soil materials contain varying amounts of gravel, cobblestones, and stones. In the A horizon there may be a few stones, cobblestones that make up as much as 15 percent of the volume in some spots, and gravel that increases with depth within the horizon but that commonly makes up between 15 and 35 percent of the volume. The content of cobblestones and stones in the C horizon may range from 25 to 40 percent, and that of gravel from 40 to 60 percent. The proportion of mica in the soil ordinarily ranges from 1 to 4 percent.

Included in mapping was a small area of essentially gravel-free soils that resemble Holbrook soils and that produce forage that contains toxic amounts of molybdenum.

Permeability is moderately rapid, and roots penetrate deeply. The available water capacity is low. Surface runoff is slow, and the erosion hazard is slight. Natural fertility is low.

Most of this soil is in range that provides limited grazing for livestock and wildlife. Grazing by deer is extremely heavy in winter. Scattered areas are irrigated and are used either for alfalfa or for alfalfa-grass mixtures grown in rotation with small grain. (Capability unit IIIe–4, irrigated)

Holbrook gravelly fine sandy loam, 4 to 8 percent slopes (HoC).—This soil is on alluvial fans. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used in the same way as Holbrook gravelly fine sandy loam, 2 to 4 percent slopes. It could be developed for cultivation. (Capability unit IVe–4, irrigated)

Holbrook gravelly fine sandy loam, water table, 2 to 4 percent slopes (HrB).—This soil is similar to Holbrook gravelly fine sandy loam, 2 to 4 percent slopes, except that its water table is at a depth of 4 to 6 feet. The water table is a result of excessive irrigation, of seepage from ditches, and of lateral seepage from higher areas of the poorly drained James Canyon soils. In places mottles caused by iron content occur at a depth below 42 inches. Gravel makes up 40 to 45 percent of the material below the surface layer. There are a few cobblestones and stones.

This soil is used for alfalfa grown in rotation with small grain. (Capability unit IIIe–4, irrigated)

Holbrook very stony fine sandy loam, 4 to 16 percent slopes (HsD).—This soil is on alluvial fans. Its profile is like that of Holbrook gravelly fine sandy loam, 2 to 4 percent slopes, except that the surface layer is very stony. In places stones and cobblestones make up as much as 60 to 80 percent of the profile. The content of stones increases but the content of gravel decreases with increasingly higher elevations. Boulders as much as 4 or 5 feet in diameter are common near canyon mouths.

The available water capacity and natural fertility are low. Surface runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is in range that provides limited grazing for both livestock and deer. Especially heavy grazing by deer can be expected in winter. (Capability unit VIIs–7, nonirrigated)

Hussman Series

The Hussman series consists of very deep, nearly level, somewhat poorly drained soils that formed in alluvium derived mainly from granite but partly from rhyolite, basalt, and other metamorphic and sedimentary rocks. Most of these soils are either slightly or strongly affected by salts and alkali. All of them are on terraces in the central part of the survey area, southeast of Gardnerville. The vegetation consists mainly of big sagebrush and grasses or, in areas affected by salts and alkali, greasewood and saltgrass. Elevations range from 4,600 to 4,800 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Hussman soils are associated with East Fork, Draper, and Gardnerville soils.

Soils of the Hussman series are mostly irrigated and used for alfalfa, small grain, and grass-legume pasture. Those that are more strongly affected by salts and alkali are in brush or are used as stackyards for hay.

Hussman clay (Hu).—This soil is on terraces along the East Fork of the Carson River in the central part of the valley, immediately southeast of Gardnerville. The surface layer typically is about 12 inches thick. It consists of clay in the upper part and silty clay in the lower part. Below this, to a depth of 28 inches, is a transitional layer of mottled, brown silty clay. The substratum consists of mottled, light brownish-gray silty clay loam over mottled, grayish-brown silty clay. All the mottles, which are caused by iron content, are dark reddish brown.

Representative profile of Hussman clay, about 2,800 feet south and 300 feet east of the northwest corner of sec. 3, T. 12 N., R. 20 E.

Ap—0 to 7 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) when moist; moderate, coarse and medium, subangular blocky structure; very hard, firm, very sticky and very plastic; many, very fine, fine, and medium alfalfa roots; many very fine and fine tubular pores; a few wormholes; mildly alkaline (pH 7.4); clear, smooth boundary.

A1—7 to 12 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to moderate, coarse and medium, subangular blocky; very hard, firm, very sticky and very plastic; many very fine, fine, and medium roots; common fine and medium tubular pores; few wormholes; mildly alkaline (pH 7.6); clear, wavy boundary.

AC—12 to 28 inches, brown (10YR 5/3) silty clay, dark grayish brown (10YR 4/2) when moist; common, fine, distinct iron mottles of dark reddish brown (5YR 3/3) caused by iron content; weak, coarse, subangular blocky structure; very hard, friable, very sticky and very plastic; many very fine and fine roots; common very fine and fine tubular pores; matrix is generally noneffervescent but strongly effervescent where there are common, fine, distinct, white (10YR 8/2) lime filaments; moderately alkaline (pH 8.2); clear, wavy boundary.

C1ca—28 to 42 inches, light brownish-gray (10YR 6/2) heavy silty clay loam, dark brown (10YR 4/3) when moist; common, fine and medium, distinct mottles of dark reddish brown (5YR 3/3) caused by iron content; many, fine, distinct, white (10YR 8/2) lime filaments; massive; very hard, friable, very sticky and very plastic; few very fine and fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

C2—42 to 54 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) when moist; common, fine and medium mottles of dark reddish brown (5YR 3/3) caused by iron content; massive; hard, friable, sticky and plastic; few very fine and fine roots; few very fine tubular pores; noneffervescent in soil matrix, but strongly effervescent in spots; moderately alkaline (pH 8.2); clear, wavy boundary.

C3—54 to 60 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; common, fine, distinct mottles of dark reddish brown (5YR 3/3) caused by iron content; massive; very hard, firm, very sticky and very plastic; no roots; many micro interstitial pores; effervescent; moderately alkaline (pH 8.3).

In the A1 horizon, structure ranges from moderate to strong in grade and the consistence from hard to very hard when dry and from friable to firm when moist. The C horizon is heavy clay loam, silty clay loam, silty clay, or clay in texture. There is generally some lime, which is segregated in places, in all horizons below the uppermost 8 to 12 inches. Finely divided mica occurs throughout the profile. Mottles caused by iron content occur below a depth of 20 inches.

The water table fluctuates between depths of 4 and 6 feet during most of the irrigation season. Permeability is slow, and the available water capacity is high. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Inherent fertility is high.

This soil is irrigated and used either for alfalfa grown in rotation with small grain or for grass-legume pasture grown in long-term rotation with small grain. On some ranches either orchardgrass or smooth brome is seeded with the alfalfa. The alfalfa is cut for hay and the aftermath lightly grazed. The pasture provides grazing for livestock. (Capability unit IIw–35, irrigated)

Hussman clay, slightly saline-alkali (Hv).—This soil is essentially the same as Hussman clay, except that the surface layer is slightly affected by salts and alkali. Because of the dispersion of particles induced by excess sodium, the intake of water is slower and crop yields are reduced. Included in mapping were areas where the surface layer is clay loam.

This soil is used in much the same way as Hussman clay. (Capability unit IIIw–356, irrigated)

Hussman clay loam, strongly saline-alkali (Hw).—The profile of this soil is similar to that of Hussman clay, except that the uppermost 6 to 12 inches is clay loam. The surface layer is strongly affected by salts and alkali.

The vegetation consists mainly of greasewood and a scant understory of saltgrass, but about 85 percent of the soil is barren. This soil either is used for hay stackyards or is idle. It could be used in the same way as Hussman clay if irrigation water were available and the excess quantities of salts and alkali were removed. (Capability unit VIIw–6, nonirrigated)

Hussman silty clay loam, slightly saline-alkali, overflow (Hy).—This soil is in the north-central part of the survey area, northeast of Genoa. It is flooded occasionally. The profile is similar to that of Hussman clay, except that the surface layer is clay loam. Because the excess sodium has dispersed soil particles in the surface layer, the intake of water is reduced. The flooding has not increased the erosion hazard, but considerable damage can result from the filling of ditches and corrugations. Reaction ranges from moderately alkaline to very strongly alkaline.

This soil is used in the same way as Hussman clay, but it is less well suited to crops because of the salt and alkali content. (Capability unit IIIw–36, irrigated)

Indian Creek Series

The Indian Creek series consists of moderately deep, gently sloping to strongly sloping, well-drained soils that have a fine-textured subsoil. These soils formed in alluvium derived from granite, basalt, rhyolite, gneiss, and some sedimentary rocks. These soils have a well-developed pavement of gravel or cobblestones and stones, the exposed surfaces of which have a desert varnish. They are on smooth high terraces along the eastern edge and in the southern part of the survey area, on both sides of the East Fork of the Carson River. The vegetation consists of low sagebrush, cheatgrass, bitterbrush, squirreltail, Sandberg bluegrass, rabbitbrush, and annual weeds. Elevations range from 4,800 to 5,200 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 45° and 49° F.

Indian Creek soils are associated with Reno and Borda soils.

Nearly the entire acreage of soils in the Indian Creek series provides grazing for livestock. Some wildlife graze during winter.

Indian Creek very cobbly loam, 0 to 4 percent slopes (IIB).—This soil is on high terraces in the southern end of the survey area, north of the California State line and on both sides of the East Fork of the Carson River. The surface layer typically consists of gray very cobbly loam about 1 inch thick over brown gravelly loam about 2 inches thick. Below this is a transitional layer of brown gravelly clay loam abut 2 inches thick. The subsoil consists of brown clay over brown gravelly clay that grades to yellowish-brown gravelly clay. A white hardpan, strongly cemented with silica and lime, begins at a depth of about 20 inches. The hardpan overlies very gravelly and cobbly loamy coarse sand that is weakly cemented with silica and lime. Below this is light brownish-gray very gravelly and cobbly coarse sandy loam.

Representative profile of Indian Creek very cobbly loam, 0 to 4 percent slopes, about 1,520 feet west and 1,500 feet north of the southeast corner of sec. 12, T. 11 N., R. 20 E.

A11—0 to 1 inch, gray (10YR 6/1) very cobbly loam, very dark grayish brown (10YR 3/2) when moist; moderate, thin, platy structure; soft, friable, slightly sticky and slightly plastic; many very fine roots; common fine and very fine vesicular pores; few bleached sand grains; slightly acid (pH 6.5); abrupt, wavy boundary.

A12—1 inch to 3 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) when moist; strong, fine, granular structure; soft, friable, slightly sticky and slightly plastic; many very fine, common fine, and few medium roots; many fine and very fine interstitial pores; many bleached sand grains; slightly acid (pH 6.1); abrupt, wavy boundary.

A&B—3 to 5 inches, brown (10YR 5/3) gravelly heavy clay loam, dark brown (10YR 3/3) when moist; strong, fine, subangular blocky structure; hard, friable, very sticky and very plastic; many very fine, common fine, and few medium roots; common very fine and fine tubular pores and common fine and very fine interstitial pores; few bleached sand grains; many fine clay films on ped faces; medium acid (pH 6.0); abrupt, wavy boundary.

B21t—5 to 11 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) when moist; strong, medium, columnar structure; extremely hard, very firm, very sticky and very plastic; many very fine, common fine, and few medium roots; common very fine and fine tubular pores; many pressure faces; medium acid (pH 6.0); clear, smooth boundary.

B22t—11 to 19 inches, brown (7.5YR 4/2) gravelly clay, dark brown (7.5YR 3/2) when moist; strong, medium, prismatic structure; extremely hard, very firm, very sticky and very plastic; common very fine roots, and few fine and medium roots; few very fine and fine tubular pores; many pressure faces; slightly acid (pH 6.4); abrupt, wavy boundary.

B3t—19 to 20 inches, yellowish-brown (10YR 5/4) gravelly clay, dark brown (7.5YR 3/4) when moist; moderate, fine, subangular blocky structure; hard, friable, very sticky and very plastic; common very fine and few fine and medium roots; few fine tubular pores; common moderately thick clay films on ped faces and in pores; effervescent; neutral (pH 6.8); abrupt, wavy boundary.

C1sicam—20 to 25 inches, white (10YR 8/2) hardpan that is strongly cemented with silica and lime, light yellowish brown (10YR 6/4) when moist; few very fine and fine roots; violently effervescent; strongly alkaline (pH 8.6); abrupt, wavy boundary.

IIC2sica—25 to 36 inches, light-gray (10YR 7/2) very gravelly and cobbly loamy coarse sand that is weakly cemented with silica and lime, dark grayish brown (10YR 4/2) when moist; massive; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many fine interstitial pores; matrix is generally effervescent but violently effervescent where undersides of pebbles and cobblestones are coated with lime; mildly alkaline (pH 7.8); clear, wavy boundary.

IIC3ca—36 to 51 inches, light brownish-gray (10YR 6/2) very gravelly and cobbly loamy coarse sand, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; many fine interstitial pores; matrix is generally effervescent but voilenty effervescent where the undersides of pebbles are coated with lime; mildly alkaline (pH 7.6); gradual, smooth boundary.

IIC4—51 to 64 inches, light brownish-gray (10YR 6/2) very gravelly and cobbly coarse sandy loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; no roots; many fine interstitial pores; mildly alkaline (pH 7.6).

The solum ranges from 20 to 30 inches in thickness. In places the A&B horizon has salt and pepper colors of brown and dark brown. In places it has weak prisms. In places a few pebbles and cobblestones occur in the B horizon. These fragments are generally unweathered along structural breaks but strongly weathered within the prisms. In places a few fine filaments of lime occur in the B3 horizon. Ordinarily, there are mottles and segregations of lime and lime coatings on pebbles, cobblestones, or stones. The lower part of the C horizon is generally free of lime. In most places the pavement consists of cobblestones and few scattered stones, but in some places it is stony. The desert varnish is weakly to moderately developed.

Permeability is very slow, and the available water capacity is low. Surface runoff is very slow to slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is moderate.

The forage provides grazing for livestock late in winter and in spring. Deer graze in some places throughout the year, but they graze heavily in winter and early in spring when heavy snow drives them from the higher elevations. (Capability unit VIIs–7, nonirrigated)

Indian Creek gravelly fine sandy loam, 4 to 16 percent slopes (IgD).—This soil occurs on terraces along the eastern margin of the survey area. The pavement consists of gravel and scattered cobblestones and stones.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used in essentially the same way as Indian Creek very cobbly loam, 0 to 4 percent slopes. Livestock graze with considerably more ease because the pavement is gravel, but there is little grazing by deer at any time of the year. (Capability unit VIc–K, nonirrigated)

Indiano Series

The Indiano series consists of moderately deep, steep, well-drained soils that have a moderately fine textured subsoil. These soils formed in residuum and alluvium derived from rhyolite. These soils are on foothills in the northeastern and southern parts of the survey area. The vegetation consists of relatively dense stands of big sagebrush, bitterbrush, desert peach, horsebrush, cheatgrass, squirreltail, bluegrass, needlegrass, and rabbitbrush, but the plants cover only 10 to 20 percent of the surface. Elevations range from 4,800 to 5,500 feet. The annual precipitation ranges from 12 to 16 inches, and the frost-free season from 95 to 105 days. The average annual temperature is between 45° and 48° F.

Indiano soils are associated with Aldax, Springmeyer, McFaul, and Glenbrook soils.

Soils of the Indiano series are used for limited grazing by livestock and wildlife.

Indiano stony fine sandy loam, 30 to 45 percent slopes (InF).—This soil is in the northeastern and southern parts of the survey area. The surface layer typically is 13 inches thick. The upper part is brown stony fine sandy loam, and the lower part is brown gravelly fine sandy loam. The subsoil is about 20 inches thick. It consists of light yellowish-brown clay loam over pale-brown loam. Weathered rhyolite bedrock begins at a depth of about 33 inches. This soil is noncalcareous and slightly acid.

Representative profile of Indiano stony fine sandy loam, 30 to 45 percent slopes, on the west side of Hot Springs Mountain, about 800 feet west and 1,500 feet north of the southeast corner of sec. 16, T. 14 N., R. 20 E.

A1—0 to 6 inches, brown (10YR 5/3) stony fine sandy loam (40 percent stones, gravel, and cobblestones), dark brown (10YR 3/3) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine, and few medium roots; many very fine and fine tubular pores; slightly acid (pH 6.4); gradual, smooth boundary.

A3—6 to 13 inches, brown (10YR 5/3) gravelly fine sandy loam, dark yellowish brown (10YR 3/4) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and a few medium roots; many very fine and fine tubular pores; slightly acid (pH 6.4); clear, smooth boundary.

B2t—13 to 24 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) when moist; massive; hard, friable, slightly sticky and plastic; common very fine and few fine and medium

385-225 O - 71 - 3

roots; many very fine and common medium tubular pores; thin continuous clay films in pores; many clay bridges between sand grains; slightly acid (pH 6.2); gradual, wavy boundary.

B3t—24 to 33 inches, pale-brown (10YR 6/3) loam; brown (10YR 5/3) when moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; common thin clay films in pores; few clay bridges between sand grains; slightly acid (pH 6.3); abrupt, irregular boundary.

R—33 inches, weathered rhyolite bedrock that becomes extremely hard at a depth of 37 inches.

The solum ranges from 12 to about 33 inches in thickness. In most places the B horizon is massive, but in some places it has weakly prismatic structure or weakly or moderately subangular blocky structure. The proportion of gravel, cobblestones, and stones varies considerably both from place to place and throughout the profile. The content of stones ranges from 10 to 15 percent, that of cobblestones from 10 to 30 percent, and that of gravel from 10 to 35 percent. The content of coarse fragments generally decreases with depth.

Included in mapping were small, very stony areas. Permeability is moderately slow, and the available water capacity is low to moderate. Surface runoff is rapid, and the erosion hazard is high. Natural fertility is moderate.

The forage provides limited grazing for livestock late in spring, in summer, and in fall. Deer graze lightly the year around, but they graze heavily in winter when heavy snow drives them from the higher mountain areas. (Capability unit VIIe-1, nonirrigated)

James Canyon Series

The James Canyon series consists of very deep, gently sloping to strongly sloping, very poorly drained to somewhat poorly drained, medium-textured soils that formed in alluvium derived mainly from slate and gneiss. These soils occur on slightly convex alluvial fans in the western part of the survey area. The vegetation consists of sedges, juncus, bluegrass, redtop, and native clover. Elevations range from 4,700 to 4,900 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 100 days. The average annual temperature is between 46° and 49° F.

James Canyon soils are associated with Holbrook and Ophir soils.

About half the acreage of soils in the James Canyon series is farmed intensively, and alfalfa, small grain, and pasture are the principal crops. The rest of the acreage is in meadow that is either grazed or cut for hay.

James Canyon loam, drained, 2 to 4 percent slopes (JcB).—This soil is in Nevada at the foot of alluvial fans formed from materials from the Sierra Nevada. The surface layer typically is grayish-brown loam about 31 inches thick. Below this is a substratum of grayish-brown gravelly loam over light brownish-gray gravelly and cobbly loam. This soil is noncalcareous and is neutral in reaction.

Representative profile of James Canyon loam, drained, 2 to 4 percent slopes, about 500 feet west and 1,500 feet north of the south quarter corner of sec. 3, T. 13 N., R. 19 E.

Ap—0 to 8 inches, grayish-brown (10YR 5/2) loam, black (10YR 2/1) when moist; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores, and few fine tubular pores; 10 percent gravel; neutral (pH 6.8); abrupt, smooth boundary.

A1—8 to 31 inches, grayish-brown (10YR 5/2) loam, black (10YR 2/1) when moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 10 percent gravel; few medium wormholes; neutral (pH 6.8); gradual, smooth boundary.

C1g—31 to 41 inches, grayish-brown (2.5Y 5/2) gravelly loam, dark grayish brown (2.5Y 4/2) when moist; few medium and coarse mottles of strong brown (7.5YR 5/6) caused by iron content; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine and few fine tubular pores; 30 percent gravel; neutral (pH 6.8); gradual, smooth boundary.

C2g—41 to 60 inches, light brownish-gray (2.5Y 6/2) gravelly and cobbly loam, dark grayish brown (2.5Y 4/2) when moist; many medium and coarse, prominent mottles of strong brown (7.5YR 5/6) caused by iron content; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 30 percent gravel and cobblestones; neutral (pH 6.8).

The A1 horizon ranges from 24 to 36 inches in thickness, depending on the amount of leveling that has taken place. The content of gravel in this horizon ranges from 5 to 15 percent. The color values in the A1 horizon range from 4 to 5 when dry and from 1 to 2 when moist. Mottles occur at depths ranging from 12 to 33 inches. They range from few to many in abundance and from fine to coarse in size. The content of gravel in the C horizon is generally twice that of the surface layer. Cobblestones generally occur at a depth below 48 inches. The entire profile ranges from slightly micaceous to moderately micaceous.

Included in mapping were small areas where the content of gravel is as much as 30 percent and small areas of soils that have a surface layer of gravelly loam.

Originally, this soil was poorly drained, but it is now only somewhat poorly drained because drainage has been improved by confining the creek water in pipelines as it flows from the canyon mouths to the fields. The water table fluctuates between depths of 4 and 6 feet during most of the irrigation season in years of normal rainfall, but it is considerably higher in years of high rainfall. The intake of water and permeability are moderate. The available water capacity is high. Surface runoff is slow, and the erosion hazard is slight, because little if any uncontrolled creek water flows over this soil. Natural fertility is high.

This soil is used either for alfalfa grown in rotation with small grain or for legume-grass pasture. The alfalfa is cut for hay and the aftermath grazed. The legume-grass pasture either is grazed by livestock or is cut once for hay and then grazed. (Capability unit IIw-1, irrigated)

James Canyon loam, 2 to 4 percent slopes (JaB).—This soil is similar to James Canyon loam, drained, 2 to 4 percent slopes, except that its water table fluctuates between depths of 2 and 3 feet. The high water table is the result of large losses of water from creeks flowing over the Holbrook soils and from the seepage of ground water that is under high hydrostatic pressure. The soil is poorly drained.

This soil is used either for native meadow or for legume-grass pasture. Use for legume-grass pasture is similar to that described for James Canyon loam, drained, 2 to 4 percent slopes. The native meadow is usually grazed throughout the growing season, but occasionally it is cut for hay and then grazed. (Capability unit IIIw–1P, irrigated)

James Canyon loam, 4 to 16 percent slopes (JaC).—This soil is on steeper, higher parts of alluvial fans than is James Canyon loam, drained, 2 to 4 percent slopes. It is similar to that soil, except that its water table fluctuates between depths of 2 and 3 feet during most of the irrigation season. The high water table is the result of seepage from creeks and the release of ground water under high hydrostatic pressure. The soil is poorly drained.

Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used in much the same way as James Canyon loam, drained, 2 to 4 percent slopes, except that it is used only for native meadow. The meadow is either grazed throughout the growing season or is cut once for hay and then grazed. (Capability unit IVw–1P, irrigated)

James Canyon loam, drained, 4 to 8 percent slopes (JcC).—This soil is on steeper, higher parts of alluvial fans than is James Canyon loam, drained, 2 to 4 percent slopes. Runoff is slow to medium, and the erosion hazard is slight to moderate.

Irrigation ditches should be constructed on the contour and should be closely spaced because it is necessary to use small heads of water to control erosion while irrigating. Newly seeded fields must be irrigated with caution. (Capability unit IIIw–1, irrigated)

James Canyon peat, 2 to 8 percent slopes (JdB).—This soil is near springs and seeps. Its profile is similar to that of James Canyon loam, drained, 2 to 4 percent slopes, except that the uppermost 4 to 10 inches is fibrous peat. The water table is at or near the surface most of the year and is the result of the release of ground water under high hydrostatic pressure along faults on the Sierra Nevada front. The peat is a result of a luxuriant growth of coarse sedges and juncus, of the lack of decomposition because of poor aeration, and of the high water table. The soil is very poorly drained.

Runoff is slow, and the erosion hazard is slight.

This soil provides very limited, if any, grazing for livestock in spring and early in summer, when runoff and the water table are at their peak. Livestock graze the forage when the water table is lower and the footing more secure. (Capability unit VIIw–2, irrigated)

James Canyon Series, Calcareous Variant

The James Canyon series, calcareous variant, consists of very deep, gently sloping to moderately sloping, poorly drained to somewhat poorly drained, medium-textured soils that formed in alluvium derived mainly from granite, gneiss, and slate. The alluvium was strongly affected by ground water from hot springs that had a high content of calcium carbonate. The content of soluble salts and exchangeable sodium in the surface layer or the subsoil depends on the drainage and the degree to which salts and alkali have been removed. These soils are on slightly convex to concave alluvial fans and in interfan areas. The vegetation is dominantly meadow, consisting of sedges, redtop, and clover or, in the areas affected by salts and alkali, saltgrass and sedges. The plants cover 25 to 50 percent of the surface, depending on the concentration of salts and alkali. Elevations range from 4,700 to 4,900 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 100 days. The average annual temperature is between 46° and 49° F.

James Canyon soils, calcareous variant, are associated with Ophir, Holbrook, and Prey soils.

Most of the soils in the James Canyon series are irrigated and used for suitable meadow grasses and clover.

James Canyon loam, calcareous variant, 2 to 4 percent slopes (JeB).—The surface layer of this soil typically is 17 inches thick. It consists of very dark gray loam over very dark brown sandy clay loam. The substratum consists of white and grayish-brown, limy loam or sandy clay loam over pale-brown sandy loam, and below this, of brown, mottled loamy sand. Beneath this is pale-brown, mottled loamy sand over pale-brown, mottled loamy coarse sand. The mottles, which are caused by iron content, are reddish brown.

Representative profile of James Canyon loam, calcareous variant, 2 to 4 percent slopes, about 1,650 feet south and 700 feet east of the northwest corner of sec. 14, T. 14 N., R. 19 E.

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; moderate, fine and medium, granular structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine roots; many very fine and fine interstitial pores; micaceous; noneffervescent; neutral (pH 7.0); abrupt, smooth boundary.

A1—9 to 17 inches, very dark brown (10YR 2/2) light sandy clay loam, black (10YR 2/1) when moist; common, faint mottles of very dark grayish brown (10YR 3/2) and few, medium, distinct mottles of dark reddish brown (5YR 3/3); all mottles caused by iron content; weak, medium and fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few fine and medium wormholes; common fine tubular pores; micaceous; noneffervescent; neutral (pH 7.2); abrupt, smooth boundary.

C1ca—17 to 30 inches, about 65 percent white (10 YR 8/2), and 35 percent grayish-brown (10YR 5/2) loam or light sandy clay loam, grayish brown (10YR 4/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine and few medium tubular pores; much disseminated lime, violently effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

C2ca—30 to 36 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 4/3) when moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine and fine tubular pores; micaceous; violently effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C3g—36 to 42 inches, brown (10YR 5/3) loamy sand, brown (10YR 4/3) when moist; few, medium and coarse, prominent mottles of reddish brown (5YR 4/4) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; micaceous; noneffervescent; neutral (pH 6.8); clear, smooth boundary.

C4g—42 to 53 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) when moist; few, medium and coarse, prominent mottles of reddish brown (5YR 4/4) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine and fine interstitial pores; noneffervescent; neutral (pH 6.8); abrupt, smooth boundary.

C5g—53 to 60 inches, pale-brown (10YR 6/3) loamy coarse sand, brown (10YR 5/3) when moist; many, medium, prominent mottles of strong brown (7.5YR 5/6) and common, coarse, prominent mottles of reddish-brown (5YR 4/4); all mottles caused by iron content; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine interstitial pores; highly micaceous; noneffervescent; neutral (pH 7.0).

The A horizon ranges from 15 to 24 inches in thickness, but the surface layer is slightly thicker or thinner as a result of leveling in a few places. Some faint mottles occur in the lower part of the A horizon in the more poorly drained areas. The content of organic matter ranges from 4 to 7 percent. There is generally a thin mat of roots where the soils have not been cultivated.

Included in mapping, near the base of the alluvial fan in Carson Valley, was an area of drained soil that has a surface layer 6 to 24 inches thick as a result of leveling, a grayish-brown subsoil containing about 15 to 25 percent white mottles caused by lime content, and a substratum of finely stratified sandy loam, fine sandy loam, and light loam. Because of the substratum textures, the available water capacity is high.

This soil is somewhat poorly drained to poorly drained. A dendritic system of deep gullies in Jacks Valley has effectively drained areas in or adjacent to the valley. Another area in Carson Valley, immediately below Jacks Valley, has been drained as a result of pumping and of installation of three reservoirs along the creek channel. In the poorly drained areas, the water table is between depths of 18 and 36 inches; in the areas that have been drained and in the somewhat poorly drained areas, it is between depths of 36 and 72 inches. Permeability is moderately slow in the subsoil and rapid in the substratum. The available water capacity is moderate. Surface runoff is slow, and other than the localized gullying, erosion is either not a hazard or only a slight hazard. Fertility is high.

This soil is either in native meadow consisting of redtop, bluegrass, sedges, and clover or in tame grass-legume meadow. These crops are harvested once a year for hay and the aftermath grazed. Alfalfa is grown in rotation with small grain in the drained areas. (Capability unit IIIw–1P, irrigated)

James Canyon loam, calcareous variant, 4 to 8 percent slopes (JeC).—This soil is essentially the same as James Canyon loam, calcareous variant, 2 to 4 percent slopes, except that the surface layer is slightly affected by excess soluble salts and exchangeable sodium. The surface layer is generally moderately alkaline, and in some places it is slightly calcareous. The depth to the water table ranges from 36 to 60 inches during the peak of the irrigation season.

Included in mapping were areas of poorly drained soils that have a surface layer strongly affected by salts and alkali. The salts and alkali are a result of evaporation of ground water that contains large quantities of calcium and sodium salts. The water table is at a depth of about 18 inches because there are several included hot springs, which together are called Hobo Hot Spring.

The native meadow is made up of plants that are tolerant of salts and alkali. It consists of as much as 40 percent saltgrass and is generally grazed but not cut for hay. In the areas that are strongly affected by salts and alkali, the vegetation consists almost entirely of saltgrass, wiregrass, and scattered greasewood. It is doubtful whether drainage or removal of salts and alkali would be either feasible or effective because both the drainage and the salts and alkali are the result of geologic faulting. (Capability unit IIIw–1, irrigated)

Job Series

The Job series consists of very deep, nearly level, somewhat poorly drained to poorly drained, somewhat stratified, medium-textured soils that formed in alluvium deposited by comparatively recent floodwaters and derived from a mixture of rocks, largely granite. These soils are on smooth, low-lying flood plains in the north-central part of the survey area. They are periodically flooded by the Carson River. The vegetation consists of rabbitbrush and an understory of bluegrass, sedges, annual weeds, and saltgrass, but about 60 to 70 percent of the surface is barren. The elevation is about 4,600 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Job soils are associated with Settlemeyer, Cradlebaugh, Voltaire, and Heidtman soils.

Much of the acreage of soils in the Job series is irrigated and used for grazing by livestock. Some areas have been leveled and are used for legume-grass pasture or alfalfa-grass mixtures grown in rotation with small grain.

Job loam (Jg).—This soil is in the north-central part of the survey area, near the confluence of the East and West Forks of the Carson River. It is occasionally flooded. The surface layer typically is light brownish-gray loam about 9 inches thick. The substratum consists of light brownish-gray, stratified very fine sandy loam and fine sandy loam over grayish-brown clay loam or silty clay loam, and below this is light brownish-gray, somewhat stratified loam. Beneath this is grayish-brown clay loam to a depth of 60 inches. This soil is calcareous.

Representative profile of Job loam, at the center of sec. 14, T. 13 N., R. 19 E.

A1—0 to 9 inches, light brownish-gray (2.5Y 6/2) loam, very dark grayish brown (2.5Y 3/2) when moist; weak, medium and fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots, and few medium roots; many very fine and fine interstitial pores; strongly effervescent; strongly calcareous; strongly alkaline (pH 8.6); abrupt, wavy boundary.

C1—5 to 25 inches, light brownish-gray (10YR 6/2), stratified very fine sandy loam and fine sandy loam, dark grayish brown (10YR 4/2) when moist; few prominent mottles of white (10YR 8/2) caused by lime content; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores and many very fine interstitial pores; effervescent; strongly alkaline (pH 8.5); abrupt, smooth boundary.

IIC2—25 to 32 inches, grayish-brown (2.5Y 5/2) clay loam or silty clay loam, dark grayish brown (2.5YR 4/2) when moist; few, fine and very fine, prominent mottles of white (10YR 8/2) caused by lime content; weak, medium, prismatic structure; very hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; violently effervescent; strongly alkaline (pH 8.5); abrupt, smooth boundary.

IIIC3—32 to 51 inches, light brownish-gray (2.5Y 6/2), somewhat stratified loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular pores; matrix generally effervescent but strongly effervescent where there are many very fine and fine mottles of white (10YR 8/2) caused by lime content; moderately alkaline (pH 8.4); clear, wavy boundary.

IVC4—51 to 60 inches, grayish-brown (2.5Y 5/2) light clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular and interstitial pores; violently effervescent; common, fine and medium mottles of light gray (10YR 7/2) caused by lime content; moderately alkaline (pH 8.3).

This soil is stratified. It is dominantly medium textured; the 8- to 40-inch zone has textures ranging from very fine sandy loam to silt loam. In places mottles caused by iron content occur at a depth below 30 inches. The content of lime is variable, but segregated lime filaments are more numerous in the finer textured strata. Strata of gravel or sand occur at a depth of more than 48 inches in places.

Included in mapping were small areas of Sandy alluvial land that are adjacent to the river.

In its natural state, this soil is somewhat poorly drained. In general, the water table fluctuates between depths of 3 to 5 feet during most of the irrigation season, but in some nonirrigated areas, near deeply entrenched river channels, the depth to the water table may be as much as 10 feet. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is high.

This soil is used for grazing by livestock throughout the growing season. Some areas have been leveled and are used for alfalfa grown in rotation with small grain and legume-grass pasture. (Capability unit IIw–2, irrigated)

Job loam, clay substratum, water table, slightly saline-alkali (Jh).—The profile of this soil is similar to that of Job loam, except that the underlying material is dense, slowly permeable clay. The surface layer is slightly affected by salts and alkali. The depth to the clay substratum ranges from 42 to 50 inches but is commonly about 44 inches. The water table fluctuates between depths of 2 and 3 feet. The high water table is the result of excessive seepage from adjacent irrigated soils, of losses of water from ditches, and of the perching of water on the clay substratum. The soil is poorly drained.

This soil is used in much the same way as Job loam, but it is less suitable for crops because of the content of salts and alkali. Although difficult to establish because of the clay substratum, drainage is needed if any salts and alkali are to be removed. (Capability unit IVw–36P, irrigated)

Job loam, slightly saline-alkali (Jk).—This soil is similar to Job loam, except that the surface layer is slightly affected by salts and alkali. The alkali has caused dispersion of soil particles and has thus reduced the intake of water.

Included in mapping were small areas of a low-lying soil that has strata of sand or gravel below a depth of 40 inches and a water table that fluctuates between depths of 24 to 36 inches. Also included were small areas, adjacent to the river, of Sandy alluvial land.

This soil is used in much the same way as Job loam. (Capability unit IIw–6, irrigated)

Job loam, water table (Jl).—This soil is similar to Job loam, except that the water table fluctuates between depths of 2 and 3 feet. The water table is a result of losses of excess irrigation water from adjacent soils and of the low position of this soil in relation to the river. Bright-colored mottles, caused by iron content, generally occur at a depth below 20 inches, and gleying at a depth of 48 inches or more. The soil is poorly drained.

Included in mapping were small areas of a soil that has a surface layer of sandy loam and, at a depth below 48 inches, gravelly strata.

This soil is used in much the same way as Job loam. Clover-grass mixtures, selected because they are water tolerant, are the most suitable plants for pasture. Alfalfa can be grown but is short lived. It is questionable whether adequate drainage can be established, because the soil is so low that obtaining sufficient grade for deep drainage is difficult. (Capability unit IIIw–2, irrigated)

Jubilee Series

The Jubilee series consists of very deep, nearly level, very poorly drained and poorly drained, moderately coarse textured soils that formed in sandy alluvium derived mainly from granitic rocks but also from basalt, rhyolite, andesite, gneiss, and slate. These soils are scattered throughout the survey area in slightly concave, low depressions and sloughs. The vegetation consists of various sedges, juncus, grasses, and clover, and the plants cover 30 to 50 percent of the surface. The elevation is about 4,700 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Jubilee soils are associated with Settlemeyer, Dressler, Cradlebaugh, and Voltaire soils.

Soils of the Jubilee series are used principally for grazing by livestock. Small areas are sufficiently well drained that meadow hay can be cut and then grazed.

Jubilee loam (Jn).—This soil is adjacent to sloughs and concave swales throughout the central part of the survey area. It is periodically flooded by the Carson River and its tributaries. The surface layer typically is about 15 inches thick. It consists of dark-gray loam over mottled, dark-gray fine sandy loam. Below this is a transitional layer of mottled, grayish-brown fine sandy loam. The substratum consists of mottled, pale olive sandy loam over mottled, olive loamy fine sand,

and below this light olive-gray, micaceous coarse sand. This soil is noncalcareous.

Representative profile of Jubilee loam, about 2,600 feet north and 2,400 feet east of the southwest corner of sec. 29, T. 12 N., R. 20 E.

A11—0 to 5 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; massive; slightly hard, very friable, nonsticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; neutral (pH 6.8); clear, smooth boundary.

A12g—5 to 15 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) when moist; many, fine prominent mottles of dark reddish brown (5YR 3/3) caused by iron content; hard, very friable, nonsticky and nonplastic; many very fine and fine roots, many very fine and fine interstitial pores; neutral (pH 6.8) abrupt, smooth boundary.

ACg—15 to 19 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark brown (10YR 2/2) when moist; many, coarse, prominent mottles of dark reddish brown (5YR 3/3) caused by iron content; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots and many very fine roots; many very fine interstitial pores; neutral (pH 6.8); clear, smooth boundary.

C1g—19 to 37 inches, pale-olive (5Y 6/3) sandy loam, but 20 percent is mottled with reddish yellow (5YR 5/6); olive (5Y 4/3) and dark reddish brown (5YR 3/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots; few very fine and fine tubular pores; neutral (pH 6.8); clear, irregular boundary.

C3g—37 to 45 inches, olive (5Y 5/3) loamy fine sand, olive gray (5Y 4/2) when moist; highly micaceous; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; neutral (pH 6.8); clear, irregular boundary.

C4g—45 to 60 inches, light olive-gray (5Y 6/2), micaceous coarse sand, olive gray (5Y 4/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; neutral (pH 6.8).

The A horizon ranges from 9 to 18 inches in thickness. In places mottles caused by iron content occur in the A11 or A12 horizon. They range from common to many in abundance and from fine to coarse in size. In places some mottles caused by manganese content occur in the substratum. In places the gleyed C horizon is only 15 inches from the surface. In some areas unconformable layers of very gravelly loamy coarse sand or very gravelly coarse sand occur below a depth of 48 inches. The content of mica ranges from 2 to 4 percent throughout the profile. Reaction ranges from slightly acid to neutral.

This soil is very poorly drained. The water table fluctuates between depths of 1 foot and 2 feet during most of the irrigation season, as a result of the low position of the soil in the bottoms of concave sloughs. Permeability is rapid in the subsoil and very rapid in the substratum. The available water capacity is moderate. Surface runoff is very slow, and there is no erosion hazard. Natural fertility is moderate, and the content of organic matter is high.

This soil supports meadow consisting of sedges, juncus, clover, and grasses, and the plants cover about 35 percent of the surface. It is used for grazing by livestock. Production of cultivated crops is doubtful, mainly because of the location and the size of the soil areas. Irrigation is generally not needed, because the water table is high. Some control of the water table can be obtained by periodic maintenance and cleaning of the channel in the slough bottoms. (Capability unit Vw–2, irrigated)

Jubilee clay, slightly saline-alkali (Jm).—The profile of this soil is similar to that of Jubilee loam, except that the uppermost 5 to 16 inches is clay. The surface layer is slightly affected by salts and alkali, and it ranges from mildly alkaline to strongly alkaline in reaction because it contains alkali. It may also contain some lime. Normally, it has subangular blocky or prismatic structure, but in some places it is massive.

In general, this soil supports the same kind of vegetation as does Jubilee loam, except that 50 percent of the stand consists of saltgrass, alkali bluegrass, and other salt- and alkali-tolerant grasses. The meadow is grazed by livestock. It is doubtful whether much of the salts and alkali could be removed and whether removal would be economically feasible because of the high water table and the low position of the soil. (Capability unit Vw–2, irrigated)

Jubilee loam, poorly drained (Jo).—This soil is similar to Jubilee loam, except that the water table fluctuates between depths of 2 and 3 feet. The water table is lower, mainly because the soil occurs in slightly higher positions. The subsoil is generally mottled. Gleying does not occur at a depth about 36 inches, but the soil is gleyed at a depth below 48 inches.

Included in mapping, in Wade Valley, was a small area of soil that is slightly affected by salts and alkali and that is moderately alkaline to strongly alkaline in reaction.

This soil is used in the same way as Jubilee loam. Small areas of meadow are occasionally cut for hay. Much of this soil can be leveled and used for cultivated, water-tolerant crops that are suited to the local climate. (Capability unit IIIw–2, irrigated)

Jubilee peat (Jp).—This soil is in local depressions where excess irrigation water from adjacent soils ponds. Its profile is similar to that of Jubilee loam, but the uppermost 2 to 8 inches is peat. Strong gleying occurs immediately below the surface layer. This soil is very poorly drained.

The vegetation consists of coarse sedges and cattails. This soil is used in much the same way as Jubilee loam, except that livestock do not graze the coarse forage so readily. A shallow drainage ditch should be constructed to remove excess waste water. If drained, this soil would support better grasses that could be grazed more readily. (Capability unit VIIw–2, irrigated)

Jubilee Series, Sand Substratum Variant

The Jubilee series, sand substratum variant, consists of very deep, nearly level, poorly drained, coarse-textured soils that formed in alluvium derived dominantly from granite. These soils are on slightly concave alluvial flood plains that are scattered throughout the valley floor or immediately adjacent to alluvial fans in the southwestern part of the survey area. The meadow vegetation consists of sedges, juncus, and some grasses, and the plants cover 35 to 40 percent of the surface. The elevation is about 4,700 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Jubilee soils, sand substratum variant, are associated with Cradlebaugh, Ophir, Bishop, and Job soils.

Soils of the Jubilee series, sand substratum variant, are mostly in meadow that provides grazing for livestock during most of the irrigation season. Some areas have been leveled and are used for locally suitable crops.

Jubilee loam, sand substratum variant (Jt).—This soil occurs as long narrow areas throughout the central part of the survey area. It is occasionally flooded by the Carson River. The surface layer typically is loam, about 15 inches thick, that is grayish brown in the upper part and dark grayish brown in the lower part. The substratum is stratified sand, fine sand, and fine gravelly sand that is dominantly grayish brown and light brownish gray. This soil is noncalcareous and is neutral in reaction. The mica content is high.

Representative profile of Jubilee loam, sand substratum variant, about 1,000 feet east and 700 feet south of the west quarter corner of sec. 7, T. 12 N., R. 20 E.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) when moist; weak, medium to fine, granular structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores, common fine tubular pores, and many interstitial pores; neutral (pH 7.0); abrupt, smooth boundary.

A1—6 to 15 inches, dark grayish-brown (2.5Y 4/2) loam, very dark grayish brown (2.5Y 3/2) when moist; common to many distinct mottles of grayish brown (2.5Y 5/2) and dark brown (10YR 4/3); massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and common fine tubular pores; neutral (pH 6.8); abrupt, smooth boundary.

C—15 to 60 inches, dominantly grayish-brown (10YR 5/2) and light brownish-gray (10YR 6/2), stratified sand, fine sand, and fine gravelly sand; very dark grayish brown (10YR 3/2) when moist; there are also colorless sand grains, dark-gray (10YR 4/1) sand grains, and very dark grayish-brown (10YR 3/2) sand grains derived from quartz and other minerals; single grain; loose when dry and moist; few fine roots in the uppermost part; many fine and very fine interstitial pores; neutral (pH 6.6).

The A horizon ranges from 6 to 18 inches in thickness, depending on the amount of leveling that has taken place. The C horizon is generally stratified, and the strata range from fine sand to very coarse sand in texture. These sands may contain pebbles that are rarely larger than half an inch in diameter. The profile contains much mica, and in some places there are very highly micaceous strata.

Included in mapping was a small area, adjacent to Big Ditch immediately south of Waterloo Lane, of partly drained soil that has dense clay at a depth of about 50 inches and a water table that has been lowered to a depth of about 18 inches by the entrenchment of Big Ditch.

The depth to the water table ranges from 24 to 36 inches during most of the year but from 18 to 28 inches in spring when excess irrigation water causes the water table to rise. The water table also fluctuates with the flow of water in adjacent rivers or sloughs. Permeability is moderate in the surface layer and very rapid in the substratum. The available water capacity is low. Surface runoff is very slow, and erosion is either not a hazard or a slight hazard.

The use of this soil is governed by the use and management of adjacent soils because the areas are generally too small to be farmed separately. Much of the acreage has been leveled and used for alfalfa grown in rotation with small grain, for legume-grass pasture, or for native meadow. This is a key soil in solving drainage problems because it acts as an aquifer as a result of its very rapid permeability. Irrigation ditches and canals lose water wherever they cross this soil. (Capability unit Vw-4, irrigated)

Jubilee clay loam, sand substratum variant, deep (Js).—This soil occurs as fairly large areas that can be managed separately, adjacent to the toe slopes of alluvial fans, on the west side of the survey area. Its profile is similar to that of Jubilee loam, sand substratum variant, except that the surface layer is gray clay loam 9 to 15 inches thick and the underlying material is dense, slowly permeable clay. In some places there are strata of gray or very dark brown, very strongly mottled sandy loam to sandy clay loam at a depth of more than 30 inches. The clay substratum is generally gleyed and in some places contains many mottles. The depth to the clay substratum ranges from 40 to 50 inches. In places the uppermost inch or two is a mat of roots.

This soil is irrigated and used for meadow that provides grazing for livestock. A small acreage has been leveled and is used for legume-grass pasture. The hay in the pasture is usually cut and the aftermath grazed. (Capability unit IIIw-4P, irrigated)

Kimmerling Series

The Kimmerling series consists of very deep, nearly level, moderately fine textured, poorly drained soils that formed in alluvium derived largely from granite but also from basalt, rhyolite, gneiss, and slate. These soils are on smooth flood plains in the south-central part of the survey area, near Minden. Most of these soils are flooded occasionally by the Carson River. The vegetation consists of sedges, juncus, grasses, and clover, and the plants cover 30 to 50 percent of the surface. Elevations range from 4,600 to 5,500 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 50° F.

Kimmerling soils are associated with Dressler, Bishop, Cradlebaugh, and Heidtman soils.

Soils of the Kimmerling series are in native meadow that is grazed by livestock or cut for hay. Some areas have been leveled and grass-legume pasture planted. These areas are cut for hay and the aftermath grazed.

Kimmerling loam (Kt).—This soil is in the central part of the survey area, west and southwest of Minden. It is occasionally flooded. The surface layer typically is about 18 inches thick. It consists of dark-gray loam over dark-gray silt loam, and below this, dark-gray clay loam. The substratum consists of gray silty clay loam that is mottled in the lower part and overlies light-gray, mottled, stratified sandy clay loam and silty clay loam. The mottles, which are caused by iron content, are reddish-brown, dark greenish gray, and greenish gray. This soil is noncalcareous and is generally neutral in reaction.

Representative profile of Kimmerling loam, about 400 feet north and 40 feet west of the south quarter corner of sec. 6, T. 12 N., R. 20 E.

A11—0 to 3 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; moderate, fine and medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

A12—3 to 8 inches, dark-gray (10YR 4/1) heavy silt loam, very dark brown (10YR 2/2) when moist; massive; hard, friable, slightly sticky and plastic; many very fine and common fine roots; many very fine interstitial pores; neutral (pH 6.8); clear, smooth boundary.

A13—8 to 18 inches, dark-gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) when moist; common, fine, prominent mottles of reddish brown (5YR 4/4) caused by iron content; massive; hard, friable, sticky and plastic; common fine and very fine roots; few very fine tubular pores and many very fine interstitial pores; neutral (pH 6.6) gradual, smooth boundary.

C1g—18 to 28 inches, gray (5Y 5/1) silty clay loam, black (5Y 2/1) when moist; massive; hard, friable, sticky and plastic; common very fine and few fine roots; no visible pores; neutral (pH 6.6); gradual, smooth boundary.

C2g—28 to 48 inches, gray (5Y 5/1) silty clay loam, very dark gray (5Y 3/1) when moist; few, fine, prominent mottles of reddish brown (5YR 4/4) and few, fine, faint mottles of dark greenish gray (5G 4/1); all mottles caused by iron content; massive; hard, firm, sticky and plastic; few very fine and fine roots; no visible pores; neutral (pH 6.6); gradual, smooth boundary.

C3g—48 to 60 inches, light-gray (5Y 6/1), stratified sandy clay loam and light silty clay loam, gray (5Y 5/1) when moist; few, fine and medium, faint mottles of greenish gray (5GY 5/1) caused by iron content; few, medium and coarse, prominent, black (10YR 2/1) manganese or organic stains; massive; hard, firm, sticky and plastic; few fine roots; no visible pores; neutral (pH 6.6).

This soil ranges from slightly micaceous to moderately micaceous in all horizons. In places there is some stratification in the C horizon. The strata range from loam to silty clay loam in texture, but they are dominantly silty clay loam. Thin strata, less than 6 inches thick, of loamy fine sand are common. Prominent mottling and gleying generally begin between depths of 18 to 30 inches. In some places strata of sand or gravel occur at a depth of more than 48 inches.

Included in mapping was a small area, in California, of soil that has 2 to 4 percent slopes and is not subject to flooding.

The water table is between depths of 20 and 36 inches during most of the irrigation season. Permeability is moderately slow, and the available water capacity is high. Surface runoff is very slow, and erosion is not a hazard. Some deposition may occur during flooding. Natural fertility is high.

The meadow vegetation consists of sedges, juncus, grasses, and native clover. Most of this soil is in meadow that provides grazing for livestock. Some areas have been leveled and seeded to legume-grass pasture. (Capability unit IIIw–2, irrigated)

Kimmerling clay loam (Kc).—The profile of this soil is similar to that of Kimmerling loam, except that it is dominantly clay loam throughout. In some places unconformable strata of gravel or sand occur at a depth below 42 inches.

This soil is used in the same way as Kimmerling loam, but plowing is more difficult because the surface layer is clay loam. The intake of water is slower than in that soil. (Capability unit IIIw–2; irrigated)

Kimmerling clay loam, clay substratum (Km).—The profile of this soil is similar to that of Kimmerling loam, except that the uppermost 6 to 10 inches is clay loam and the underlying material at a depth of about 42 inches is dense, slowly permeable clay. The surface layer takes in water at a somewhat slower rate. The depth to strata of clay ranges from about 38 to 48 inches. Water is perched over the slowly permeable clay.

Included in mapping were small areas of depressions where the water table is at a depth of about 12 inches during most of the irrigation season. In these areas the soil has prominent mottling and gleying at a depth of 12 to 13 inches. The vegetation consists of coarse sedges and juncus that have low palatability.

This soil is used in much the same way as Kimmerling loam. Deep drainage would be difficult to establish because of the slowly permeable clay. (Capability unit IIIw–3P, irrigated)

Kimmerling clay loam, slightly saline-alkali (Ks).—The profile of this soil is similar to that of Kimmerling loam, except that the uppermost 6 to 10 inches is clay loam. The surface layer is slightly affected by salts and alkali. The excess alkali has dispersed soil particles in the surface layer, and consequently, the intake of water is considerably reduced.

Included in mapping were several small areas of similar soils that have slowly permeable clay at a depth of more than 48 inches and areas of depressions where the water table fluctuates between depths of 12 and 24 inches during most of the irrigation season.

The meadow vegetation is similar to that on Kimmerling loam, but saltgrass and alkali bluegrass make up 50 percent of the plant composition. This soil is used in much the same way as Kimmerling loam, but it is less well suited to crops. (Capability unit IIIw–6P, irrigated)

McFaul Series

The McFaul series consists of very deep, nearly level to moderately sloping, well-drained, moderately fine textured soils that formed in sandy alluvium derived mainly from granite but also from sandstone, basalt, and rhyolite. These soils are on smooth to very gently convex alluvial fans in the eastern part of the survey area, south of Hot Springs Mountain. The vegetation consists mainly of big sagebrush and an understory of cheatgrass, Indian ricegrass, and squirreltail, but about 85 to 90 percent of the surface is barren. A few small juniper trees are invading from adjacent, higher elevations. Elevations range from 4,750 to 4,900 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

McFaul soils are associated with Haybourne, Toll, Indiano, Aldax, and Stodick soils.

Soils of the McFaul series are mostly in range that provides limited grazing for livestock. Some areas below the existing irrigation canals are farmed intensively and are used principally for alfalfa and small grain. Some areas are used for small homesites.

McFaul sand, 2 to 8 percent slopes (McB).—This soil is in the northeastern part of the survey area, mainly south of Hot Springs Mountain. The surface layer typically is about 11 inches thick. It consists of pale-brown sand over grayish-brown loamy sand. The subsoil consists of grayish-brown gravelly sandy loam over brown gravelly sandy clay loam, and below this, of yellowish-brown sandy loam to a depth of about 28 inches. The substratum consists of yellowish-brown loamy sand over pale-brown sand. This soil is generally micaceous throughout the profile. It is noncalcareous and is neutral to slightly acid in reaction.

Representative profile of McFaul sand, 2 to 8 percent slopes, about 50 feet north and 20 feet east of the west quarter corner of sec. 21, T. 14 N., R. 20 E.

A11—0 to 3 inches, pale-brown (10YR 6/3) sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; slightly acid (pH 6.4); abrupt, smooth boundary.

A12—3 to 11 inches, grayish-brown (10YR 5/2) loamy sand, dark brown (10YR 3/3) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores and common very fine and fine tubular pores; neutral (pH 6.6); clear, smooth boundary.

B1t—11 to 16 inches, grayish-brown (10YR 5/2) gravelly sandy loam (30 percent gravel), brown (10YR 4/3) when moist; massive; very hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine and few fine tubular pores; thin clay films on sand grains; neutral (pH 6.6); clear, smooth boundary.

B2t—16 to 20 inches, brown (10YR 5/3) gravelly sandy clay loam (35 percent gravel), brown (10YR 4/3) when moist; massive; extremely hard, firm, sticky and plastic; common very fine and fine roots; many very fine and common fine tubular pores; common thin clay bridges between sand grains and thin, continuous clay films in pores; slightly acid (pH 6.5); clear, wavy boundary.

B3t—20 to 28 inches, yellowish-brown (10YR 5/4) sandy loam (10 percent gravel), dark yellowish brown (10YR 4/4) when moist; massive; very hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine interstitial pores; few thin clay bridges between sand grains; slightly acid (pH 6.5); clear, wavy boundary.

C1—28 to 34 inches, yellowish-brown (10YR 5/4) loamy sand, dark yellowish brown (10YR 4/4) when moist; massive; hard, very friable, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; slightly acid (pH 6.4); clear, wavy boundary.

C2—34 to 60 inches, pale-brown (10YR 6/3) sand, brown (10YR 4/3) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; slightly acid (pH 6.5); clear, wavy boundary.

The solum ranges from 18 to 33 inches in thickness and is thickest where soil material eroded from soils in higher areas has been deposited. The content of gravel and cobblestones in the soil varies and is greater near the foothills from which the soil material has been washed. The content of gravel in the A horizon and in the C horizon is generally less than 15 percent, and that of gravel and cobblestones in the B horizon is as much as 40 percent in places. The coarse fragments range from angular to subrounded in shape, are of mixed origin, and show little or no weathering. Generally, there is a thin (¼- to 1-inch) layer of windblown sand on the surface.

Included in mapping were several small, stony areas near Hot Springs Mountain and mostly along drainageways.

Permeability is moderately slow, and the available water capacity is low. Surface runoff is very slow to slow, and the erosion hazard is slight. Natural fertility is low.

This soil is used for grazing by livestock and wildlife. (Capability unit VIc–K, nonirrigated)

McFaul sand, 0 to 2 percent slopes (McA).—This soil is on the smooth, lower parts of alluvial fans. Its profile is similar to that of McFaul sand, 2 to 8 percent slopes, except that the content of gravel and cobblestones is less, rarely more than 20 percent in any part of the profile. Runoff is very slow.

This soil is used in much the same way as McFaul sand, 2 to 8 percent slopes. Small areas below the existing irrigation ditches are used for alfalfa grown in rotation with small grain or legume-grass pasture. (Capability unit IIIs–4, irrigated)

McFaul sand, moderately deep, 2 to 4 percent slopes (MfB).—The profile of this soil is similar to that of McFaul sand, 2 to 8 percent slopes, but it is underlain by very hard conglomerate. It has somewhat less, but still low, available water capacity. The depth to conglomerate ranges from 22 to 31 inches, but it is commonly 28 inches. Runoff is very slow.

This soil is used in about the same way as McFaul sand, 2 to 8 percent slopes. The entire acreage is in range or wildlife habitat. (Capability unit VIc–K, nonirrigated)

Millich Series

The Millich series consists of shallow, well-drained, very stony soils that formed in residuum weathered from andesitic tuff that is high in content of hornblende. These soils are on gently sloping ridgetops and on steep to very steep side slopes of foothills in Alpine County. The vegetation consists of open stands of pinyon pine, a few Jeffrey pine, and an understory of bitterbrush, big sagebrush, needlegrass, and cheatgrass, but the plants cover only about 5 to 15 percent of the surface. The crown density ranges from 15 to 30 percent. Elevations range from 5,400 to 5,700 feet. The annual precipitation ranges from 13 to 16 inches, and the frost-free season from 95 to 110 days. The average temperature is 51° F.

Millich soils are associated with Aldax, Borda, and Calpine soils.

Soils of the Millich series are used for grazing by livestock and deer.

Millich very stony sandy loam, 4 to 30 percent slopes (MhE).—This soil is near the southern boundary of the survey area, in Alpine County. The surface layer typically is grayish-brown very stony sandy loam about 1 inch thick. The subsoil consists of about 3 inches of dark grayish-brown cobbly and stony clay loam overlying about 13 inches of grayish-brown clay that contains a few cobblestones and stones. Hard, gray andesitic bedrock is at a depth of about 17 inches. This soil is slightly acid to medium acid in reaction.

Representative profile of Millich very stony sandy loam, 4 to 30 percent slopes, about 500 feet west and 700 feet north of the southeast corner of sec. 20, T. 11 N., R. 20 E.

A1—0 to 1 inch, grayish-brown (10YR 5/2) very stony sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, platy structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many very fine and few fine interstitial pores; medium acid (pH 6.0); abrupt, smooth boundary.

B1t—1 inch to 4 inches, dark grayish-brown (10YR 4/2) cobbly and stony clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; many very fine interstitial and tubular pores; common moderately thick clay films in pores, and common thin clay bridges between sand grains; medium acid (pH 6.0); abrupt, smooth boundary.

B21t—4 to 12 inches, grayish-brown (10YR 5/2) clay and few cobblestones and stones, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure; very hard, firm, very sticky and very plastic; common very fine and fine roots; common very fine tubular pores; many thick clay films in pores; common moderately thick clay films on ped faces; slightly acid (pH 6.3); clear, smooth boundary.

B22t—12 to 17 inches, grayish-brown (10YR 5/2) clay and few cobblestones and stones, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; extremely hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular and interstitial pores; common moderately thick clay films on ped faces; slightly acid (pH 6.3); abrupt, irregular boundary.

R—17 inches, gray (N 6/0), hard andesitic bedrock, dark grayish brown (2.5Y 4/2) when moist; many black hornblende crystals; few filaments that appear to contain asbestos or glassy material.

The depth to bedrock ranges from 8 to 20 inches. The B horizon generally has prismatic structure, but in places it has subangular blocky structure if the texture is sandy clay. In depressional areas, most of the stones in this horizon are strongly weathered. Bedrock is andesitic tuff, tuff breccia, and andesite. In some of the shallower areas the surface of the bedrock has weathered to a depth of 2 to 6 inches.

Included in mapping were areas where the depth to bedrock is as much as 24 inches and several small areas of andesite outcrop.

Permeability is slow, and the available water capacity is very low. Surface runoff is slow to medium. The erosion hazard is slight to moderate, and shallow gullies have formed on many of the steeper slopes. Natural fertility is low.

The soil provides forage for livestock. Migratory deer from the Sierra Nevada graze these areas. They make especially heavy use of these areas in winter. (Capability unit VIIs–8, nonirrigated)

Millich very stony sandy loam, 30 to 60 percent slopes (MhF).—This soil is on the steep and very steep side slopes of foothills. It is similar to Millich very stony sandy loam, 4 to 30 percent slopes, except that it is steeper and is generally shallower over bedrock. The depth to bedrock ranges from 10 to 14 inches. Included in mapping were a few rock outcrops.

Runoff is rapid to very rapid. Erosion is a high to very high hazard, and shallow gullies have formed on the steeper slopes.

This soil is used in the same way as Millich very stony sandy loam, 4 to 30 percent slopes. The grazing of livestock is limited because the very steep slopes make these areas inaccessible. (Capability unit VIIs–8, nonirrigated)

Mottsville Series

The Mottsville series consists of very deep, gently sloping to steep, excessively drained soils that formed in sandy alluvium derived from granite. These soils are on gently sloping to strongly sloping, gently concave alluvial fans and on steep alluvial toe slopes of the Carson Range, in the southwestern and northwestern parts of the survey area, adjacent to the mountain front. The vegetation consists of moderately dense stands of big sagebrush and bitterbrush, an understory of cheatgrass, needlegrass, and Indian ricegrass, and, on the upper parts of alluvial fans and along some drainageways, some Jeffrey pine. The plants cover only 15 to 20 percent of the surface. Elevations range from 4,800 to 5,000 feet. The annual precipitation ranges from 12 to 15 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Mottsville soils are associated with Ophir, Toiyabe, Brockliss, and Dressler soils.

Soils of the Mottsville series are used for grazing by livestock and wildlife. The wildlife make heavy use of the range in winter, when they are driven from the higher elevations by snow. Some areas are irrigated and used for alfalfa or meadow, and other areas are used for homesites.

Mottsville loamy coarse sand, 4 to 16 percent slopes (MlD).—This soil is on gently convex alluvial fans adjacent to the eastern slope of the Carson Range, mainly south of Walleys Hot Springs. The surface layer typically is about 24 inches thick. It consists of grayish-brown gravelly coarse sand overlying grayish-brown loamy coarse sand. Beneath this is a transitional layer of light brownish-gray loamy coarse sand about 20 inches thick. The substratum is pale-brown stony and gravelly loamy coarse sand. This soil is noncalcareous and slightly acid in reaction.

Representative profile of Mottsville loamy coarse sand, 4 to 16 percent slopes, about 275 feet south and 1,320 feet west of the northeast corner of sec. 15, T. 12 N., R. 19 E.

Ap—0 to 1½ inches, mostly grayish-brown (10YR 5/2) gravelly coarse sand, dark grayish brown (10YR 4/2) when moist; winnowed angular and subangular fragments of white (N 8/0), grayish-brown (10YR 5/2), and very dark gray (10YR 3/1) granitic rock; single grain; loose when dry and moist, nonsticky and nonplastic; no roots; very porous; slightly acid (pH 6.4); abrupt, smooth boundary.

A11—1½ to 9 inches, grayish-brown (10YR 5/2) loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; very porous; some fine granitic gravel; slightly acid (pH 6.4); clear, smooth boundary.

A12—9 to 24 inches, grayish-brown (10YR 5/2) loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; very porous; about 5 percent granitic gravel; slightly acid (pH 6.5); clear, smooth boundary.

AC—24 to 44 inches, light brownish-gray (10YR 6/2) loamy coarse sand, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; very porous; about 5 percent fine gravel; slightly acid (pH 6.5); clear, smooth boundary.

C—44 to 60 inches, pale-brown (10YR 6/3) stony and gravelly loamy coarse sand, dark brown (10YR 3/3) when moist; single grain; loose when dry and moist; many very fine and fine roots; very porous; slightly acid (pH 6.5). This horizon contains about 10 percent rounded to subangular granitic stones and about 20 pecent gravel.

The profile ranges from loamy coarse sand to coarse sand in texture, and in any strata there may be gravel, cobblestones, or stones. Scattered stones or boulders, generally adjacent to drainageways, are as much as 10 to 15 feet in diameter. The A1 horizon ranges from 18 to 26 inches in thickness, and in the uppermost 15 to 20 inches, the content of organic matter is 1 percent or more. The pebbles in the A1 horizon are generally half an inch or less in diameter. The pH value ranges from 6.0 to 6.7.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow to very slow, and erosion is a slight to moderate hazard. This soil is particularly susceptible to wind erosion when the vegetation has been removed. Natural fertility is low.

The available forage is used for limited grazing by livestock and wildlife. Deer graze these areas, especially in winter when heavy snow drives them from the higher elevations. Small areas adjacent to farmsteads are used for stackyards, feedlots, and homesites. Trees grow only at the upper edges of alluvial fans and in some drainageways, where they receive extra moisture from ground water. No attempt is made to harvest the timber. (Capability unit VIIs–L, nonirrigated)

Mottsville loamy coarse sand, 2 to 4 percent slopes (MlB).—This soil is on the toe slopes of alluvial fans. Included in mapping was a small area, near the head of Diamond Valley, of soil that has a surface layer of coarse sandy loam.

Runoff is very slow, and the erosion hazard is slight. This soil is used in much the same way as Mottsville loamy coarse sand, 4 to 16 percent slopes. A few small areas are irrigated and used for alfalfa or meadow. (Capability unit IVs–4L, irrigated)

Mottsville very bouldery loamy coarse sand, 2 to 16 percent slopes (MoD).—The profile of this soil is similar to that of Mottsville loamy coarse sand, 4 to 16 percent slopes, except for the large number of boulders throughout. The boulders are commonly 2 to 3 feet in diameter, but at the upper edges of the fans near the canyon mouths, there are a few boulders as much as 10 to 15 feet in diameter.

The available water capacity and fertility are very low. Surface runoff is medium to rapid, and erosion is a moderate hazard.

This soil is used in much the same way as Mottsville loamy coarse sand, 4 to 16 percent slopes, but plant density is appreciably lower as a result of the content of stones and boulders. One area on a high terrace along the West Fork of the Carson River supports an open stand of Jeffrey pine and an understory of big sagebrush and bitterbrush. (Capability unit VIIs–L, nonirrigated)

Mottsville very bouldery loamy coarse sand, 16 to 45 percent slopes (MoF).—This soil is on moderately steep to steep alluvial talus slopes of the Carson Range and the steep side slopes of a terminal or lateral moraine east of Woodfords. Its profile is similar to that of Mottsville loamy coarse sand, 4 to 16 percent slopes, except for the content of boulders. Boulders and stones make up 30 to 50 percent of the profile. These coarse fragments range from 1 foot to 10 feet in diameter, but the average fragment is 3 to 4 feet in diameter.

The available water capacity and natural fertility are very low. Surface runoff is medium to rapid, and the erosion hazard is moderate to high.

This soil is used in essentially the same way as Mottsville loamy coarse sand, 4 to 16 percent slopes. (Capability unit VIIs–L, nonirrigated)

Mottsville-Toiyabe association, 4 to 8 percent slopes (MtC).—This association is in the northwestern corner of the survey area on the northwestern edge of Jacks Valley. It is made up of about 60 percent Mottsville loamy coarse sand, 4 to 8 percent slopes, 30 percent Toiyabe loamy coarse sand; and 10 percent inclusions of granite outcrops and steep Toiyabe loamy coarse sand.

The Mottsville soil is on moderately sloping fans and saddles and in basins and drainageways adjacent to gently rolling ridges. The vegetation consists dominantly of second-growth Jeffrey pine, but there are scattered bitterbrush, big sagebrush, needlegrass, and Indian ricegrass. Under the Jeffrey pine, leaf litter covers most of the surface and the pH value ranges from 5.9 to 6.2 throughout the profile.

The Toiyabe soil is dominant and is adjacent to outcrops that are scattered along the broad gently rolling ridgetops. The vegetation consists of scattered Jeffrey pine trees and a dense understory of bitterbrush, big sagebrush, needlegrass, Indian ricegrass, and cheatgrass. Some bitterbrush and big sagebrush grow in crevices in the outcrops.

This association is used mainly for timber. The Mottsville soil produces more timber than the Toiyabe soil. The vegetation is used for limited grazing by livestock in spring, summer, and fall. Deer graze the available forage throughout the year, except when they are driven to lower elevations by heavy snow. (Capability unit VIIs–L, nonirrigated)

Ophir Series

The Ophir series consists of very deep, nearly level to moderately sloping, poorly drained to somewhat poorly drained, coarse-textured soils that formed in sandy alluvium derived mainly from granite. These soils are on alluvial fans along the eastern flank of the Sierra Nevada. They are along the western side of the valley, mainly south of Walleys Hot Springs, and also occur near the southern margin of the survey area west of Diamond Valley and near the northern margin of the survey area in Jacks Valley. The vegetation consists mainly of sedges, juncus, bluegrass, redtop, Sierra clover, and other native clover and grasses. Plants cover 25 to 45 percent of the surface. Elevations range from 4,700 to 4,900 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Ophir soils are associated with Calpine, Mottsville, and James Canyon soils.

Most areas are in meadows that provide grazing for livestock. The meadows are occasionally cut for hay and the aftermath grazed. Some areas have been seeded to legume-grass pasture.

Ophir gravelly sandy loam, 2 to 8 percent slopes (OgB).—This soil occurs on the lower parts of alluvial fans that originate in the Sierra Nevada along the western side of the valley, south of Walleys Hot Springs. Some soil material is deposited in small areas adjacent to streams as a result of runoff and erosion in nearby mountain areas. The surface layer typically is about 30 inches thick. It consists of dark-gray gravelly sandy loam over dark-gray gravelly loamy coarse sand, and below this, gravelly sandy loam. The mottles, which are caused by iron content, are brown in the upper part and dark-brown in the lower part. The substratum is grayish-brown gravelly loamy sand. It has mottles throughout. All of the mottles are caused by iron content. This soil is moderately micaceous. It is noncalcareous and is neutral in reaction.

Representative profile of Ophir gravelly sandy loam, 2 to 8 percent slopes, about 1,200 feet south and 400 feet east of the northwest corner of sec. 14, T. 12 N., R. 19 E.

Ap—0 to 10 inches, dark-gray (10YR 4/1) gravelly light sandy loam, black (10YR 2/1) when moist; few, fine, distinct mottles of brown (7.5YR 4/3) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; many fine interstitial pores; neutral (pH 6.6); clear, smooth boundary.

A11—10 to 13 inches, dark-gray (10YR 4/1) gravelly loamy coarse sand, black (10YR 2/1) when moist; few, fine, distinct mottles of brown (7.5YR 4/3) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine and fine interstitial pores; neutral (pH 6.6); gradual, smooth boundary.

A12—13 to 30 inches, dark-gray (10YR 4/1) gravelly light sandy loam, black (10YR 2/1) when moist; common, medium, distinct mottles of dark brown (10YR 4/3) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine interstitial pores; neutral (pH 6.8); gradual, smooth boundary.

C1—30 to 45 inches, grayish-brown (10YR 5/2) gravelly loamy sand, very dark gray (10YR 3/1) when moist; many, coarse, distinct mottles of brown (7.5YR 4/4) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; neutral (pH 6.8); diffuse, smooth boundary.

C2—45 to 60 inches, grayish-brown (2.5Y 5/2) gravelly loamy sand, very dark grayish brown (2.5Y 3/2) when moist; many, coarse, distinct mottles of dark brown (10YR 4/3) caused by iron content; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; neutral (pH 6.8).

The A1 horizon ranges from 16 to 34 inches in thickness. This difference, in many places, is the result of leveling. Mottles caused by iron content in the surface layer range from few to common and from fine to medium. In places the A11 horizon is gravelly sandy loam or gravelly loam. Some stratification occurs in the C horizon. The strata range from coarse sand to gravelly light sandy loam in texture. Gravelly loamy sand is dominant. The pebbles are ordinarily half an inch or less in diameter. Some of the strata have yellowish colors. The mottles in the C horizon range from common to many and from medium to coarse. The content of gravel varies throughout the profile. It ranges from 15 to 40 percent, but in most strata it is not more than 30 percent. This soil ranges from moderately micaceous to highly micaceous. Reaction ranges from neutral to slightly acid. A root mat 1 inch to 3 inches thick occurs on the surface in virgin areas.

Natural drainage is poor because of the release of ground water under high hydrostatic pressure. The pressure is governed mostly by faulting in the bedrock. The water table fluctuates between depths of 18 and 35 inches during most of the year, but it may be at the surface in winter and early in spring. It drops gradually throughout the summer, but it starts to rise in the fall. Permeability is rapid, and the available water capacity is low. Surface runoff is very slow to slow, and the erosion hazard is slight to moderate. Natural fertility is low.

The vegetation is grazed by livestock during most of the growing season. Occasionally, it is cut once for hay and the aftermath grazed. A large area of meadow has been plowed and seeded to clover-grass pasture. (Capability unit IVw–49P, irrigated)

Ophir gravelly sandy loam, 0 to 2 percent (OgA).—This soil is on the toe slopes of alluvial fans, immediately above the flood plains. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard.

This soil is used in much the same way as Ophir gravelly sandy loam, 2 to 4 percent slopes. (Capability unit IVw–49P, irrigated)

Ophir gravelly sandy loam, somewhat poorly drained, 2 to 8 percent slopes (OhC).—This soil occurs between the poorly drained Ophir soils and the excessively drained Mottsville soils. It is similar to Ophir gravelly sandy loam, 2 to 8 percent slopes, except that it has somewhat poor drainage. The water table is between depths of 2 and 3 feet in winter and early in spring, but it is between depths of 4 and 5 feet late in summer. The dark-colored A horizon ranges from 10 to 18 inches in thickness. The root mat, where present, is ordinarily less than 1 inch thick. There is mottling in the A11 and A12 horizons but not in the Ap horizon. Included in mapping was an area where the creek channel has been entrenched and a dendritic gully pattern has formed. The gullies have effectively drained the surrounding soil. (Capability unit IVw–49, irrigated)

Ophir peat, 2 to 4 percent slopes (OpB).—This soil is adjacent to areas of springs and seeps caused by faulting in the underlying bedrock. Its profile is similar to that of Ophir gravelly sandy loam, 2 to 8 percent slopes, except that the uppermost 6 to 8 inches is fibrous peat. The water table is at or near the surface. The high water table is the result of the release of ground water under high hydrostatic pressure. Natural drainage is very poor.

Included in mapping were small nearly level areas and small moderately sloping areas.

The vegetation consists mainly of coarse sedges and juncus. The springs are generally surrounded by cattails. They are slightly raised in relation to the rest of the soil. This soil is used in much the same way as Ophir gravelly sandy loam, 2 to 8 percent slopes. Irrigation is not needed because of the high water table. Drainage is very difficult because each spring and seep must be drained separately. (Capability unit VIIw–2, irrigated)

Ormsby Series

The Ormsby series consists of very deep, nearly level, somewhat poorly drained, coarse-textured soils that have a hardpan weekly cemented with silica. These soils formed in material derived mainly from granite, andesite, and rhyolite. They are on smooth alluvial terraces in the north-central part of the survey area. The vegetation consists of big sagebrush, cheatgrass, and annual weeds. About 85 to 90 percent of the surface is barren. The elevation is about 4,600 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Ormsby soils are associated with Gardnerville and Dangberg soils. Most areas are used for crops; some are used for limited grazing by livestock. The grazed areas could be used for crops if irrigation water were available.

Ormsby gravelly loamy sand (Or).—This soil is in the north-central part of the survey area, mainly south of Cradlebaugh Bridge. The surface layer typically is about 16 inches thick. It consists of dark-gray gravelly loamy sand over dark grayish-brown gravelly loamy coarse sand. The substratum consists of grayish-brown gravelly coarse sand over brown or light brownish-gray gravelly coarse sand that is weakly cemented with silica. Below this, to a depth of 60 inches, is pale-brown gravelly coarse sand. This soil is noncalcareous and is mildly alkaline to moderately alkaline.

Representative profile of Ormsby gravelly loamy sand, about 1,000 feet north and 75 feet west of the south quarter corner of sec. 6, T. 13 N., R. 20 E.

Ap—0 to 7 inches, dark-gray (10YR 4/1) gravelly loamy sand (about 30 percent gravel), very dark brown (10YR 2/2) when moist; weak, medium and fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and few fine roots; common fine and very fine tubular pores and common fine and very fine interstitial pores; mildly alkaline (pH 7.7); abrupt, smooth boundary.

A1—7 to 16 inches, dark grayish-brown (10YR 4/2) gravelly loamy coarse sand (30 percent gravel), very dark brown (10YR 2/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine and many very fine roots; few very fine and fine tubular pores and common fine and many very fine interstitial pores; moderately alkaline (pH 8.2); gradual, smooth boundary.

C1—16 to 24 inches, grayish-brown (10YR 5/2) gravelly coarse sand (20 percent gravel), very dark grayish brown (10YR 3/2) when moist; massive; hard, very friable, nonsticky and nonplastic; few fine and many very fine roots; common very fine interstitial pores and few fine and very fine tubular pores; moderately alkaline (pH 7.9); clear, wavy boundary.

C2si—24 to 35 inches, brown (10YR 5/3), weakly silica-cemented gravelly coarse sand (25 percent gravel), very dark grayish brown (10YR 3/2) when moist; common, fine and medium, faint mottles of dark brown (7.5YR 3/2) caused by iron content; massive; very hard, firm, brittle; common very fine roots; few very fine and fine interstitial pores; mildly alkaline (pH 7.8); clear, wavy boundary.

C3si—35 to 44 inches, light brownish-gray (10YR 6/2), weakly silica-cemented gravelly coarse sand (30 percent gravel), dark grayish brown (10YR 4/2) when moist; common, medium, faint mottles of very dark grayish brown (10YR 3/2) caused by iron content; massive; very hard, firm, brittle; few very fine roots; few very fine and fine interstitial pores; mildly alkaline (pH 7.7); clear, wavy boundary.

C4si—44 to 52 inches, light brownish-gray (10YR 6/2), weakly silica-cemented gravelly coarse sand (35 percent gravel), dark grayish brown (10YR 4/2) when moist; common, coarse, faint mottles of very dark grayish brown (10YR 3/2) caused by iron content; massive; hard, friable, slightly brittle; no roots; common very fine and fine interstitial pores; mildly alkaline (pH 7.7); clear, wavy boundary.

C5—52 to 60 inches, pale-brown (10YR 6/3) gravelly coarse sand (40 percent gravel), dark grayish brown (10YR 4/2) when moist; few, coarse, faint mottles of very dark grayish brown (10YR 3/2) caused by iron content; single grain; loose when dry and moist; no roots; many very fine interstitial pores; mildly alkaline (pH 7.5).

The A horizon ranges from 9 to 20 inches in thickness, mainly as a result of leveling. The depth to the silica-cemented Csi horizon ranges from 8 to 26 inches, and the degree of cementation from weak to very weak. The depth to mottles caused by iron content ranges from 24 to 36 inches, depending on fluctuation of the water table. The content of gravel in any one horizon ranges from 15 to 40 percent. The pebbles range from subangular to rounded in shape. They are commonly about half an inch in diameter; some measure as much as 1 inch.

Included in mapping was a small area, on a low terrace north of Genoa Lane, that is occasionally flooded and has a water table that fluctuates between depths of 24 and 36 inches during most of the irrigation season.

The water table in this Ormsby soil is at a depth of about 4 feet during most of the irrigation season, and for short periods it is perched above the layer that is strongly cemented with silica. This layer slows the growth of roots and, in some places, inhibits their growth. Permeability is moderately slow, and the available water capacity is low. Surface runoff is very slow, and erosion is either not a hazard or a slight hazard. The control of wind erosion is a problem if the soil is left barren for prolonged periods. Natural fertility is low.

Much of this soil has been leveled and is used for locally suitable crops. Areas in vegetation provide limited grazing for livestock in spring, summer, and fall. Subsoiling is needed in areas where the hardpan restricts the growth of roots. (Capability unit IVw–L, irrigated)

Ormsby gravelly loamy sand, slightly saline-alkali (Os).—This soil is on slightly raised terraces above the poorly drained Dangberg soils. It is similar to Ormsby gravelly loamy sand, except that the surface layer is slightly affected by salts and alkali. The salts are drawn into the soil from lower lying soils that are affected by salts and alkali. The alkali has dispersed soil particles and consequently has reduced the intake of water. Reaction is strongly alkaline throughout the profile. The water table fluctuates between depths of 30 and 48 inches.

Included in mapping were soils on several small, isolated low terraces that are strongly affected by salts because they cannot be irrigated. These soils have a hardpan that is strongly cemented with silica and is slowly permeable.

The vegetation is dominantly saltgrass, but there is a scattering of greasewood. It is grazed by livestock throughout the growing season along with adjacent meadows. The soil can be plowed, and pasture mixtures that are tolerant of salts and alkali can be grown. (Capability unit IVw–6L, irrigated)

Ormsby loamy sand (Oy).—The profile of this soil is similar to that of Ormsby gravelly loamy sand, except that the gravel content of the surface layer is less than 15 percent. This soil has slightly higher available water capacity.

The use of this soil is similar to that of Ormsby gravelly loamy sand. (Capability unit IVw–L, irrigated)

Peat

Peat consists of very deep, very poorly drained, organic soil material that formed over moderately fine textured alluvium derived mainly from granite but partly from rhyolite, andesite, basalt, gneiss, and slate. This soil material is in nearly level to very gently concave, basinlike areas between alluvial fans and flood plains in the southwestern part of the survey area. The vegetation consists of various sedges and juncus or saltgrass, and the plants cover 20 to 25 percent of the surface. Elevations range from about 4,700 to 5,000 feet. The annual precipitation ranges from 12 to 14 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 46° and 51° F.

Peat is associated with and lies between Ophir and Bishop soils.

Peat is in meadow that is used mainly for grazing. The hay may be cut once and the aftermath grazed.

Peat (Pe).—This land type is in the northwestern and southwestern parts of the survey area, in nearly level to slightly concave, basinlike areas. Typically, at the surface is 6 inches of very dark gray peat over 18 inches or gray muck stratified with several thin layers of silt loam. The first 6 inches of mineral soil is light olive-gray, mottled sandy clay loam, and below this is 30 inches of light-gray, mottled gravelly loamy coarse sand. Peat is noncalcareous and is slightly acid to neutral in reaction.

Representative profile of Peat, about 1,800 feet north and 1,300 feet east of the south quarter corner of sec. 23, T. 12 N., R. 19 E.

O1—24 to 18 inches, very dark gray (10YR 3/1) peat, black (10YR 2/1) when moist; slightly acid (pH 6.2); abrupt, smooth boundary.

O2—18 inches to 0, gray (10YR 5/1) muck stratified with ⅛- to 2-inch layers of silt loam, very dark gray (10YR 3/1) when moist; mineral soil is massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine tubular pores; many micro, fine and very fine, interstitial pores; neutral (pH 6.6); abrupt, smooth boundary.

C1g—0 to 6 inches, light olive-gray (5Y 6/2) sandy clay loam, olive gray (5Y 4/2) when moist; many, medium and coarse, faint mottles of olive (5Y 5/6); massive; hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; slightly acid (pH 6.2); abrupt, wavy boundary.

IIC2g—6 to 36 inches, light-gray (5Y 6/1) gravelly loamy coarse sand, olive gray (5Y 4/2) when moist; a few strata, 2 to 4 inches thick, of gray (5Y 5/1) loamy coarse sand; many, medium and coarse, prominent mottles of yellowish brown (10YR 5/4) caused by iron content; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; common fine tubular pores; slightly acid (pH 6.2).

The O horizon ranges from 17 to more than 60 inches in thickness. It is thicker near Saratoga Hot Springs than it is in other places. The underlying mineral soil material is mainly sandy clay loam or clay loam overlying loamy coarse sand. The boundary between the loamy and sandy soil materials is either abrupt or gradual. The color hues are 5Y, 5GY, or 5BG. The quantity of very fine or fine mica in the entire profile ranges from small to large, and in the area near Saratoga Hot Springs, the content of gypsum is also high.

The water table is at the surface or within half a foot of it late in winter, in spring, and early in summer, but it drops to a depth of about 20 inches late in summer and in fall. The high water table is caused by the normal spring runoff of snowmelt from the adjacent mountains by seepage, by loss of excess irrigation water from surrounding soils, or by the activity of hot springs. Permeability of the mineral soil material is moderately slow. The available water capacity is high. Surface runoff is very slow to ponded, depending on the season of the year and the depth to the water table. Erosion is not a hazard. Natural fertility is high.

The meadow vegetation is grazed by livestock or is cut for hay once and the aftermath grazed. The water table is too high for good suitability for crops, and the quality of the hay is poor. (Capability unit Vw–9, irrigated)

Prey Series

The Prey series consists of nearly level to strongly sloping, well drained, moderately coarse textured soils that formed in sandy alluvium derived mainly from granite but also from other igneous rocks and gneiss. These soils occur on smooth, dissected, old alluvial terraces in the northern part of the survey area. The vegetation consists of big sagebrush, bitterbrush, and rabbitbrush, and an understory of squirreltail, cheatgrass, and needlegrass. The plants cover about 80 to 85 percent of the surface. The elevation is about 5,100 feet. The annual precipitation ranges from 12 to 16 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Prey soils are associated with Toll, Mottsville, and Glenbrook soils.

Soils of the Prey series are in range that provides limited grazing for livestock in spring, summer, and fall. Deer also graze these areas in winter, especially after heavy snowfall in the nearby mountains. In several places there are clusters of small homesites.

Prey gravelly loamy sand, 0 to 4 percent slopes (PgB).—This soil is on old alluvial terraces on both sides of U.S. Highway 395 near the northern end of the survey area. The surface layer typically consists of about 2 inches of light-gray gravelly sand overlying about 11 inches of grayish-brown gravelly loamy sand. The subsoil, to a depth of 30 inches, consists of brown gravelly coarse sandy loam overlying yellowish-brown coarse sandy loam. Below this is gravelly coarse sandy loam that is brown in the upper part and light yellowish brown in the lower part. The substratum consists of a very pale brown hardpan, strongly cemented with silica. This layer overlies light-gray loamy coarse sand that is weakly cemented with silica. Below this is very pale brown loamy coarse sand. The cementation consists of thin (1/64- to 1/8-inch) plates that are in horizontal, vertical, and diagonal positions. This soil is noncalcareous and is medium acid to mildly alkaline in reaction.

Representative profile of Prey gravelly loamy sand, 0 to 4 percent slopes, about 1,100 feet east and 2,200 feet north of the south quarter corner of sec. 6, T. 14 N., R. 20 E.

A11—0 to 2 inches, light-gray (10YR 7/2) gravelly sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; many very fine roots; many very fine interstitial pores; medium acid (pH 6.0); abrupt, smooth boundary.

A12—2 to 5 inches, grayish-brown (10YR 5/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, medium, platy structure; soft, very friable, nonsticky and nonplastic; many very fine, plentiful fine, and few medium roots; many very fine, and common fine tubular pores; many very fine and fine interstitial pores; slightly acid (pH 6.3); abrupt, wavy boundary.

A13—5 to 13 inches, grayish-brown (10YR 5/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; common very fine, and few fine and medium roots; many very fine and fine interstitial pores; slightly acid (pH 6.4); clear, wavy boundary.

B1t—13 to 16 inches, brown (10YR 5/3) gravelly coarse sandy loam, dark yellowish brown (10YR 3/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine roots; few very fine and fine tubular pores and common very fine and fine interstitial pores; common thin clay bridges between sand grains; slightly acid (pH 6.4); clear, smooth boundary.

B21t—16 to 20 inches, yellowish-brown (10YR 5/4) coarse sandy loam, dark yellowish brown (10YR 3/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine and fine tubular pores and common very fine and fine interstitial pores; many thin clay bridges between sand grains; medium acid (pH 6.0); clear, smooth boundary.

B22t—20 to 26 inches, brown (10YR 5/3) gravelly coarse sandy loam, dark yellowish brown (10YR 3/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine and fine tubular pores and common very fine and fine interstitial pores; thin continuous clay films on sand grains and clay bridges between sand grains; medium acid (pH 5.6); abrupt, irregular boundary.

B3t—26 to 30 inches, light yellowish-brown (10YR 6/4) gravelly coarse sandy loam that contains a gravel erosion line; yellowish brown (10YR 5/6) when moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine and fine tubular pores and common very fine and fine interstitial pores; few, moderately thick, dark yellowish-brown (10YR 3/4) clay bridges between sand grains; slightly acid (pH 6.3); abrupt, wavy boundary.

C1sim—30 to 35 inches, very pale brown (10YR 7/3), strongly silica-cemented hardpan, dark brown (10YR 4/3) when moist; massive; many 1/32- to 1/8-inch, unoriented, strongly silica-cemented laminae; few very fine and fine roots between laminae; mildly alkaline (pH 7.7); clear, smooth boundary.

C2si—35 to 52 inches, light-gray (10YR 7/2), weakly silica-cemented heavy loamy coarse sand, brown (10YR 5/3) when moist; massive; very hard, friable, nonsticky and nonplastic; no roots; few very fine and fine tubular pores; mildly alkaline (pH 7.8); clear, smooth boundary.

C3—52 to 60 inches, very pale brown (10YR 7/3) loamy coarse sand; brown (10YR 5/3) when moist; massive; hard, very friable, nonsticky and nonplastic; no roots; few very fine and fine interstitial pores; mildly alkaline (pH 7.6).

The solum ranges from 26 to 38 inches in thickness. The structure of the B horizon generally ranges from prismatic to subangular blocky, but in some places this horizon is massive. The content of gravel ranges from 5 to 25 percent, but in most places it is not more than 20 percent. The silica-cemented plates or bands in the Csim horizon vary considerably in thickness and number; they also occur in the B3t horizon. The plates range from few to many in number and from 1/64 to 1/8 inch in thickness. The bands range from neutral to mildly alkaline in reaction. Windblown soil material ranging from 1/8 inch to about 2 inches in thickness lies on the surface.

Included in mapping, and making up about 10 percent of this unit, were areas of Prey gravelly loamy sand, 4 to 16 percent slopes. These are on terrace breaks.

Permeability is slow, and the available water capacity is low to moderate, depending on the thickness of the subsoil. Surface runoff is very slow, and the erosion hazard is slight to moderate. Natural fertility is moderate.

The available forage is used by livestock in spring, summer, and fall. Some deer also graze these areas the year around. Heavy grazing by deer can be expected in winter, especially after heavy snowfall in the nearby mountains. In places small tracts, 2½ acres in size, are used for homesites. (Capability unit VIc–K, nonirrigated)

Prey loamy sand, 0 to 2 percent slopes (PhA).—This soil is on lower terraces. Its profile is similar to that of Prey gravelly loamy sand, 0 to 4 percent slopes, except that the gravel content of the surface layer is less than 15 percent. The content of clay in the B2t horizon is about 5 percent less than is typical of the series; the subsoil is sandy loam. The silica-cemented plates are fewer than is typical. The available water capacity is low.

This soil is used in the same way as Prey gravelly loamy sand, 0 to 4 percent slopes, and it has similar vegetation. (Capability unit VIc–K, nonirrigated)

Prey stony sandy loam, 4 to 16 percent slopes (PmD).—This soil is on gently rolling to moderately sloping terraces. Its profile is similar to that of Prey gravelly loamy sand, 0 to 4 percent slopes, except that the uppermost 5 to 9 inches is stony sandy loam.

The available water capacity is moderate. Surface runoff is slow to medium, and the erosion hazard is slight to moderate.

The vegetation has a higher density of bitterbrush than of big sagebrush because of the higher available water capacity and the somewhat higher rainfall. This soil is used in the same way as Prey gravelly loamy sand, 0 to 4 percent slopes. (Capability unit VIc–K, nonirrigated)

Prey Series, Heavy Subsoil Variant

The Prey series, heavy subsoil variant, consists of shallow, gently sloping to strongly sloping, well-drained, stony, medium-textured soils that formed in gravelly and cobbly, loamy alluvium derived mainly from granite, gneiss, and slate. These soils are on eroded terrace tops in the northwestern part of the survey area, flanking Jacks Valley on the east. The vegetation consists of big sagebrush, bitterbrush, cheatgrass, squirreltail, needlegrass, and bluegrass. The plants cover 15 to 25 percent of the surface. The elevation is about 5,200 feet. The average annual precipitation is between 14 and 16 inches, and the average temperature is between 49° and 51° F. The frost-free season ranges from 95 to 110 days.

Prey soils, heavy subsoil variant, are in range that provides limited grazing for both livestock and wildlife.

Prey stony loam, heavy subsoil variant, 2 to 16 percent slopes (PnC).—This soil, in the northwestern part of the survey area, is on a high, dissected terrace that forms the eastern boundary of Jacks Valley. The surface layer typically consists of about 1 inch of brown stony sand overlying about 9 inches of grayish-brown gravelly and cobbly loam and scattered stones. The subsoil consists of brown gravelly sandy loam to a depth of 15 inches. The substratum consists of a hardpan that is strongly cemented with silica. It is brown in the upper part and light yellowish brown in the lower part. Below this is pale-brown gravelly fine sandy loam that is weakly cemented with silica. This layer overlies light yellowish-brown very gravelly and cobbly sandy loam that is weakly cemented with silica. This soil is medium acid to mildly alkaline in reaction.

Representative profile of a Prey soil, heavy subsoil variant, about 400 feet west and 810 feet south of the east quarter corner of sec. 14, T. 14 N., R. 19 E.

A11—0 to 1 inch, brown (10YR 5/3) stony sand, very dark brown (10YR 2/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; few fine and many very fine roots; many very fine and fine interstitial pores; medium acid (pH 5.9); abrupt, smooth boundary.

A12—1 inch to 3 inches, grayish-brown (10YR 5/2) gravelly and cobbly loam and scattered stones, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; few medium, common fine, and many very fine roots; many very fine and fine interstitial pores; neutral (pH 6.8); abrupt, smooth boundary.

A13—3 to 10 inches, grayish-brown (10YR 5/2) gravelly and cobbly loam and scattered stones, very dark brown (10YR 2/2) when moist; massive; soft, very friable, nonsticky and nonplastic; few medium, common fine, and many very fine roots; few very fine and fine tubular pores and many very fine interstitial pores; neutral (pH 7.0); abrupt, wavy boundary.

B1t—10 to 13 inches, brown (10YR 5/3) gravelly sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, friable, sticky and plastic; few fine and common very fine roots; common very fine and fine interstitial pores and few very fine tubular pores; many, thin, dark-brown (10YR 4/3) clay bridges between sand grains and clay films in pores; slightly acid (pH 6.5); abrupt, wavy boundary.

B2t—13 to 15 inches, brown (10YR 5/3) gravelly heavy loam, dark brown (10YR 4/3) when moist; few, coarse, prominent, dark reddish-brown (5YR 2/2) iron or manganese stains derived from weathering gravel; massive; very hard, friable, sticky and plastic; few fine and many very fine roots; common very fine and fine tubular pores; many moderately thick clay bridges between sand grains and moderately thick continuous clay films in pores; slightly acid (pH 6.4); abrupt, wavy boundary.

C1sim—15 to 18 inches, brown (10YR 6/4), strongly silica cemented hardpan, dark brown (10YR 4/3) when moist; massive; many very fine roots, but only along unoriented silica laminae; moderately thick, continuous, dark yellowish-brown (10YR 3/4) clay films on silica laminae; neutral (pH 6.6); abrupt, wavy boundary.

C2sim—18 to 22 inches, light yellowish-brown (10YR 6/4), strongly silica-cemented hardpan, dark brown (10YR 4/3) when moist; few, coarse, prominent, dark reddish-brown (5YR 3/4) iron stains derived from weathered rock; massive; very few very fine roots along silica laminae; very strongly weathered pebbles and cobblestones, 2 to 9 inches in diameter, make up 40 percent of the mass; mildly alkaline (pH 7.4); gradual, smooth boundary.

C3si—22 to 36 inches, pale-brown (10YR 6/3), weakly silica-cemented gravelly fine sandy loam, dark brown (10YR 4/3) when moist; massive; very hard, very firm, nonsticky and nonplastic; no roots; mildly alkaline (pH 7.8); gradual, smooth boundary.

C4si—36 to 60 inches, light yellowish-brown (10YR 6/4), weakly silica-cemented very gravelly and cobbly sandy loam, dark brown (10YR 4/3) when moist; massive; very hard, firm, nonsticky and nonplastic; no roots; few very fine interstitial pores; mildly alkaline (pH 7.6); pebbles and cobblestones are very strongly weathered.

The solum ranges from 14 to 20 inches in thickness. The B2t horizon ranges from heavy loam to light sandy clay loam in texture and in places has weak or moderate prismatic structure that breaks to moderate or strong subangular blocky. The strong to weak silica cementation in the C horizon is soluble only in a strongly alkaline solution. In places very thin (less than 1/8 inch) discontinuous silica layers are indurated. These are scattered throughout the upper part of the C horizon. The material between the indurated layers is softer. Most of the plant roots are between the layers. The content of gravel, cobblestones, and stones throughout the profile ranges from 5 to 50 percent. The coarse fragments are subangular to moderately rounded. The relative absence of gravel in the subsoil may be the result of weathering in place. Most of the gravel, cobblestones, and stones in the substratum are very highly weathered, and little, if any, of this material can be removed intact. There is no lime in the profile.

Permeability is very slow, and the available water capacity is low. Surface runoff is slow to medium, and the erosion hazard is slight to moderate. Natural fertility is moderate.

The available forage provides grazing for livestock in spring, summer, and fall. Wildlife graze these areas throughout the year. Deer make very heavy use of the available forage late in fall and in winter, especially after heavy snowfall in the surrounding mountains. (Capability unit VIc–K, nonirrigated)

Puddle Series, Gypsic Variant

The Puddle series, gypsic variant, consists of very deep, nearly level, somewhat poorly drained, medium-textured soils that formed in loamy alluvium, in which large quantities of gypsum, precipitated from hot spring water, had accumulated. This alluvium was derived mainly from granite but also from basalt, rhyolite, gneiss, sandstone, and slate. These soils are on low terraces that have hummocky relief caused by wind erosion. They occur in the northeastern part of the survey area, near Hot Springs Mountain. The vegetation consists of very sparse stands of greasewood and an understory of saltgrass; about 95 to 98 percent of the surface is barren. Elevations range from 4,600 to 5,000 feet. The annual precipitation ranges from 8 to 12 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Puddle soils, gypsic variant, are associated with Ormsby, Toll, and Voltaire soils.

Soils of the Puddle series, gypsic variant, provide very limited grazing for livestock.

Puddle silt loam, gypsic variant (Pu).—This soil is in the northeastern part of the survey area, at the base of Hot Springs Mountain, near Saratoga Hot Springs. Typically, there is only a substratum of white, gypsiferous silt loam to a depth of 60 inches. This soil is very strongly calcareous and high in content of gypsum.

Representative profile of Puddle silt loam, gypsic variant, 300 feet south and 1,300 feet west of the east quarter corner of sec. 20, T. 14 N., R. 20 E.

C1—0 to 7 inches (a salt crust 1/8 to 1/4 inch thick on the surface); white (N 8/0) gypsiferous silt loam, gray (10YR 6/1) when moist; massive to a depth of 2 inches, then moderate, medium to thin, platy structure; soft, very friable, nonsticky and slightly plastic; many very fine and common medium saltgrass stolons; many very fine vesicular pores in uppermost 2 inches, and below this many very fine tubular pores; violently effervescent; moderately alkaline (pH 8.4); abrupt, wavy boundary.

C2—7 to 13 inches, white (10YR 8/1) gypsiferous silt loam, gray (10YR 6/1) when moist; moderate, medium to thin, platy structure; soft, very friable, nonsticky and slightly plastic; common very fine and fine roots; many very fine tubular pores; violently effervescent; moderately alkaline (pH 8.3); abrupt, wavy boundary.

C3cs—13 to 22 inches, white (N 8/0), gypsiferous silt loam, gray (10YR 6/1) when moist; weak, thin, platy structure; hard, friable, nonsticky and slightly plastic; common very fine and fine roots; many very fine tubular pores; violently effervescent; mildly alkaline (pH 7.4); gradual, smooth boundary.

C4—22 to 46 inches, white (N 8/0), gypsiferous silt loam, gray (10YR 6/1) when moist; massive; hard, friable, nonsticky and slightly plastic; very few very fine roots; many very fine tubular pores; violently effervescent; moderately alkaline (pH 8.2); diffuse, smooth boundary.

C5csca—46 to 60 inches, white (N 8/0), gypsiferous silt loam, gray (10YR 6/1) when moist; few to common gypsum nodules that range from 1/8 to 1/2 inch in diameter; massive; hard, friable, nonsticky and slightly plastic; no plant roots; common very fine tubular pores and interstitial pores; violently effervescent; moderately alkaline (pH 8.2).

Gypsum nodules range from few to many in abundance and from hard to very hard in consistence. They occur at a depth below 36 inches. The content of gypsum throughout the profile ranges from 5 to 25 percent. There is no orderly sequence in gypsum content from one stratum to another. The soil material is effervescent, but not violently effervescent, in some layers at a depth below 36 inches.

Natural drainage is somewhat poor. The water table is generally between depths of 5 and 7 feet. Permeability is moderate, and the available water capacity is high. Surface runoff is very slow, and the hazard of wind erosion is moderate. Fertility is moderate.

The available forage provides very limited grazing for livestock. (Capability unit VIIw–6, nonirrigated)

Quincy Series

The Quincy series consists of very deep, gently sloping to moderately steep, excessively drained, coarse-textured soils that formed in sandy wind-worked material derived from mixed rocks, predominantly granite. These soils are on partly stabilized dunes in the northeastern part of the survey area, adjacent to Hot Springs Mountain. The vegetation consists of Mormon-tea, rabbitbrush, bitterbrush, and desert peach and an understory of Indian ricegrass and annuals. The plants cover only 5 to 10 percent of the surface. Elevations range from 4,600 to 5,500 feet. The annual precipitation ranges from 8 to 16 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Quincy soils are associated with Toll, Aldax, Indiano, and Stodick soils.

Soils of the Quincy series are used for grazing by livestock in winter and spring.

Quincy fine sand, 2 to 30 percent slopes (QuE).—This soil occurs as partly stabilized dunes in the northeastern corner of the survey area, east and north of Hot Springs Mountain and on the southern slopes of the mountain. Typically, the soil consists of light-gray fine sand to a depth of 60 inches. It is neutral in reaction.

Representative profile of Quincy fine sand, 2 to 30 percent slopes, about 500 feet west and 800 feet north of the southeast corner of sec. 23., T. 14 N., R. 20 E.

C—0 to 60 inches, light-gray (10YR 7/2) fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist; common very fine and fine roots at a depth of 30 to 60 inches; few very fine and fine roots at a depth of 30 to 60 inches; many very fine and fine interstitial pores; neutral (pH 6.8).

In places there is a surface layer of coarse sand ranging from ½ to 1 inch in thickness. In places the texture is sand instead of fine sand.

Permeability is very rapid, and the available water capacity is low. Surface runoff is very slow to slow, depending on the slope. The erosion hazard is high, especially from wind. Inherent fertility is low.

The available forage provides limited grazing for livestock. (Capability unit VIIs–L, nonirrigated)

Reno Series

The Reno series consists of moderately deep, gently sloping to strongly sloping, well-drained, fine-textured soils that formed in old alluvium derived mainly from granite but also from basalt, rhyolite, tuff, gneiss, and some sandstone. These soils are on smooth to slightly convex high terraces, mainly east of and above irrigated parts of the survey area. The vegetation consists of big sagebrush and horsebrush and an understory of cheatgrass and squirreltail. The plants cover only 10 to 15 percent of the surface. Elevations range from 4,800 to 5,100 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Reno soils are associated with Indian Creek, Turria, Glenbrook, and Washoe soils.

Soils of the Reno series are used for grazing by livestock either in winter and spring or in spring, summer, and fall. They are also used for homesites.

Reno gravelly sandy loam, 2 to 8 percent slopes (ReB).—This soil is in the east-central part of the survey area, immediately above the irrigated area. The surface layer typically consists of 1 inch of light brownish-gray gravelly loamy sand over 1½ inches of light-gray gravelly fine sandy loam. Beneath this are transitional layers consisting of light brownish-gray sandy clay loam overlying grayish-brown sandy clay loam to a depth of 5 inches. The subsoil consists of dark-brown, sandy clay over dark-brown sandy clay loam. Below this is pale-brown gravelly sandy clay loam to a depth of about 24 inches. The substratum consists of light yellowish-brown gravelly coarse sand over a very pale brown hardpan that is strongly cemented with fine silica. Below this is pale-brown very gravelly sand. The surface layer and subsoil are noncalcareous, and the substratum is calcareous.

Representative profile of Reno gravelly sandy loam, 2 to 8 percent slopes, about 600 feet north and 900 feet west of the southeast corner of sec. 2, T. 12 N., R. 20 E.

A1—0 to 1 inch, light brownish-gray (10YR 6/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; slightly acid (pH 6.2); abrupt, smooth boundary.

A2—1 to 2½ inches, light-gray (10YR 7/2) gravelly fine sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, platy structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine vesicular pores; many very fine and few fine roots; many bleached sand grains; slightly acid (pH 6.3); abrupt, smooth boundary.

A&B—2½ to 3 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark brown (10YR 3/3) when moist; moderate, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial pores; many bleached sand grains; common thin clay films on ped surfaces; slightly acid (pH 6/4); abrupt, broken boundary.

B&A—3 to 5 inches, grayish-brown (10YR 5/2) sandy clay loam, dark brown (10YR 3/3) when moist; strong, very fine, subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and many very fine roots; many very fine tubular pores; few bleached sand grains; thin continuous clay films in pores and on ped faces; slightly acid (pH 6.4); very abrupt, wavy boundary.

B21t—5 to 15 inches, dark-brown (10YR 4/3) sandy clay, dark yellowish brown (10YR 3/4) when moist; strong, medium, prismatic structure; extremely hard, very firm, very sticky and very plastic; common very fine and few fine roots; few very fine tubular and interstitial pores; many slickensides and pressure cutans; neutral (pH 6.7); clear, smooth boundary.

B22t—15 to 19 inches, dark-brown (10YR 4/3) heavy sandy clay loam, dark yellowish brown (10YR 3/4) when moist; weak, medium, prismatic structure breaking to strong, coarse, angular blocky; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few very fine tubular and interstitial pores; moderately thick continuous clay films on peds and in pores; neutral (pH 6.8); clear, wavy boundary.

IIB3t—19 to 24 inches, pale-brown (10YR 6/3) gravelly light sandy clay loam, dark brown (10YR 3/3) when moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores, and common very fine interstitial pores; common, thin and moderately thick, dark-brown (10YR 4/3) clay bridges between sand grains; continuous thin and moderately thick clay films in pores; neutral (pH 6.8); clear wavy boundary.

IIIC1—24 to 32 inches, light yellowish-brown (10YR 6/4) gravelly coarse sand, dark yellowish brown (10YR 4/4) when moist; single grain; loose when dry and moist; few very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.8); abrupt, wavy boundary.

IVC2sicam—32 to 44 inches, very pale brown (10YR 8/3) hardpan strongly cemented with fine silica, light yellowish brown (10YR 6/4) when moist; few very fine roots in cracks; violently effervescent; moderately alkaline (pH 8.1); abrupt, wavy boundary.

VC3—44 to 60 inches, pale-brown (10YR 6/3) very gravelly sand, dark brown (10YR 4/3) when moist; single grain; loose when dry and moist, nonsticky and nonplastic; no roots; many very fine and fine interstitial pores; effervescent; the undersides of some pebbles are coated with lime; moderately alkaline (pH 8.1).

The solum ranges from 18 to 30 inches in thickness. The B&A horizon has weak fine columnar structure that breaks to strong subangular or angular blocky. It contains few bleached sand grains, and it is a result of degradation of the B2t horizon. The B2t horizon ranges from heavy sandy clay loam to clay in texture and from 11 to 21 inches in thickness. In places there is some lime in the lower part of the B horizon. The depth to the strongly cemented hardpan generally ranges from 26 to 36 inches. The content of lime ranges from 10 to 25 percent, but it is commonly between 10 and 18 percent. There is generally an unconformity in the lower part of the B or C horizon. The content of gravel and cobblestones in the IIB and IIIC horizons ranges from 30 to 70 percent. In places the underlying bedrock is tuff.

Included in mapping were steep to very steep terrace breaks that consist of Rough broken land. These areas make up about 2 percent of the acreage.

Permeability is very slow, and the available water capacity is moderate. Surface runoff is slow, and the erosion hazard is slight. Natural fertility is moderate.

The available forage is used by livestock in winter and spring. Small areas have been used as stackyards and feedlots. (Capability unit VIc–K, nonirrigated)

Reno gravelly sandy loam, moderately deep, 2 to 8 percent slopes, eroded (RgC2).—The profile of this soil is similar to that of Reno gravelly sandy loam, 2 to 8 percent slopes, except that the underlying material, at depths ranging from about 26 to 36 inches, is tuff. A hardpan, strongly cemented with lime and silica, caps the tuff. Lime, in the form of soft nodules or coarse mottlings and coatings, occurs in the lower part of the subsoil or in the tuff. There is no unconformable gravelly and very gravelly substratum material. A combination of sheet erosion, which has removed the A1 horizon and exposed the A2 horizon, and shallow gully erosion has taken place.

This soil is used in much the same way as Reno gravelly sandy loam, 2 to 8 percent slopes, except that it is grazed in spring, summer, and fall. Heavy grazing by deer can be expected in winter, when heavy snowfall forces them from adjacent mountainous areas. (Capability unit VIc–K, nonirrigated)

Reno stony sandy loam, 4 to 16 percent slopes (RnD).—This soil in on high terraces in the southern part of the survey area, northeast of Mud Lake. Its profile is similar to that of Reno gravelly sandy loam, 2 to 8 percent slopes, except that the content of stones and cobblestones in the surface layer ranges from 10 to 15 percent, and, because of the slightly higher rainfall, the solum ranges from 30 to 40 inches in thickness. The C horizon, to a depth of 5 feet, is a hardpan that is weakly cemented with lime and silica. This horizon contains many coarse segregations and nodules of lime. Unconformable strata of gravel and cobblestones occur only at depths of more than 48 inches. The substratum material normally grades from gravelly and cobbly to very gravelly.

This soil is used for limited grazing by livestock in spring, summer, and fall. Heavy grazing by deer can be expected in winter, when heavy snowfall forces them from adjacent mountainous areas. (Capability unit VIc–K, nonirrigated)

Rock Land

Rock land (Ro) occurs in foothill areas, mainly in the southern part of the survey area. It consists of rock outcrops and very shallow soil. The outcrops are mainly volcanic plugs of andesite and rhyolite and cliffs of andesite breccia and tuff.

Rock land is used for very limited grazing by wildlife, for water supply, and for recreation. The vegetation is sparse. (Capability unit VIIIs–8, nonirrigated)

Rough Broken Land

Rough broken land (Ru) occurs near Woodfords adjacent to California State Highway 88. It consists of steep terrace breaks. The variations in local elevation range from about 25 to 100 feet. The soil materials are poorly sorted, stratified, alluvial fan materials and glacial outwash. Surface runoff is rapid, and the erosion hazard is high.

The vegetation consists of big sagebrush, rabbitbrush, and cheatgrass. The plants cover only 2 to 5 percent of the surface. Rough broken land is used for very limited grazing by livestock. (Capability unit VIIe–1, nonirrigated)

Sandy Alluvial Land

Sandy alluvial land (Sa) occurs as sandy and gravelly bars in the Carson River channels and along Indian Creek in California. Areas along the Carson River are nearly level, and the soil material consists of unconsolidated sandy and gravelly alluvium that is well stratified and has wide variations in texture. Areas along Indian Creek are gently sloping, and the soil material consists of very cobbly, sandy and loamy alluvium that was recently deposited and is subject to frequent alteration by stream overflow. The vegetation consists of sparse stands of native and introduced grasses and clover. The plants cover not more than 10 percent of the surface, and in some places the surface is barren.

Sandy alluvial land is used for limited grazing by livestock when the level of the river and the creeks has dropped. This land type has little other farming value because of the severe hazard of flooding. The flooding ordinarily occurs in at least 1 year out of 2. (Capability unit VIIw-L, irrigated)

Settlemeyer Series

The Settlemeyer series consists of very deep, nearly level, poorly drained to somewhat poorly drained, moderately fine textured soils that formed in loamy alluvium derived from granite and other rocks. These soils are on smooth to very gently concave flood plains. They occur mainly as scattered areas throughout the survey area adjacent to the Carson River and its two main tributaries, the East Fork and the West Fork. They are subject to flooding when the Carson River and its tributaries overflow. The vegetation consists of sedges, creeping wildrye, bluegrass, weeds, and some strawberry clover and alta fescue. Saltgrass grows in areas where the soils are slightly to strongly affected by salts and alkali. The plants cover 35 to 50 percent of the surface. The elevation is about 4,500 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Settlemeyer soils are associated with Job, Heidtman, Voltaire, and Henningsen soils.

Soils of the Settlemeyer series are in meadow that is cut for hay or is grazed throughout the growing season. The areas more affected by salts and alkali are in saltgrass. There are extensive areas where alfalfa-grass mixtures are grown in rotation with small grain.

Settlemeyer clay loam (Sc).—This soil occurs as small, scattered areas in the central and southeastern part of the survey area along the flood plains of the East Fork and the Carson River. The surface layer typically consists of about 5 inches of dark-gray clay loam over about 10 inches of gray silty clay loam. Beneath this, to a depth of about 22 inches, is a transitional layer of gray silty clay loam. The substratum consists of light brownish-gray, mottled silty clay loam over olive-gray, mottled light sandy clay loam or loam. Below this is olive-gray, mottled fine sandy loam. The mottles, which are caused by iron content, are brown or dark brown. The surface layer is calcareous, but the rest of the profile is noncalcareous.

Representative profile of Settlemeyer clay loam, about 1,100 feet west and 1,100 feet south of the northeast corner of sec. 14, T. 13 N., R. 19 E.

A11—0 to 5 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) when moist; strong, fine and medium, granular structure; hard, friable, sticky and plastic; many very fine and common fine roots; many very fine and fine interstitial pores; effervescent; strongly alkaline (pH 8.5); abrupt, smooth boundary.

A12—5 to 15 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; common, fine, prominent, white (10YR 8/2) lime filaments; weak, medium prismatic structure; hard, friable, sticky and plastic; many very fine and common fine roots; few very fine and fine tubular pores and common very fine interstitial pores; many worm casts; violently effervescent; strongly alkaline (pH 8.6); clear, wavy boundary.

AC—15 to 22 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; massive; hard, friable, sticky and plastic; common very fine and fine roots; few very fine and fine tubular pores and common very fine and fine interstitial pores; moderate number of worm casts; matrix is generally noneffervescent, but strongly effervescent where there are a few, fine prominent, white mottles (10YR 8/1) caused by lime content; moderately alkaline (pH 8.2); gradual, wavy boundary.

C1—22 to 35 inches, light brownish-gray (2.5Y 6/2) silty clay loam, olive gray (5Y 4/2) when moist; common, fine, distinct mottles of brown (10YR 5/3) caused by iron content; massive; hard, friable, sticky and plastic; many very fine and few fine roots; many very fine and few fine tubular pores; moderate number of worm casts; noneffervescent; moderately alkaline (pH 8.2); abrupt, wavy boundary.

C2—35 to 41 inches, olive-gray (5Y 5/2) light sandy clay loam or loam, olive gray (5Y 4/2) when moist; common, fine, distinct mottles of dark brown (10YR 4/3) caused by iron content; massive; hard, friable slightly sticky and slightly plastic; few very fine and fine roots; common very fine and fine tubular pores; noneffervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

C3—41 to 60 inches, olive-gray (5Y 5/2) fine sandy loam, olive gray (5Y 4/2) when moist; many fine, medium, and coarse mottles of dark brown (10YR 3/3) caused by iron content; massive; hard, friable, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; noneffervescent; mildly alkaline (pH 7.4).

The A1 horizon is calcareous. It ranges from weakly effervescent to violently effervescent, but in some places the lower part is noneffervescent. In places this horizon contains scattered, very hard, subangular lime nodules ¼ to ½ inch thick. In some areas the C1 horizon is effervescent or strongly effervescent; in places it is stratified. The texture is generally sandy clay loam, clay loam, or silty clay loam, but strata of fine sandy loam, sandy loam, loamy fine sand, and sand are common. An unconformable layer of gravel is at a depth of more than 42 inches in places. The strata in the C horizon have greener or bluer colors than are typical at depths of more than 42 inches in some areas. In various strata of the profile, reaction ranges from neutral to strongly alkaline.

Included in mapping were several small areas of soils that are underlain at a depth below 48 inches by dense, slowly permeable clay.

Natural drainage is poor. The water table fluctuates between depths of 18 and 30 inches during most of the irrigation season. Permeability is moderately slow, except in the included areas of clay substratum soil, where it is slow. The available water capacity is high. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is high.

This soil is in meadow used mostly for grazing by livestock. In some places a crop of hay is cut and the aftermath grazed. Some areas are used for improved pasture, consisting of alfalfa-grass mixtures grown in rotation with small grain. Alfalfa is short lived. (Capability unit IIIw–2, irrigated)

Settlemeyer clay loam, somewhat poorly drained (Se).—This soil is similar to Settlemeyer clay loam, except for the somewhat poor drainage and the water table that fluctuates between depths of 3 and 4 feet. The water table is caused by entrenchment of the river and slough channels and by the deepening of ditches. Gleyed mottling and yellowish colors ordinarily occur at a depth of more than 48 inches. The mottles also occur immediately below the surface layer, but they are less prominent.

Included in mapping were areas of soil that have dense, slowly permeable clay at a depth of more than 48 inches.

This soil is used in much the same way as Settlemeyer clay loam, except that it is used for alfalfa-grass mixtures grown in rotation with small grain. (Capability unit IIw–2, irrigated)

Settlemeyer clay loam, slightly saline-alkali (Sg).—The profile of this soil is similar to that of Settlemeyer clay loam, except for the underlying material of dense, slowly permeable clay. The surface layer is slightly affected by excess salts and alkali. The depth to the strata of dense clay ranges from 42 to 54 inches. These strata retard the normal downward movement of irrigation water and result in a temporarily perched water table. The subsoil may have a slightly higher content of salts and alkali because the movement of water is restricted. Reaction ranges from strongly alkaline to very strongly alkaline above the water table, but it is mildly alkaline at a depth of 5 feet.

As much as half the meadow vegetation is made up of saltgrass and other salt- and alkali-tolerant plants. The soil is used in much the same way as Settlemeyer clay loam, but it is less well suited to crops because of the salts and alkali. (Capability unit IIIw–2, irrigated)

Settlemeyer clay loam, strongly saline-alkali (Sk).—This soil is on slightly raised terraces. It is similar to Settlemeyer clay loam, except that the surface layer is strongly affected by salts and alkali. Because of the raised position of this soil, plants extract their moisture from ground water, and salts and alkali concentrate on the surface.

Included in mapping were several small areas of soils where the surface layer is silty clay 8 to 14 inches thick, as well as small areas that are somewhat poorly drained.

The vegetation consists either of saltgrass alone or of greasewood and a sparse understory of saltgrass. The forage in these meadows, together with that in adjacent meadows, is grazed during the growing season, or the meadows are cut for hay and then grazed. Some areas are used for stackyards. (Capability unit VIw-6, irrigated)

Springmeyer Series

The Springmeyer series consists of very deep, gently sloping to steep, well-drained, gravelly, moderately fine textured soils that formed in gravelly and cobbly, loamy alluvium derived from mixed rocks, including granite, basalt, rhyolite, andesite, and slate. These soils are on small alluvial fans and on terraces and side slopes of terraces, mainly in the south-central part of the survey area, both north and south of the Nevada-California State line. The vegetation consists of moderate stands of big sagebrush and bitterbrush and an understory of cheatgrass, squirreltail, bluegrass, needlegrass, and annual weeds. The plants cover only about 15 percent of the surface. Elevations range from 4,800 to 5,500 feet. The annual precipitation ranges from 12 to 14 inches, and the frost-free season from 95 to 105 days. The average annual temperature is between 49° and 51° F.

Springmeyer soils are associated with Borda, Aldax, Reno, and Indian Creek soils.

Soils of the Springmeyer series are in range that provides grazing for livestock in spring, summer, and fall. Deer also graze throughout the year, but they make heavy use of the range in winter, when snow drives them from the high mountain ranges. Areas on alluvial fans are irrigated and used for meadow or alfalfa.

Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes (SlD).—This soil occurs immediately west of Mud Lake on an old valley-fill terrace. The surface layer typically is brown gravelly fine sandy loam about 10 inches thick. The subsoil consists of pale-brown gravelly loam or gravelly sandy clay loam over brown gravelly sandy clay loam to a depth of about 22 inches. The substratum is pale-brown gravelly sandy clay loam. This soil is noncalcareous and generally neutral in reaction.

Representative profile of Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes, 500 feet north and 1,300 feet east of the south quarter corner of sec. 4, T. 11 N., R. 20 E.

A11—0 to 3 inches, brown (10YR 5/3) gravelly fine sandy loam, dark brown (10YR 3/3) when moist; moderate, thick, platy structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine vesicular pores; neutral (pH 6.6); abrupt, smooth boundary.

A12—3 to 10 inches, brown (10YR 5/3) gravelly fine sandy loam, dark brown (10YR 3/3) when moist; weak, medium and fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine tubular pores; neutral (pH 6.6); clear, wavy boundary.

B1t—10 to 16 inches, pale-brown (10YR 6/3) gravelly loam or gravelly light sandy clay loam, dark brown (10YR 3/3) when moist; weak, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very fine and fine roots; few very fine and fine tubular pores; few thin clay films on ped faces and in pores; neutral (pH 6.8); clear, wavy boundary.

B2t—16 to 22 inches, brown (10YR 5/3) gravelly heavy sandy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure; hard, friable, sticky and plastic; few very fine and fine tubular pores; moderately thick, continuous clay films on ped faces and in pores; slightly acid (pH 6.4); clear, wavy boundary.

C—22 to 60 inches, pale-brown (10YR 6/3) gravelly sandy clay loam, dark brown (10YR 4/3) when moist; many fine, and few medium, distinct, yellowish-brown (10YR 5/6) and reddish-brown (5YR 5/4) iron stains resulting from weathering of rock fragments; weak, medium and fine, subangular blocky structure in upper part and massive below; hard, friable, slightly sticky and slightly plastic; very few very fine roots; common very fine tubular pores; few thin clay films on some ped faces in the upper part; neutral (pH 6.6).

The solum ranges from 20 to 28 inches in thickness. The B2t horizon is heavy sandy clay loam, clay loam, or light sandy clay in texture. Its structure ranges from weak to moderate in grade, from medium to coarse in class, and from prismatic to subangular blocky in type, depending on the gravel content. The content of gravel ranges from 25 to 35 percent in the surface layer and from 20 to 30 percent in the subsoil; it is as much as 40 percent in the substratum. The pebbles range from subrounded to angular in shape. There are scattered stones in the A horizon and some cobblestones and stones in the B and C horizons.

Included in mapping were the steeper terrace breaks and stony areas that make up about 10 percent of this mapping unit.

Permeability is moderately slow, and the available water capacity is moderate. Surface runoff is slow to medium, and the erosion hazard is slight to moderate. Natural fertility is high.

The available forage is grazed by livestock in spring, summer, and fall and by wildlife throughout the year. Heavy grazing by deer can be expected in winter. (Capability unit VIc–K, nonirrigated)

Springmeyer loam, 2 to 4 percent slopes (SmB).—This soil is on short, convex, gently sloping alluvial fans that originate from local drainageways on the higher terraces. Its profile is similar to that of Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes, except that the uppermost 12 to 18 inches is loam. The subsoil is gravelly sandy clay loam. The content of gravel is less than 10 percent in the surface layer; it ranges from 15 to 25 percent in the subsoil and from 15 to 25 percent in the substratum.

Surface runoff is slow, and the erosion hazard is slight.

Most of this soil is irrigated from higher lying ditches. It is used for meadows or for alfalfa-grass or grass-legume pasture grown in rotation with small grain. Areas that are not irrigated are in range that provides limited grazing for livestock and wildlife. These areas could be cultivated and used for crops if irrigation water were available. (Capability unit IIe–1, irrigated)

Springmeyer stony fine sandy loam, 16 to 45 percent slopes (SnF).—This soil is on strongly sloping to steep terraces and terrace breaks. Its profile is similar to that of Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes, except that the content of stones in the surface layer is only about 10 percent. The content of stones in the profile is as much as 20 percent.

Surface runoff is medium to rapid, and the erosion hazard is moderate to high.

The use of available forage on this soil is similar to that on Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes. Some areas in the northern part of the valley adjacent to Jacks Valley have been burned over and produce cheatgrass and small rabbitbrush. (Capability unit VIIe–1, nonirrigated)

Springmeyer stony fine sandy loam, moderately deep, 4 to 16 percent slopes (SoD).—This soil has a profile similar to that of Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes, except that the surface layer is stony, the subsoil grades directly to tuff bedrock, and there is no substratum. The content of stones in the surface layer is only about 10 percent. The depth to unconformable tuff bedrock ranges from 24 to 36 inches. The lack of a substratum is not ordinarily a characteristic of Springmeyer soils.

This soil is used in much the same way as Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes. (Capability unit VIc-K, nonirrigated)

Springmeyer very stony fine sandy loam, 30 to 45 percent slopes (SpF).—This soil is on the steep side slopes of the high terrace in the northern part of the survey area, adjacent to Jacks Valley. Its profile is similar to that of Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes, except that the content of stones in the surface layer is about 20 percent. The content of stones throughout the profile is as much as 15 percent.

Bitterbrush makes up 20 percent of the vegetation, as a result of the somewhat higher rainfall. This soil is used in much the same way as Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes. (Capability unit VIIs–7, nonirrigated)

Stodick Series

The Stodick series consists of shallow, moderately sloping to strongly sloping, well-drained, very stony, moderately fine textured soils that formed in alluvium derived from mixed rocks, mainly andesite, basalt, rhyolite, granite, and sandstone. The alluvium is underlain by consolidated conglomerate. These soils are on foothills in the northeastern part of the survey area. The vegetation consists of sparse stands of black sagebrush, little rabbitbrush, scattered juniper, horsebrush, piny hopsage, and Mormon-tea, and an understory of needlegrass, cheatgrass, squirreltail, and bluegrass. The plants cover only 5 to 10 percent of the surface. Elevations range from 4,800 to 5,300 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Stodick soils are associated with McFaul, Toll, and Haybourne soils.

Soils of the Stodick series are in range used mainly for limited grazing by livestock. Wildlife also use these areas in winter and spring.

Stodick very stony fine sandy loam, 4 to 16 percent slopes (Std).—This soil is along the northeastern edge of the survey area, on foothills that resulted from the folding of underlying sedimentary rocks. The surface layer typically is pale-brown very stony fine sandy loam about 3 inches thick. The subsoil consists of 2 inches of very pale brown clay loam over 5 inches of yellowish-brown gravelly clay loam. Below this is 8 inches of pale-olive very gravelly loam. Gray, slightly weathered conglomerate underlies the subsoil. This soil is noncalcareous and is neutral in reaction.

Representative profile of Stodick very stony fine sandy loam, 4 to 16 percent slopes, about 2,400 feet east of the north quarter corner of sec. 35, T. 14 N., R. 20 E.

A1—0 to 3 inches, pale-brown (10YR 6/3) very stony fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard, friable, nonsticky and nonplastic; many very fine and few fine roots; many fine and very fine vesicular pores; neutral (pH 6.8); abrupt, wavy boundary.

B1t—3 to 5 inches, very pale brown (10YR 7/3) clay loam, dark brown (10YR 4/3) when moist; weak, fine and very fine, granular structure; soft, very friable, sticky and plastic; many very fine and fine roots; many very fine and fine interstitial pores; thin clay coatings on sand grains and clay bridges between sand grains; few bleached sand grains at the top of this horizon; neutral (pH 6.7); abrupt, wavy boundary.

B2t—5 to 10 inches, yellowish-brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 4/4) when moist; moderate, fine, angular and subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine and few medium and coarse roots in the upper part; very few very fine tubular pores and interstitial pores; few, moderately thick, continuous, dark-brown (7.5YR 3/4) clay films on ped faces and in pores; neutral (pH 6.8); gradual, wavy boundary.

IIB3t—10 to 18 inches, pale-olive (5Y 6/3) very gravelly loam, olive (5Y 5/3) when moist; massive; hard, firm and friable, sticky and plastic; many fine and very fine roots and few medium roots; few fine tubular pores; common, thin, dark-brown (7.5YR 3/4) clay films in pores and as bridges between sand grains; approximately 40 percent gravel and 10 percent cobblestones; neutral (pH 6.6); clear, wavy boundary.

IIR—18 inches, gray (5Y 6/1), slightly weathered conglomerate, olive (5Y 4/3) when moist; breaks to thick plates; common thick clay films along cleavage planes. This bedrock consists of weakly consolidated tuff and conglomerate with visible crystals of mica and hornblende and quartz sand grains.

The thickness of the solum and the depth to underlying bedrock range from 10 to 20 inches. The B2t horizon has subangular blocky structure that ranges from weak to strong in grade and from fine to medium in class, depending upon the content of gravel. The IIB3t horizon has yellowish colors that have been inherited from the underlying bedrock. The content of gravel, cobblestones, and stones throughout the profile is variable; it may range from 25 to 60 percent in any given stratum. A very stony, cobbly, and gravelly pavement covers 50 to 60 percent of the surface, and scattered pebbles have a faint coating of desert varnish.

Permeability is moderately slow, and the available water capacity is very low. Surface runoff is slow to medium, and the erosion hazard is slight to moderate. Natural fertility is low.

The available forage is used by livestock in winter and spring. A few deer graze in winter. (Capability unit VIIs-8, nonirrigated)

Toiyabe Series

The Toiyabe series consists of shallow to very shallow, steep to very steep, excessively drained, stony, sandy soils that formed in residuum weathered from granite. These soils are on mountain slopes along the western margin of the survey area, mainly in the mountains south of Genoa. The vegetation consists of a sparse to moderate cover of Jeffrey pine, mountain-mahogany, big sagebrush, bitterbrush, snowberry, and grasses. These plants are scattered, and they cover between 20 and 50 percent of the surface. In many areas fire has destroyed all the Jeffrey pine. Elevations range from 5,000 to 7,000 feet. The annual precipitation ranges from 16 to 24 inches, and the frost-free season from 75 to 85 days. The average annual temperature is between 42° and 45° F.

Toiyabe soils are associated with Mottsville and Franktown soils.

Soils of the Toiyabe series are used mostly for grazing by wildlife, for recreation, and for water supply.

Toiyabe very rocky loamy coarse sand, 30 to 60 percent slopes (ToF).—The surface of this soil is covered by a 2-inch layer of dark grayish-brown pine needles over decomposing needles. The surface layer typically is dark-gray stony loamy coarse sand about 7 inches thick. The substratum is light brownish-gray stony loamy coarse sand to a depth of about 15 inches. The underlying rock consists of decomposing gray and white granite that has many crystals of biotite mica and other ferromagnesian minerals. This soil is micaceous, noncalcareous, and medium acid.

Representative profile of a Toiyabe stony loamy coarse sand, about 800 feet south and 400 feet east of the north quarter corner of sec. 27, T. 13 N., R. 19 E.

O1—2 inches to 0, dark grayish-brown (10YR 4/2) pine needles over decomposing needles, very dark brown (10YR 2/2) when moist; medium acid (pH 5.6); abrupt, smooth boundary.

A1—0 to 7 inches, dark-gray (10YR 4/1) stony loamy coarse sand, black (10YR 2/1) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; medium acid (pH 5.8); clear, smooth boundary.

C1—7 to 15 inches, light brownish-gray (2.5Y 6/2) stony loamy coarse sand, dark grayish brown (2.5Y 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and few fine, medium, and coarse roots; many very fine and fine interstitial pores; medium acid (pH 6.0); abrupt, irregular boundary.

R—15 inches, decomposing gray and white granite that has many dark-brown (10YR 3/3) crystals of biotite mica and other ferromagnesian minerals; slightly weathered and can be cut with a spade to a depth of 20 or 25 inches; must be broken with a hammer within a depth of 12 additional inches.

The depth to weathered bedrock ranges from 4 to 20 inches, but it is commonly about 16 inches. Because of differences in weathering, the depth to hard bedrock ranges from 4 to 60 inches, but it is commonly about 30 inches. The content and the size of gravel, cobblestones, and stones are variable. Most of the pebbles are ⅛ to ¾ inch in diameter, and the cobblestones and stones as much as 48 inches in diameter. The cobblestones and stones are generally rounded or subangular as a result of weathering and exfoliation. On south-facing slopes the soil is generally slightly lighter colored than that shown in the profile described as representative, and has color values of 5 when dry and 3 when moist. In places the C horizon has strong-brown or yellowish-brown colors where iron oxide has stained the sand grains. There is an O1 horizon in most areas under trees, but not in areas under brush.

Included in mapping were outcrops of granitic rocks, which make up 20 percent of the acreage, and areas of Mottsville very stony loamy coarse sand and Mottsville loamy coarse sand, which together make up 10 percent of the acreage. The rock outcrops are scattered through the acreage. They vary greatly in size; some are as much as 200 feet across.

Permeability is rapid, and the available water capacity is very low. Surface runoff is rapid to very rapid, and the erosion hazard is high to very high. Natural fertility is very low.

This soil is used mainly for grazing by wildlife, for water supply, and for recreation. Generally, it is too steep and the footing too soft for grazing livestock. A limited amount of commercial timber has been cut, but the steepness and the relative sparseness of the timber stands limit the harvest. (Capability unit VIIs-l, nonirrigated)

Toll Series

The Toll series consists of very deep, nearly level to strongly sloping, somewhat excessively drained, sandy soils that formed in alluvium derived mainly from granite but partly from sandstone, conglomerate, rhyolite, andesite, basalt, and schist. These soils are on smooth to gently convex alluvial fans in the northeastern part of the survey area, near Hot Springs Mountain. The vegetation consists of big sagebrush, desert peach, rabbitbrush, horsebrush, and an understory of cheatgrass, Indian ricegrass, needlegrass, and squirreltail. The vegetation covers only 10 to 15 percent of the surface. Elevations range from 4,600 to 5,000 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season is about 100 days. The average annual temperature is between 49° and 51° F.

Toll soils are associated with Haybourne, McFaul, and Godecke soils. Most areas are in range that provides limited grazing for livestock in winter and spring. Some areas are homesteaded.

Toll sand, 0 to 4 percent slopes (TlB).—This soil is in the northeastern part of the survey area, immediately south and east of Hot Springs Mountain. The surface layer typically is 12 inches thick. It consists of light brownish-gray sand over brown loamy sand. The substratum consists of pale-brown loamy sand over pale-brown coarse sand. This soil is noncalcareous and slightly acid to neutral.

Representative profile to Toll sand, 0 to 4 percent slopes, about 270 feet south and 50 feet west of the north quarter corner of sec. 28, T. 14 N., R. 20 E.

A11—0 to 4 inches, light brownish-gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist; few very fine and fine roots; many very fine and fine interstitial pores; slightly acid (pH 6.2); clear, smooth boundary.

A12—4 to 12 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; neutral (pH 6.7); clear, smooth boundary.

C1—12 to 20 inches, pale-brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) when moist; massive; slightly hard and hard, very friable, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.6); clear, smooth boundary.

C2—20 to 54 inches, pale-brown (10YR 6/3) loamy sand, dark grayish-brown (10YR 4/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; common very fine and fine interstitial pores; neutral (pH 6.7); clear, smooth boundary.

C3—54 to 60 inches, pale-brown (10YR 6/3) coarse sand; dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist; few very fine roots; many fine interstitial pores; neutral (pH 6.7).

The surface generally has a thin layer of windblown very coarse sand ⅛ to ½ inch thick. The content of mica in the horizons varies but is generally not more than 5 percent. The depth to strata of sand or coarse sand ranges from 36 to 58 inches.

Permeability is rapid, and the available water capacity is low. Surface runoff is very slow. Erosion is a slight to moderate hazard. Wind erosion is particularly a hazard in areas where the brush cover has been removed. Natural fertility is low.

The available forage provides grazing for livestock in winter and spring. Recently a large acreage was homesteaded and used for homesites. This soil can be used for suitable cultivated crops if irrigation water becomes available. Tree windbreaks would be needed to control wind erosion and to reduce the sandblasting of seedlings during the period of establishment. (Capability unit IVs-4L, irrigated)

Toll sand, 4 to 16 percent slopes (TlD).—This soil is on the higher alluvial fans. Surface runoff is slow to medium, and the hazard of both water and wind erosion is slight to moderate.

This soil is used in much the same way as Toll sand, 0 to 4 percent slopes. If water were available for irrigation, sprinklers would be needed to control erosion. (Capability unit VIIs-L, nonirrigated)

Toll sand, clay substratum, water table, 0 to 2 percent slopes (TmA).—This soil is on toe slopes of an alluvial fan that has been faulted. Its profile is similar to that of Toll sand, 0 to 4 percent slopes, except that the substratum is slowly permeable heavy clay loam or clay. The movement of ground water downslope has been impeded, and the water table has risen to within 6 to 8 feet of the surface. Drainage is somewhat poor. The lower part of the subsoil and the substratum have yellowish-red and reddish-brown mottles caused by iron content and black mottles caused by manganese content. The depth to the clay substratum ranges from about 43 to 54 inches.

The vegetation consists of rubber rabbitbrush and a luxuriant growth of big sagebrush. This soil is used in much the same way as Toll sand, 0 to 4 percent slopes, but it has not been used for homesteading. All crops that are suited to the climate can be grown if irrigation water becomes available. Drainage is not needed if the soil is carefully irrigated. (Capability unit IVw–L, irrigated)

Toll sandy loam, 0 to 4 percent slopes (ToB).—This soil is on very slightly concave, nearly level alluvial fans. Its profile is similar to that of Toll sand, 0 to 4 percent slopes, except that the uppermost 4 to 7 inches is sandy loam. This texture results from the deposition of material that has been eroded from higher lying soils. Erosion is either not a hazard or only a slight hazard.

Included in mapping is an area south of Stewart and west of the Nevada penal farm that has a high water table as a result of constant irrigation with water from Clear Creek. Irrigation ceases when the creek dries up. As a result of the high water table, there are common to many reddish and yellowish mottles below a depth of 10 inches.

The vegetation consists of meadow sedge and juncus. This soil is used in much the same way as Toll sand, 0 to 4 percent slopes. It is more desirable for cultivated crops than that soil because firmer seedbeds can be prepared and the risk of sandblasting the seedlings is much less. The quality of forage grown can be improved greatly by irrigating periodically rather than continuously. (Capability unit IVs-4L, irrigated)

Turria Series

The Turria series consists of very deep, nearly level, well-drained, moderately fine textured soils that formed in loamy alluvium derived from a mixture of rocks that includes granite, basalt, rhyolite, volcanic ash, and some gneiss, slate, and sedimentary rocks. These soils are on broad, smooth or very gently convex alluvial fans in the east-central part of the survey area, adjacent to Buckeye Creek. The vegetation consists of spiny hopsage, big sagebrush, bud sagebrush, saltbrush, horsebrush, and an understory of cheatgrass and squirreltail. It covers only 10 to 20 percent of the surface. Elevations range from 4,700 to 4,900 feet. The annual precipitation ranges from 8 to 10 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Turria soils are associated with Gardnerville, McFaul, and Reno soils. Most of the acreage is irrigated and used for cultivated crops, principally alfalfa and small grain. The rest of the acreage is range that provides limited grazing for livestock.

Turria loam (Tu).—This soil is in the east-central part of the survey area, near Buckeye Creek. The surface layer typically is light brownish-gray loam about 2 inches thick. The subsoil consists of brown clay loam over brown loam to a depth of about 12 inches. The substratum is pale brown. It consists of loam over very fine sandy loam, and below this silt loam. The surface layer and subsoil are noncalcareous, and the substratum is calcareous.

Representative profile of Turria loam, about 1,300 feet south and 750 feet west of the north quarter corner of sec. 10, T. 13 N., R. 20 E.

A1—0 to 2 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and thin, platy structure; slightly hard, friable, nonsticky and nonplastic; few fine and common very fine roots; many very fine and few fine vesicular pores; neutral (pH 7.0); abrupt, smooth boundary.

B21t—2 to 5 inches, brown (10YR 5/3) clay loam; dark brown (10YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, thin, platy; hard, friable, sticky and plastic; few fine and common very fine roots; few fine and very fine tubular pores and many very fine interstitial pores; neutral (pH 6.7); abrupt, wavy boundary.

B22t—5 to 9 inches, brown (10YR 5/3) clay loam; dark brown (10YR 3/3) when moist; weak, medium, prismatic structure breaking to strong, medium, subangular blocky; hard, friable, sticky and plastic; few fine and many very fine roots; few fine and common very fine tubular pores and few very fine interstitial pores; many thin clay films on ped surfaces and thin continuous clay films in pores; neutral (pH 6.7); abrupt, wavy boundary.

B3t—9 to 12 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure breaking to moderate, medium and coarse, subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine and many very fine roots; common fine and many very fine tubular pores; common thin clay films on ped faces and thin continuous clay films in pores; neutral (pH 7.0); clear, smooth boundary.

C1—12 to 20 inches, pale-brown (10YR 6/3) light loam; brown (10YR 4/3) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine and many very fine roots; few fine and common very fine tubular pores; mildly alkaline (pH 7.4); clear, smooth boundary.

C2—20 to 32 inches, pale-brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine and common very fine roots; common fine and very fine tubular pores; mildly alkaline (pH 7.8); clear, smooth boundary.

C3—32 to 39 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine and common very fine roots; common fine and very fine tubular pores; matrix is noncalcareous but strongly calcareous where there are common, fine, distinct, white (10YR 8/2) lime segregations; mildly alkaline (pH 7.8); clear, wavy boundary.

C4—39 to 44 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine and common very fine tubular pores; effervescent; few, fine, distinct, white (10YR 8/2) lime segregations; moderately alkaline (pH 7.9); clear, smooth boundary.

C5—44 to 55 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; massive; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores; effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C6—55 to 62 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and few fine tubular pores; effervescent; few, fine, distinct, white (10YR 8/2) lime segregations; mildly alkaline (pH 7.8).

The solum ranges from 12 to about 20 inches in thickness. The primary structure is prismatic and ranges from weak to moderate and from medium to coarse. The compound structure is strong subangular blocky and ranges from medium to fine. If moist, the B2t horizon ranges from friable to firm in consistence. Lime may occur in the lower part of the C horizon as few to common fine segregations, or it may be disseminated. Stratification of moderately coarse textured material, generally less than 6 inches thick, may occur in the substratum.

Permeability is moderately slow, and the available water capacity is high. Surface runoff is very slow to slow, and erosion is either not a hazard or only a slight hazard. Natural fertility is high.

The available forage provides grazing for livestock. A large acreage has been leveled and irrigated and is used for alfalfa grown in rotation with small grain. An additional acreage could be cultivated, if water were available for irrigation. (Capability unit IIc–K, irrigated)

Turria clay loam (Tr).—This soil is similar to Turria loam, except that the surface layer has been mixed with part of the subsoil by leveling or plowing. Consequently, the solum is only 10 to 15 inches thick and the intake of water is somewhat slower.

All of this soil is cultivated and used for alfalfa grown in rotation with small grain. (Capability unit IIc-K, irrigated)

Turria clay loam, water table (Tt).—This soil is similar to Turria loam, except that the water table fluctuates between depths of 4 and 6 feet during most of the irrigation season. The water table is a result of excess irrigation on higher lying soils and of canal seepage. Drainage is somewhat poor.

This soil is used in much the same way as Turria loam. Careful use of irrigation water keeps the level of the water table nearly constant. In areas where there is a fluctuating water table, the soil is less well suited to crops. Drainage should not be attempted, except for shallow ditches that remove excess irrigation water at the bottom of fields. (Capability unit IIw-2, irrigated)

Turria loam, water table (Tw).—This soil is similar to Turria loam, except that the water table is at a depth of 4 to 6 feet during most of the irrigation season. The water table is a result of excess irrigation on higher lying soils and of normal canal seepage. Drainage is somewhat poor.

This soil is used in much the same way as Turria loam. Careful use of irrigation water keeps the level of the water table nearly constant. In areas where there is a fluctuating water table, the soil is less well suited to crops. Drainage should not be attempted, except for shallow ditches that remove excess irrigation water from the bottom of fields. (Capability unit IIw–2, irrigated)

Voltaire Series

The Voltaire series consists of very deep, nearly level, poorly drained to very poorly drained, fine-textured soils that formed in clay alluvium derived mainly from granite but also from rhyolite, andesite, basalt, gneiss, and slate. These soils are on smooth to very gently concave flood plains or in basins, in the north-central part of the survey area, near the Carson River. They are flooded occasionally when the Carson River floods. The vegetation consists of saltgrass, povertyweeds, sour dock, foxtail, sedges, bluegrass, strawberry clover and fescue, and the plants cover 20 to 40 percent of the surface. In some of the better drained areas, rabbitbrush and greasewood and an understory of saltgrass, sedges, and juncus are growing. Elevations range from 4,600 to 4,700 feet. The annual precipitation ranges from 10 to 12 inches, and frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Voltaire soils are associated with James Canyon, Heidtman, and Fettic soils.

Soils of the Voltaire series are in meadow that provides grazing for livestock. A small acreage is irrigated and is used principally for alfalfa-grass mixtures and small grain.

Voltaire clay, slightly saline-alkali (Va).—This soil is in the north-central part of the survey area, adjacent to the Carson River. It is flooded occasionally by the Carson River. The surface layer typically consists of dark-gray silty clay over gray, mottled clay and is about 9 inches thick. Beneath this is a transitional layer of gray, mottled clay to a depth of about 20 inches. The substratum consists of olive-gray, mottled loam over olive-gray, mottled silty clay, and below this gray silty clay loam. At a depth of about 45 inches is gray, mottled loam over olive-gray, mottled very fine sandy loam. The mottles, which are caused by iron content, are reddish brown, dark grayish brown, yellowish brown, or greenish gray. The surface layer and all but the lowermost 10 inches of the substratum are calcareous.

Representative profile of Voltaire clay, slightly saline-alkali, about 500 feet west and 250 feet south of the east quarter corner of sec. 14, T. 13 N., R. 19 E.

A11—0 to 3 inches, dark-gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky and angular blocky structure; very hard, firm, very sticky and very plastic; many very fine and few fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

A12—3 to 9 inches, gray (10YR 5/1) clay, very dark brown (10YR 2/2) when moist; few, fine, prominent mottles of reddish brown (5YR 4/4) caused by iron content; weak, coarse, prismatic structure; very hard, firm, very sticky and very plastic; common very fine and few fine roots; common very fine and few fine tubular pores; strongly effervescent; very strongly alkaline (pH 9.2); abrupt, wavy boundary.

AC—9 to 20 inches, gray (10YR 5/1) clay, very dark gray (10YR 3/1) when moist; common, medium, faint mottles of dark grayish brown (2.5Y 4/2) caused by iron content; weak, medium, prismatic structure; very hard, friable, sticky and plastic; common very fine and few fine roots; many very fine and fine tubular pores; effervescent; strongly alkaline (pH 8.8); clear, wavy boundary.

C1g—20 to 29 inches, olive-gray (5Y 5/2) heavy loam, olive gray (5Y 4/2) when moist; common, fine and medium, prominent mottles of yellowish brown (10YR 5/4) and few, fine, prominent mottles of reddish brown (5YR 4/4); all mottles caused by iron content; many worm casts; weak, medium, prismatic structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; effervescent; strongly alkaline (pH 8.8); clear, wavy boundary.

C2g—29 to 38 inches, olive-gray (5Y 5/2) silty clay, olive gray (5Y 4/2) when moist; common, fine and medium, prominent mottles of yellowish brown (10YR 5/4) and few, fine, prominent mottles of reddish brown (5YR 4/4); all mottles caused by iron content; few worm casts; massive; hard, friable, very sticky and very plastic; common very fine and fine roots; many very fine tubular pores; effervescent; strongly alkaline (pH 8.6); clear, wavy boundary.

C3g—38 to 45 inches, gray (5Y 5/1) silty clay loam, dark olive gray (5Y 3/2) when moist; massive; hard, friable, sticky and plastic; many very fine and few fine roots; many very fine and fine tubular pores; effervescent; few fine lime nodules up to one-eighth inch in diameter; moderately alkaline (pH 8.4); gradual, wavy boundary.

C4g—45 to 50 inches, gray (5Y 5/1) loam, dark olive gray (5Y 3/2) when moist; common, fine, prominent mottles of reddish brown (5YR 4/4) caused by iron content; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; effervescent; few fine lime nodules about one-eighth inch in diameter; moderately alkaline (pH 8.4); gradual, wavy boundary.

IIC5g—50 to 60 inches, olive-gray (5Y 5/2) very fine sandy loam; olive gray (5Y 4/2) when moist; many, fine, faint mottles of dark greenish gray (5GY 4/1) and common, fine, prominent mottles of reddish brown (5YR 4/4); all mottles caused by iron content; massive; hard, friable, nonsticky and nonplastic; no roots; many very fine interstitial pores; noneffervescent; mildly alkaline (pH 7.6).

The A1 horizon ranges from 10 to 20 inches in thickness. The content of lime in the A horizon and in the C horizon varies considerably, and these horizons range from violently effervescent to effervescent. The IIC horizon is generally noneffervescent, but in places the upper part is effervescent. In some places the A and C horizons contain small, extremely hard nodules of lime up to a half inch in diameter. The mottles vary greatly from place to place both in kind and amount. The surface layer and the upper part of the substratum have mottles in various shades of red. The lower part of the substratum has mottles of gray to green. The depth to the IIC horizon ranges from 30 to 50 inches. Generally, the IIC horizon is coarser textured than the other horizons, and in some places, it is sandy loam. In some places strata of very gravelly coarse sand occur at a depth of more than 54 inches.

Natural drainage is poor. A water table fluctuates between depths of 20 and 36 inches during most of the irrigation season. Permeability is slow, and the available water capacity is high. Surface runoff is very slow, and erosion is not a hazard. Natural fertility is high.

Because of the content of salts and alkali, saltgrass and other salt-tolerant plants make up at least 25 percent of the meadow, and in some areas, greasewood and rabbitbrush are invading. This soil is mostly in meadow that provides grazing for livestock. Most of the meadows are irrigated by flooding, and a few are subirrigated. Some areas have been leveled and are used for alfalfa grown in rotation with small grain. (Capability unit IVw-36P, irrigated)

Voltaire silty clay (Vc).—This soil has a profile similar to that of Voltaire clay, slightly saline-alkali, except that the surface layer is silty clay. The surface layer is free of salts and alkali, but the subsoil is slightly affected by them.

This soil is used in much the same way as Voltaire clay, slightly saline-alkali. It is used mainly for alfalfa grown in rotation with small grain or grass-legume pasture. The meadow lacks saltgrass and other salt- and alkali-tolerant plants (Capability unit IVw–36P, irrigated)

Voltaire silty clay, water table, slightly saline-alkali (Ve).—This soil is in or is adjacent to areas of potholes and sloughs where water ponds during most of the irrigation season. It is similar to Voltaire clay, slightly saline-alkali, except that it has a water table that fluctuates between depths of 10 and 20 inches. Drainage is very poor. Included in mapping were small areas of soils that have a surface layer that is affected by alkali but not by salts, and small areas of strongly saline soils.

This soil is in meadow that provides grazing for livestock throughout the growing season. (Capability unit Vw–3, irrigated)

Voltaire silty clay, water table, strongly saline-alkali (Vr).—This soil is in low, slightly concave positions adjacent to sloughs that have no outlet. It is similar to Voltaire clay, slightly saline-alkali, except that the surface layer is strongly affected by salts and alkali and the water table fluctuates between depths of 10 and 20 inches during most of the irrigation season. Drainage is very poor. The salts have accumulated as they precipitated from the ground water that rose to the surface and evaporated.

The vegetation consists of a saltgrass meadow and scattered greasewood and rabbitbrush plants. This soil is used for grazing livestock throughout the growing season. (Capability unit VIw–6, irrigated)

Voltaire silty clay loam, strongly saline-alkali (Vs).—This soil is in slightly concave depressions adjacent to potholes and sloughs that have no outlet. Its profile is similar to that of Voltaire clay, slightly saline-alkali, except that the uppermost 6 to 10 inches is silty clay loam. The surface layer is strongly affected by salts and alkali. The salts have accumulated as they precipitated from the ground water that rose to the surface and evaporated.

Included in mapping was a small area of soil that receives deposition as a result of flooding and that, consequently, has a surface layer of sandy loam about 9 inches thick.

This soil supports a saltgrass meadow and some greasewood and rabbitbrush that provide grazing for livestock throughout most of the grazing season. (Capability unit VIw–6, irrigated)

Voltaire Series, Seeped Variant

The Voltaire series, seeped variant, consists of very deep, very poorly drained soils that are strongly affected by salts and alkali. These soils formed in alluvium derived from a mixture of rocks. They are in concave or slightly concave interalluvial fan areas in the east-central part of the survey area, north of Buckeye Creek. The meadow vegetation consists mainly of sedges, juncus, saltgrass, sweetclover, Bassia, alkali bluegrass, and in the wettest areas, cattails. The plants cover 25 to 40 percent of the surface, depending on the content of salts and alkali. Elevations range from 4,600 to 4,700 feet. The annual precipitation ranges from 10 to 12 inches, and the frost-free season from 95 to 110 days. The average annual temperature is between 49° and 51° F.

Voltaire soils, seeped variant, are associated with Turria and Gardnerville soils.

Soils of the Voltaire series, seeped variant, are in meadow that provides grazing for livestock during most of the grazing season. They also provide a habitat for wildlife.

Voltaire clay loam, seeped variant (Vt).—This soil is immediately north of Buckeye Creek and west of Dangberg No. 4 Reservoir. The surface layer typically is light brownish-gray, mottled silty clay loam over silt loam that is grayish brown and mottled in the upper part and very pale brown in the lower part. The mottles, which are caused by iron content, are reddish yellow or yellowish red. This soil is calcareous and is very strongly alkaline to strongly alkaline.

Representative profile of Voltaire clay loam, seeped variant, about 1,200 feet west and 500 feet north of the southeast corner of sec. 15, T. 13 N., R. 20 E.

A1—0 to 6 inches, light-gray (10YR 6/1) clay loam, very dark grayish brown (10YR 3/2) when moist; many, medium, distinct mottles of reddish yellow (7.5YR 6/6) caused by iron content; massive; very hard, firm, sticky and plastic; many very fine and fine and few medium roots; many very fine and fine tubular pores; violently effervescent; common, medium, faint, light-gray (10YR 7/2) lime segregations; very strongly alkaline (pH 9.6); abrupt, smooth boundary.

C1—6 to 25 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; many, fine and medium, prominent mottles of reddish yellow (7.5YR 6/6) and yellowish red (5YR 6/6) caused by iron content; few, fine, distinct, very dark grayish-brown (10YR 3/2) organic stains; massive; very hard, firm, very sticky and very plastic; many very fine, common fine, and few medium roots; many very fine and fine tubular pores; strongly effervescent; very strongly alkaline (pH 9.0); abrupt, smooth boundary.

IIC2—25 to 33 inches, light-gray (2.5Y 6/1) silt loam, grayish-brown (2.5Y 5/2) when moist; few, medium and coarse, distinct mottles of reddish yellow (7.5YR 6/6) caused by iron content; massive; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine and fine tubular pores; effervescent; strongly alkaline (pH 8.6); clear, smooth boundary.

IIC3—33 to 60 inches, very pale-brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and few fine tubular pores; effervescent; moderately alkaline (pH 8.3).

Depth to the water table ranges from 1 foot to 2 feet. The water table is high because of the seepage from higher lying canals and from Dangberg No. 4 Reservoir. The water table did not reach its high level until the reservoir was constructed in 1905. The mottles, which are caused by iron content, range from common to many and from fine to medium. The mottles in the A and C horizons have dominantly reddish colors, and those in the IIC horizon yellowish colors. The reaction decreases with increasing depth; the A horizon is very strongly alkaline, and the IIC horizon is moderately alkaline to strongly alkaline.

Drainage is poor, and in some included areas, it is very poor. Permeability is slow in the subsoil. The available water capacity is high. Surface runoff is very slow, and erosion is not a hazard. Natural fertility is high.

This soil is in meadow that provides grazing for livestock throughout the growing season. It is also used for food and for nesting cover by upland game birds. In some areas the vegetation is dense and rank enough to afford excellent cover for both pheasant and quail. (Capability unit VIw–6, irrigated)

Washoe Series

The Washoe series consists of very deep, nearly level to very gently sloping, well-drained, moderately fine textured soils that formed in gravelly and cobbly, sandy alluvium derived predominantly from granite. These soils are on a smooth to very gently convex, prominent terrace, called Dressler Bench, in the south-central part of the survey area, between the East Fork and the West Fork of the Carson River. The vegetation consists of big sagebrush, Mormon-tea, rabbitbrush, and desert peach and an understory of cheatgrass and squirreltail. About 85 to 90 percent of the surface is barren. Elevations range from 4,700 to 4,800 feet. The annual precipitation ranges from 10 to 14 inches, and the frost-free season from 90 to 105 days. The average annual temperature is between 48° and 51° F.

Washoe soils are associated with Glenbrook, Dressler, and Henningsen soils.

Soils of the Washoe series are mostly in range that provides limited grazing for livestock in winter and spring. In areas where water is available for irrigation, they are used for cultivated crops, principally alfalfa grown in rotation with small grain. A few small areas are used for clover-grass pasture.

Washoe cobbly sandy loam (Wa).—This soil is on Dressler Bench in the south-central part of the survey area. The dominant slope is 0 to 2 percent. The surface layer typically consists of 2 inches of brown cobbly coarse sand over 3 inches of pale-brown cobbly light sandy loam, and below this, 3 inches of brown gravelly coarse sandy loam. The subsoil is brown and extends to a depth of about 42 inches. It consists of gravelly coarse sandy loam over gravelly clay loam, and below this, gravelly coarse sandy loam. The substratum is light yellowish-brown gravelly loamy coarse sand. This soil is noncalcareous and is slightly acid to neutral.

Representative profile of Washoe cobbly sandy loam, about 300 feet east and 75 feet south of the center of sec. 28, T. 12 N., R. 20 E.

A11—0 to 2 inches, brown (10YR 5/3) cobbly coarse sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry or moist, nonsticky and nonplastic; few fine and common very fine roots; many very fine and fine interstitial pores; slightly acid (pH 6.1); abrupt, smooth boundary.

A12—2 to 5 inches, pale-brown (10YR 6/3) cobbly light sandy loam, very dark grayish brown (10YR 3/3) when moist; weak, medium and fine, granular structure; soft, very friable, nonsticky and nonplastic; common fine and many very fine roots; common fine and very fine vesicular pores; slightly acid (pH 6.4); abrupt, smooth boundary.

A3—5 to 8 inches, brown (10YR 5/3) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, granular structure; soft, friable, nonsticky and nonplastic; common fine and many very fine roots; common fine and very fine interstitial pores and few very fine tubular pores; slightly acid (pH 6.5); abrupt, smooth boundary.

B1t—8 to 11 inches, brown (10YR 5/3) gravelly coarse sandy loam, dark brown (10YR 3/3) when moist; moderate, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and many very fine roots; common very fine and few fine tubular pores; common thin clay films on ped faces and in pores; neutral (pH 6.7); abrupt, wavy boundary.

B2t—11 to 20 inches, brown (7.5YR 4/3) gravelly light clay loam, dark brown (7.5YR 3/3) when moist; massive; very hard, friable, sticky and plastic; very few fine and common very fine roots; few fine and very fine interstitial pores and few fine tubular pores; thin continuous clay bridges between sand grains; thin clay films in pores; pebbles and cobblestones show visible signs of weathering; slightly acid (pH 6.5); clear, wavy boundary.

B31t—20 to 28 inches, brown (7.5YR 4/4) gravelly heavy coarse sandy loam, dark brown (7.5YR 3/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine and very fine interstitial pores; thin continuous clay bridges between sand grains and thin clay films on sand grains; most pebbles and cobblestones show visible signs of weathering; slightly acid (pH 6.5); gradual, wavy boundary.

B32t—28 to 42 inches, brown (7.5YR 4/4) gravelly coarse sandy loam, dark brown (7.5YR 3/2) when moist; massive; hard, friable, slightly sticky and slightly plastic; very few very fine roots; many very fine and fine interstitial pores; common thin clay bridges between sand grains and thin films on sand grains; few pebbles and cobblestones show visible signs of weathering; slightly acid (pH 6.5); gradual, wavy boundary.

C—42 to 60 inches, light yellowish-brown (10YR 6/4) gravelly loamy coarse sand, yellowish brown (10YR 5/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; no roots; many very fine and fine interstitial pores; neutral (pH 6.9).

The solum ranges from 33 to 46 inches in thickness. The content of gravel and cobblestones in the horizons is variable. In the B32t and C horizons, it increases greatly and in places ranges from 45 to 55 percent. The content of cobblestones in the horizons ranges from 25 to 35 percent. There are also a few strongly weathered stones.

Included in mapping were gently sloping to steep terrace breaks and fault scarps and areas of Washoe stony sandy loam.

Permeability is moderately slow, and the available water capacity is moderate. Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard.

If water were available for irrigation, this soil could be cultivated to suitable crops. The cobblestones should be picked mechanically to reduce the risk to farm machinery. (Capability unit VIc–K, nonirrigated)

Washoe gravelly sandy loam (Wg).—This soil occurs along the western side of Dressler Bench in the south-central part of the survey area. It is similar to Washoe cobbly sandy loam, except that the cobblestones have been removed from the surface layer so that the soil can be farmed. The dominant slope is 0 to 2 percent.

Surface runoff is very slow, and erosion is either not a hazard or only a slight hazard.

This soil is used for alfalfa, alfalfa-grass mixtures, and small grain. (Capability unit IIIs–4, irrigated)

Use and Management of the Soils

This section explains the system of capability grouping used by the Soil Conservation Service and discusses the management of the soils in the Carson Valley Area by capability units. Estimated yields of the principal crops are given. Also discussed are the use and management of soils that are affected by salts and alkali and the management of soils for wildlife. Soil properties that affect engineering practices are enumerated, mainly in the form of tables.

Salts and Alkali

Most soils in arid regions contain soluble salts, and in places these salts are highly concentrated. The origin and, to some extent, the direct source of all the salt are the primary minerals found in soils and in exposed rocks. The salts set free by weathering of soil minerals normally remain in soils of arid regions because the combination of low rainfall and high evapotranspiration prevents deep penetration of water and the consequent leaching of the salts.

Although weathering of primary minerals is a direct or indirect source of nearly all soluble salts, there are probably few instances where sufficient salts have accumulated in place from this source alone to form a saline-alkali soil. Saline-alkali soils generally occur in areas receiving salts from other places, and water is the primary carrier. In Carson Valley the direct sources of salts are surface water, ground water, and thermal water.

Surface and ground water contains much dissolved salts. The concentration is dependent upon the salt content of the soil and geologic material with which the water has been in contact. The water adds salts to the soils under natural conditions, as when it floods lowlands or when ground water rises to the surface and evaporates. Surface water also acts as a source of salts when used for irrigation.

The outflow of thermal water from local fumaroles in Carson Valley is high in soluble salts and alkali. The water has a pronounced effect upon surrounding soils. Each area is unique, as the soils are characterized by being very high in the specific salts carried by the water. Soils adjacent to Hobo Hot Spring are high in sulfates. Soils adjacent to Walleys Hot Springs are high in sodium bicarbonate.

Generally, surface and ground water in the southern and western parts of the valley are low in soluble salts, and there are no saline-alkali problems in the irrigated parts of these areas.

Soils in the northern, northeastern, and central parts of the Carson Valley are typical of arid regions. They are saline-alkali because both soluble salts and alkali salts are being deposited almost simultaneously. The term "saline-alkali soils" is defined on the basis of determinations made on soil samples. As long as their salt content is excessive, the appearance and properties of saline-alkali soils are generally similar to those of saline soils. The pH values are generally less than 8.5, and the soil particles remain flocculated. If the excess soluble salts are leached out, however, the properties of these soils change markedly. As the concentration of salts in the soil solution is lowered, some of the exchangeable sodium hydrolyzes and forms sodium hydroxide. Sodium carbonate forms when carbon dioxide is absorbed from the atmosphere. After it has been leached, a saline-alkali soil may become strongly alkaline (pH values about 8.5), the individual soil particles may disperse, and the soil may be unsuitable for tillage.

Saline or saline-alkali phases of several of the soils have been mapped. In the Carson Valley Area, four saline and alkali classes are defined. These classes are based primarily on the amount of salts or alkali in the surface layer of the soil. The amount of salts and alkali was determined by examining the vegetation and the characteristics of the surface layer and subsoil and by laboratory analysis of soil samples collected in the field. The four classes are—

1. *Soils free of excess salts and alkali* contain less than 0.15 percent of salts, or the conductivity of the saturation extract is less than 4 millimhos at 25° C. The sodium adsorption ratio is less than 12.
2. *Slightly saline-alkali soils* contain 0.15 to 0.35 percent of salts, or the conductivity of the saturation extract is 4 to 8 millimhos at 25° C. The sodium adsorption ratio is 12 to 40 for coarse textured and moderately coarse textured soils and 12 to 25 for medium-textured to fine-textured soils.
3. *Slightly saline, strongly alkali soils* contain 0.15 to 0.35 percent of salts, or the conductivity of the saturation extract is 4 to 8 millimhos at 25° C. The sodium adsorption ratio is more than 40 for coarse textured and moderately coarse textured soils and more than 25 for medium-textured to fine-textured soils.
4. *Strongly saline-alkali soils* contain more than 0.65 percent of salts, or the conductivity of the saturation extract is more than 15 millimhos at 25° C. The sodium adsorption ratio is more than 40 for coarse textured and moderately coarse textured soils and more than 25 for medium-textured to fine-textured soils.

Although a distinct gap between slightly saline and strongly saline is recognized, no moderately saline soils were mapped in the survey area. This result agrees with results of laboratory experiments and past experience, which indicate that few soil samples fall into the moderately saline class.

Slightly saline, strongly alkali soils were recognized, because they are a direct result of irrigation in areas where excess salts have been leached from the surface layer and sodium-reducing amendments have not been used. The recognition of this kind of soil is important because management of irrigation water, the selection of crops, and productivity are affected. Little or no irrigation water enters and moves downward in the soil, and consequently, there are barren spots or spots where only the most alkali-tolerant plants will grow.

Use and Management of Saline-Alkali Soils

Removal of salts and removal of alkali require individual treatment. Adequate drainage and large quantities of irrigation water are needed for both operations, but a sodium-reducing amendment is needed for removal of alkali.

Saline-alkali soils can be improved by the following practices:

1. Providing adequate drainage.
2. Leveling the soil so that irrigation water can be spread more uniformly.
3. Providing a delivery system for irrigation water.

4. Constructing high border dikes that hold large quantities of water.
5. Applying sodium-reducing amendments according to the results of soil tests, and then disking lightly.
6. Irrigating first and then seeding either a salt-tolerant grass or barley.
7. Continuing to irrigate with large quantities of water at normal frequency throughout the growing season.

If these practices are followed and normal allocations of irrigation water are available, improvement can be expected within a short time. The success of this procedure is demonstrated if results of soil tests at the end of the irrigation season are favorable and at least part of the crop is harvested at the end of the year. Some spots are likely to need further treatment to remove excess alkali during the next year. The application of sodium-reducing amendments to the entire field in amounts sufficient to remove excess alkali from the most severely affected spots would ordinarily result in the use of two to five times as much amendment as is required. When the content of salts and alkali has been reduced to a safe level, the cropping system may be changed to include forage and row crops that are less tolerant of salts and alkali.

The amount of sodium to be replaced must be determined by laboratory analysis of the soils. Among the several sodium-reducing amendments that can be used successfully in Carson Valley are the following:

Amendment:	*Tons equivalent to 1 ton of sulfur*
Sulfur	1.00
Sulfuric acid	3.06
Gypsum ($CaSO_4 \cdot 2H_2O$)	5.38
Iron sulfate ($FeSO_4 \cdot 7H_2O$)	8.69
Aluminum sulfate ($Al_2SO_4 \cdot 318H_2O$)	6.94

The choice of amendment depends on availability and cost. In Carson Valley, cost narrows the choice to gypsum, even though sulfur, iron sulfate, or aluminum sulfate may give more rapid results.

In Carson Valley it is advisable to leach out only part of the soluble salts before applying sodium-reducing amendments. Leaching out most of the soluble salts would be advantageous, but the advantage gained is likely to be more than offset by the decrease in permeability that ordinarily accompanies the leaching of saline-alkali soils. Once permeability has been decreased, some time will be needed before soil structure can be restored and permeability increased.

Sodium-reducing amendments are ordinarily broadcast and then should be incorporated into the soils with a light disking. They can be added to irrigation water, but this is not a good method. Gypsum does not dissolve readily, and consequently, cannot be applied efficiently in water; the amount that dissolves is generally much less than is needed on the soils. Using this method may prolong improvement of the soils over several years.

As soon as the amendment has been applied, the soils should be leached of the soluble salts that form as a result of calcium replacement. If sulfur is used, the soils should be kept moist and ordinarily not leached until most of the sulfur has oxidized to form sulfate. Moisture is essential to this process. Sulfur should be applied in fall rather than in spring.

An alternative to reclamation by using large quantities of gypsum is the seeding of tall wheatgrass, weatern wheatgrass, and alta fescue (Gore's fescue). These grasses can grow in relatively strong concentrations of both soluble salts and alkali.

To establish a stand of grass, frequent light irrigations (3- to 5-day intervals) are required to leach soluble salts from the immediate vicinity of the seeds and to prevent soil crusting. Salt inhibits the ability of seeds to extract moisture from the soil, and the seeds may not germinate even after two or three irrigations. In addition, saline-alkali soils form a hard crust as they dry, and the crust prevents emergence of seedlings. Light applications of gypsum help to reduce crusting. Once the stand of grass has grown several inches, irrigation may be less frequent.

Soils that have been previously irrigated should not be deep plowed to establish a stand of grass. Past irrigation has lowered the salt content in the uppermost 2 or 3 inches and concentrated the salts immediately below that depth. Deep plowing only returns the salts to the surface. Shallow plowing or disking keeps this hazard to a minimum.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for wildlife sites or engineering.

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

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

Class I soils have few limitations that restrict their use. (There are no class I soils in the Carson Valley Area.)

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

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or wildlife habitat.
Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or wildlife habitat.
Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or wildlife habitat.
Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils.

In this survey, 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, as the symbols are a key to some of the problems or limitations. The numbers and letters used to designate the units are—

1. Erosion.
2. Wetness.
3. Slow permeability.
4. Low available water capacity.
5. Fine texture.
6. Excess salts and alkali.
7. Stones.
8. Depth limitation (over hardpan bedrock).
9. Toxicity.

L. Coarse texture.
K. Climate.
P. Poor drainage.

Management by Capability Units

The capability classification of the soils in this survey area is based on the assumption that irrigation water is available for all soils that can be cultivated safely. No attempt has been made to evaluate the economic feasibility of providing water or determining its source.

In the following pages each of the capability units in the Carson Valley Area is described, and suggestions for the use and management of the soils in each unit are given. The units are not numbered consecutively, because not all the units in the statewide system are represented in this area. The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils in a given series are in the unit. The capability classification of each soil is given in the "Guide to Mapping Units."

Capability unit IIe–1, irrigated

This unit consists of Springmeyer loam, 2 to 4 percent slopes, a very deep, well-drained soil on small alluvial fans. This soil has a moderately fine textured subsoil. Permeability is moderately slow, the available water capacity is moderate, and inherent fertility is high. Runoff is slow, and erosion is a slight hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

All crops that are suited to the climate can be grown, but close-growing crops are preferred. Among the suitable crops are corn for silage, potatoes, onions, garlic, barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, smooth brome, orchardgrass, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crops is suitable; and if the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops.

This soil is easy to cultivate. Excessive cultivation should be avoided because it impairs tilth, reduces intake of water, and increases the hazard of erosion. The best method of irrigation is the corrugation system, because deep cuts would be necessary to level this soil, and a cut of more than 3 feet would not leave an adequate root zone. Smoothing would make irrigation easier. Erosion can be controlled in irrigated fields by placing irrigation ditches on the contour, installing drop structures in delivery ditches to keep the slope to a minium, and keeping the irrigation streams small. Crops respond well to nitrogen and phosphorus.

Capability unit IIw–1, irrigated

This unit consists of James Canyon loam, drained, 2 to 4 percent slopes, a very deep, somewhat poorly drained soil on alluvial fans. Permeability is moderate, and inherent fertility is high. In most areas the available water capacity is high, but in small areas where the surface layer contains as much as 30 percent gravel, it is slightly lower. Erosion is a slight hazard.

All crops that are suited to the climate can be grown, but alfalfa or alfalfa-grass mixtures grown in rotation with small grain or permanent pasture is preferred. Among the suitable crops are corn for silage, potatoes, onions, garlic, barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, smooth brome, orchardgrass, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crops is suitable; and if the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops. The use of a specific crop depends mainly on the availability of late-season irrigation water.

Good management of irrigation water is needed if the water table is to be kept below the root zone. Furrow irrigation is preferred for row crops and border or corrugation irrigation for other crops, depending on the late-season water supply. Moderate irrigation runs and narrow borders can be used. The present drainage is the result of pumping for irrigation water or of conveying water to the fields through pipelines. Erosion can be controlled by keeping the slope of irrigation ditches to a minimum. Installing drop structures in the ditches maintains the minimum slope and keeps the irrigation streams small. Leveling is needed mainly on side slopes, but the depth of cuts should be limited to less than 36 inches to allow an ample root zone above the water table.

This soil is easy to cultivate. Continued excessive cultivation should be avoided because it impairs tilth and reduces the intake of water. Crops respond to nitrogen and phosphorus.

Capability unit IIw-2, irrigated

This unit consists of nearly level, deep to very deep, somewhat poorly drained soils on flood plains and on toe slopes of alluvial fans. These soils are members of the Draper, East Fork, Heidtman, Job, Settlemeyer, and Turria series. Most of them are flooded occasionally by the Carson River.

The surface layer of these soils in loam or clay loam. Permeability is moderately rapid to moderately slow in most areas, but it is very rapid in soils that are underlain by clay at this depth. The available water capacity and inherent fertility are high. In some areas erosion is a slight hazard. Some soil material is deposited by floodwater, and some by runoff during high-intensity rainstorms.

All crops that are suited to the climate can be grown, but alfalfa or alfalfa-grass mixtures grown in rotation with crops or grain are preferred. Among the suitable crops are corn for silage, potatoes, onions, garlic, barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, smooth brome, orchardgrass, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crops is suitable. If the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops is suitable. The use of a specific crop or crop rotation depends on the availability of irrigation water.

Careful use of irrigation water will keep the water table low and avoid rise of salts and alkali into the root zone, thus avoiding damage to deep-rooted crops. Artificial drainage can be used to keep the water table slightly lower, but it is needed mainly to control wide fluctuation in the height of the water table. The furrow method of irrigation is preferred for row crops and the border method for other crops. Some leveling is needed to increase irrigation efficiency, but the depth of the cuts should be limited to less than 36 inches. Moderate to long runs can be used, depending on the head of water available and the width of the border.

These soils are easy to cultivate. Excessive cultivation should be avoided because it impairs tilth and reduces intake of water. Crops respond to nitrogen and phosphorus.

Capability unit IIw-3, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained soils on alluvial fans and flood plains. These soils are members of the Cradlebaugh and Gardnerville series. These soils have a surface layer of clay loam. Some of them are underlain by a weakly cemented hardpan that restricts the downward movement of water and the growth of roots. Permeability is slow in the subsoil and moderately rapid or very rapid in the substratum. The available water capacity is high to moderate, and inherent fertility is high. Erosion is a slight hazard in some areas. Some areas are occasionally flooded by the Carson River. The flooding is not damaging but results in the deposition of small amounts of soil material in some areas.

The depth to the water table is generally more than 36 inches, but the water table rises if areas of Gardnerville clay loam, gravel substratum, are irrigated. The underlying gravel is at a depth of 24 to 36 inches.

All crops that are suited to the climate can be grown, but alfalfa or alfalfa-grass mixtures grown in rotation with row crops or grain is the preferred cropping system. Permanent pasture seeded to grass-legume mixures also does well. Among the suitable crops are corn for silage, potatoes, onions, garlic, barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, smooth brome, orchardgrass, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crops is suitable, and if the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops. The use of a specific crop or crop rotation is dependent upon the availability of irrigation water.

These soils are slowly permeable. Careful use of irrigation water will keep the water table at its present level and avoid rise of salts and alkali into the root zone. In general, improved drainage does not lower the natural water table, but it does help to keep the water table low in irrigated areas. The furrow method of irrigation is preferred for row crops and the border flooding method for other crops. Long runs can be used, depending on the head of water available and the width of the border. Some leveling is needed in some areas to increase irrigation efficiency, but the depth of the cuts should be limited to less than 24 inches.

These soils are easy to cultivate. Excessive cultivation should be avoided because it impairs tilth and reduces the intake of water. Leveling is necessary before brushland can be cultivated. Subsoiling helps to make the material more permeable to water and roots. Crops respond well to nitrogen and phosphorus.

Capability unit IIw-35, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained soils on toe slopes of alluvial fans and on terraces. These soils are members of the Gardnerville and Hussman series.

These soils have a surface layer of clay. Some are underlain by a weakly cemented hardpan that retards the movement of water and restricts the growth of roots. The depth to the water table is more than 36 inches. In some areas permeability is slow throughout the profile. In others it is slow in the surface layer and subsoil but rapid in the substratum. The available water capacity is moderate to high, and inherent fertility is high. In some areas erosion is a slight hazard.

All crops that are suited to the climate can be grown, but alfalfa or alfalfa-grass mixtures grown in rotation with small grain is preferred. Permanent pasture of grass-legume mixtures also does well. Among the suitable crops are barley, wheat, oats, alsike clover, red clover, alfalfa, birdsfoot trefoil, White Dutch clover, orchardgrass, smooth brome, alta fescue, intermediate wheatgrass, and pubescent wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of clover-grass mixtures, alfalfa-grass mixtures, or trefoil-grass mixtures and 1 year or 2 years of small grain is suitable.

Careful use of irrigation water is needed to keep the water table from fluctuating excessively and thus damaging deep-rooted crops, as well as to keep salts and alkali from rising into the root zone. Care is also needed because of the clayey surface layer and the slow permeability of the subsoil. In general, on a single-ranch basis, improved drainage does not effectively lower the water table. The furrow method of irrigation is preferred for row crops, and the border flooding method for other crops. Smoothing or light leveling helps to increase irrigation efficiency. Long runs can be used on the clayey surface layer, the length depending on the head of water available and the width of the border.

Careful cultivating is necessary. The soils puddle and are difficult to manage if they are plowed when the moisture content is too high. Subsoiling helps to make the hardpan more permeable to water and roots. All crops respond to nitrogen and phosphorus.

Capability unit IIw-6, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained, slightly saline-alkali soils on flood plains and alluvial terraces. These soils are members of the Heidtman and Job series.

These soils have a surface layer of loam. In general, permeability is moderately slow or moderate, but it is very rapid where there is gravel or coarse sand at a depth below 48 inches. The available water capacity is moderate to high, and inherent fertility is high. In some areas erosion is a slight hazard. The soils are less suited to crops because of the content of salts and alkali, which is sufficient to reduce the intake of water, and in some places to keep the seeds from germinating or the seedlings from emerging.

Only crops that are tolerant of salts and alkali should be grown. Other than sugar beets, row crops should not be grown. Alfalfa and tall fescue grown in rotation with barley is the preferred cropping system. Among the suitable crops are barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crops is suitable, and if the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops.

Careful use of irrigation water, including heavy applications periodically, and the use of gypsum would lower the content of salts and alkali in the soils. This practice is effective only if adequate artificial drainage is established and maintained to provide an outlet for excess water and its content of dissolved salts. Careful use of irrigation water and drainage are also needed to keep the water table at its present level during the irrigation season and thus avoid damaging alfalfa and other deep-rooted crops. These practices also keep more salts and alkali from rising into the root zone. The furrow method of irrigation is preferred for sugar beets, and the border flooding method for all other crops. Long runs can be used, the length depending on the head of water available and the width of the border. They can be used because the intake of water is reduced as a result of the alkali in the soils.

Tillage should be kept to a minimum to reduce the risk of bringing salts and alkali back to the surface by plowing. Crops respond to nitrogen and phosphorus, but the amount of phosphorus available may be limited.

Capability unit IIs-4, irrigated

This unit consists of nearly level, very deep, well-drained soils on alluvial fans, flood plains, and terraces. These soils are members of the Cashmere and Haybourne series.

These soils have a surface layer of loam or fine sandy loam. In some areas permeability is moderately rapid throughout the profile, but in others it is moderately slow in the subsoil and moderately rapid in the

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substratum. The available water capacity is moderate, and inherent fertility is moderate to high. Erosion is a slight hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

All crops that are suited to the climate can be grown, but alfalfa or alfalfa-grain mixtures grown in rotation with row crops or small grain is the preferred cropping system. Among the suitable crops are corn for silage, potatoes, onions, garlic, barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, smooth brome, orchardgrass, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crops is suitable; and if the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops. The use of a specific crop or crop rotation depends upon the availability of irrigation water late in the season.

These soils are easy to cultivate. Excessive cultivation should be avoided because it impairs tilth and reduces the intake of water. Wind erosion is a slight hazard in areas where the practice of clean tillage is continuously employed. This hazard can be reduced by establishing windbreaks, using a suitable crop rotation, and maintaining a plant cover on the soil as long as possible. Crops respond to nitrogen and phosphorus.

There are no management problems caused by the water table, and none will develop if irrigation water is carefully managed. The furrow method of irrigation is preferred for row crops and the border flooding method for other crops. Light leveling or smoothing makes irrigating easier. Moderate runs should be used, the length depending on the head of water available and the width of the border. Relatively frequent applications of water are needed to offset the moderate available water capacity of the soils.

Capability unit IIc–K, irrigated

This unit consists of nearly level, very deep, well-drained soils on alluvial fans. These soils are members of the Turria series.

These soils have a surface layer of loam or clay loam. Permeability is moderately slow, and the available water capacity and inherent fertility are high. In some areas erosion is a slight hazard. Rapid runoff during high-intensity rain storms deposits soil material brought down from upslope soils to these areas.

All crops that are suited to the climate can be grown, but alfalfa or alfalfa-grass mixtures grown in rotation with row crops or grain is the preferred cropping system. Among the suitable crops are corn for silage, potatoes, onions, garlic, barley, wheat, and oats. Among those suitable for hay and pasture are alfalfa, smooth brome, orchardgrass, alta fescue, and wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain or row crops. If the main crops are row crops, 4 to 6 years of alfalfa, 1 year of small grain, and 3 years of row crop is suitable, and if the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture and 1 year to 2 years of small grain or row crops. The use of a specific crop or crop rotation depends upon the availability of irrigation water.

These soils are easy to cultivate. Excessive cultivation should be avoided because it impairs tilth and reduces the intake of water. There are no water table problems, even when brushland is converted to irrigated cropland, but low areas should not be over irrigated. Light leveling is needed to remove slight irregularities in areas newly used for crops, and some smoothing helps to increase irrigation efficiency in other areas. The depth of cuts does not have to be limited. The furrow method of irrigation is preferred for row crops and the border flooding method for other crops. Moderate to long runs can be used, the length depending on the head of water available and the width of the border. The control of salts and alkali should not be a problem if irrigation water is carefully managed. All crops respond to nitrogen and phosphorus.

Capability unit IIIe–4, irrigated

This unit consists of gently sloping, deep, well-drained to somewhat excessively drained soils on alluvial fans. These soils are members of the Haybourne and Holbrook series.

These soils have a surface layer of loam, sand, or gravelly fine sandy loam. In some places permeability is moderately rapid throughout the profile, and in others it is moderately rapid in the surface layer and subsoil and very rapid in the substratum. The available water capacity and inherent fertility are low to moderate. Erosion is a slight to moderate hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas. The water table in Holbrook gravelly fine sandy loam, water table, 2 to 4 percent slopes, is at a depth of more than 48 inches.

All crops that are suited to the climate can be grown, but alfalfa grown in rotation with grain or a permanent legume-grass pasture is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of an alfalfa-grass mixture and 1 year to 2 years of small grain is suitable.

Generally, these soils are easy to cultivate, but in some areas the gravelly soils may be somewhat difficult to cultivate. Crops respond to nitrogen and phosphorus.

Careful use of irrigation water is needed to reduce the hazard of erosion. The border furrow method of irrigation is preferred for row crops, but the border flooding method or the sprinkler method is preferred for other crops. The corrugation method of irrigation can be used where the topography does not lend itself to leveling. Leveling should be limited to light cuts that remove side slopes and smooth irregularities in the topography. Frequent light applications of water are needed to offset the low to moderate available water capacity.

Capability unit IIIw-1, irrigated

This unit consists of moderately sloping, very deep, somewhat poorly drained soils on alluvial fans. These soils are members of the James Canyon series.

These soils have a surface layer of loam. Permeability is moderate to moderately slow, and the available water capacity and inherent fertility are high. Erosion is a slight to moderate hazard. During most of the irrigation season, the water table is at depths between 36 and 60 inches. James Canyon loam, calcareous variant, is slightly affected by salts and alkali.

All crops that are suited to the climate can be grown, but close-growing crops are preferred. Among the suitable crops are barley, wheat, oats, alfalfa, birdsfoot trefoil, alta fescue, and pubescent wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain. If the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture or trefoil-grass mixture and 2 years of small grain is suitable.

Tile drains are needed to lower the water table appreciably. Careful use of irrigation water will then keep the water table low and avoid the rise of salts and alkali into the root zone. The best methods of irrigation are the sprinkler and corrugation systems. Some leveling or smoothing is needed to remove slight irregularities. Small heads of water and moderate to short runs should be used to control erosion. Irrigation ditches should be placed on the contour. Supply ditches on slopes should be lined with concrete, routed through a pipeline, or provided with sufficient drop structures to keep the slope. Excessive cultivation increases erosion, impairs tilth, and reduces intake of water. The crops respond well to nitrogen and phosphorus.

Applications of gypsum followed by leaching can be used to reduce the alkali content in James Canyon loam, calcareous variant, and an occasional heavy application of water reduces the salt content.

Capability unit IIIw-14P, irrigated

This unit consists of Dressler sandy loam, water table, 2 to 4 percent slopes, a very deep, poorly drained soil on flood plains. The water table fluctuates at depths between 20 and 36 inches during most of the growing season. Permeability is rapid, and the available water capacity and inherent fertility are moderate. In some areas erosion is a slight hazard.

Most crops that are suited to the climate can be grown, but grass-clover mixtures grown in long-term rotation with small grain are preferred. Alfalfa can be grown, but it is short lived because water damages its taproot. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable crop rotation, if the main crop is hay or pasture, is 6 to 10 years or more of grass-clover mixtures and 1 year of grain to reestablish the main crop. The choice of a specific species of grass or clover depends on the availability of late-season irrigation water.

This soil is easy to cultivate. Plowing should be done in fall or early in spring before higher areas are irrigated. Crops respond to nitrogen and phosphorus.

The best method of irrigation is the contour flooding system because of the size and shape of the mapped areas and their relationship to higher areas. Irrigation ditches should be placed on the contour to control erosion. Short runs and small heads of water should be used.

Capability unit IIIw-1P, irrigated

This unit consists of gently sloping, very deep, poorly drained soils on alluvial fans. These soils are members of the James Canyon series and the calcareous variant of the James Canyon series.

These soils have a surface layer of loam. The water table is between depths of 20 and 36 inches during most of the growing season as a result of the release of ground water. Permeability is moderate to moderately slow in the subsoil, and the available water capacity and inherent fertility are high. Erosion is a slight hazard. Soil material that runoff brought down from higher areas is deposited in some areas during high-intensity rainstorms.

Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable rotation, if the main crop is hay or pasture, is 6 to 10 years or more of a grass-clover mixture and 1 year of grain to reestablish the main crop.

Draining these soils is not feasible. Careful use of irrigation water keeps the water table low and thus avoids damaging the roots of desirable plants. The best method of irrigation is the corrugation system because of the topography and the limited late-season supply of water. Only light leveling can be done, because the depth of cuts is limited by the high water table. Leveling should not be done on narrow convex fans, because the depth of the cuts would be excessive, but smoothing between the ditches would make irrigation easier.

Plowing should be done early in fall because the water table is at its peak in spring. Final preparation of the seedbed and seeding may be done in spring. Fall seeding should not be attempted unless an adequate supply of water is available. Additions of organic matter help to maintain tilth and intake of water. Droppings should be scattered periodically to promote maximum grazing in cropped areas. Mowing weeds occasionally before they go to seed discourages their growth. Crops respond to nitrogen and phosphorus.

Capability unit IIIw-2, irrigated

This unit consists of nearly level, very deep, poorly drained soils on flood plains. These soils are members of the Job, Jubilee, Kimmerling, and Settlemeyer series. They are flooded occasionally by the Carson River.

These soils have a surface layer of loam or clay loam. The water table is at depths between 18 and 36 inches during most of the irrigation season. Permeability is rapid to moderately slow, but in some soils it is very rapid at a depth below 36 inches as a result of stratification with coarse sand. The available water capacity and inherent fertility are low to high. Erosion is a slight hazard in some areas. In places small amounts of soil material are deposited by floodwaters of the Carson River. This deposition is not damaging.

Most crops that are suited to the climate can be grown, but grass-clover mixtures grown in long-term rotation with small grain is the preferred cropping system. Alfalfa can be grown but is short lived because water damages its taproot. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable crop rotation, if the main crop is hay or pasture, is 6 to 10 years or more of a grass-clover mixture and 1 year of grain to reestablish the main crop. The use of a specific crop depends upon the availability of late-season irrigation water.

Complete drainage of these soils is difficult because of their natural position and outlets. A drainage program should first be studied carefully so that benefits can be determined before the drainage system is installed. Shallow drains can be constructed to lower the water table slightly and thus reduce the damage to deep-rooted crops. A good irrigation system keeps the water table at about its present level and avoids the rise of salts and alkali into the root zone. A drainage system installed along with a good irrigation system can be an improvement.

The best method of irrigation is the border flooding system, but where late-season irrigation water is scarce, the corrugation system can be used to advantage. In some areas leveling is needed to make irrigation easier, but the cuts have to be limited to less than 18 inches because of the high water table. Moderate to long runs can be used, the length depending on the head of water available and the width of the border.

These soils are easy to cultivate. Most tillage operations, such as plowing and leveling, should be done early in fall when the water table is at its lowest level. Excessive cultivation should be avoided because it impairs tilth and reduces the intake of water. Crops respond to nitrogen and phosphorus.

Capability unit IIIw–356, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained, slightly saline-alkali soils on alluvial fans, terraces, and flood plains. These soil are members of the Gardnerville and Hussman series.

These soils have a surface layer of clay. In some areas permeability is slow throughout the profile, but in others it is slow in the subsoil and moderately rapid to very rapid in the substratum. The available water capacity is moderate to high, and inherent fertility is high. Erosion is a slight hazard in some places.

In some areas there is a weakly cemented, alkali-soluble hardpan that retards the movement of water and restricts the growth of roots.

Only crops that are tolerant of salts and alkali should be grown. Row crops, other than sugar beets, are not suitable. Tall fescue or alfalfa and tall fescue grown in rotation with barley is the preferred cropping system.

Careful plowing is necessary to keep the soils from puddling. Tillage should be kept to a minimum so that salts and alkali are not so likely to be brought to the surface.

Improving these soils is difficult because of the clayey surface layer and the slow permeability throughout the profile. Soil conditioning with gypsum, leaching, and careful irrigation reduce the content of salts and alkali. Artificial drainage must be established and maintained so that there is an outlet for excess water and the dissolved salts and alkali. Drainage is also needed to keep the water table low during the irrigation season and thus permit the growth of alfalfa and other deep-rooted crops. Careful use of irrigation water reduces the risk of wide fluctuation in the height of the water table. Heavy applications of water are needed periodically, however, to flush out excess salts.

The furrow method of irrigation is preferred for sugar beets, and the border flooding method for other crops. Leveling is needed in some areas to spread the water more uniformly. Long runs can be used, the length depending on the head of water available and width of the border.

Capability unit IIIw–36, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained, slightly saline-alkali soils on alluvial fans, terraces, and flood plains. These soils are members of the Cradlebaugh, Gardnerville, and Hussman series. Some areas are occasionally flooded by the Carson River. The flooding is not detrimental.

The surface layer of these soils is clay loam, silty clay loam, or clay. The Gardnerville soil is underlain by a weakly cemented, alkali-soluble hardpan that restricts the growth of roots and retards the movement of water. Permeability is slow throughout the profile in some areas, but it is slow in the subsoil and moderately rapid to rapid in the substratum in other areas. The available water capacity is moderate to high, and inherent fertility is high. Erosion is a slight hazard in some places.

Only crops that are tolerant of salts and alkali should be grown. Except for sugar beets, row crops should not be grown. Tall fescue or alfalfa and tall fescue grown in rotation with barley is preferred. Among the suitable crops are barley, wheat, oats, alfalfa, birdsfoot trefoil, alta fescue, and pubescent wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 2 years of small grain. If the main crop is hay or pasture, 6 to 8 years of alfalfa-grass mixture or trefoil-grass mixture and 2 years of small grain is suitable.

These soils are easy to cultivate. Tillage should be kept to a minimum so that there is less risk of bringing salts and alkali to the surface by plowing. Crops respond to nitrogen and phosphorus, but the high alkalinity of the soil somewhat limits the ability of plants to use phosphorus.

Soil conditioning with gypsum, leaching, and careful irrigating will reduce the content of salts and alkali. Artificial drainage must be established and maintained so that there is an outlet for excess water and the dissolved salts and alkali. Drainage is also needed to keep the water table low during the irrigation season and thus permit the growth of alfalfa and other deep-rooted crops. Careful use of irrigation water reduces the risk of wide fluctuation in the height of the water table. Heavy applications of water are needed periodically, however, to flush out excess salts.

The furrow system of irrigation is preferred for sugar beets, and the border flooding system for other crops. Light leveling or smoothing helps to make irrigation easier. Long runs can be used, the actual length depending on the head of water available and the width of the borders.

Capability unit IIIw-3P, irrigated

This unit consists of Kimmerling clay loam, clay substratum, a nearly level, very deep, poorly drained soil on flood plains. This soil is occasionally flooded by the Carson River. The water table fluctuates between depths of 20 and 36 inches during most of the growing season. Permeability is moderately slow in the subsoil and, as a result of buried clay strata, slow in the substratum. The available water capacity and inherent fertility are high. In places soil material is deposited by flooding. This deposition is not detrimental. Erosion is not a hazard.

Most crops that are suited to the climate can be grown, but grass-clover mixtures grown in long-term rotation with small grain are preferred. Alfalfa can be grown but is short lived because water damages its taproot. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable rotation, if the main crop is hay or pasture, is 6 to 10 years or more of grass-clover mixtures and 1 year of grain to reestablish the main crop. The choice of kinds of grass or clover depends on the availability of late-season irrigation water.

Complete drainage of this soil is difficult, partly because of its natural position and outlets and partly because of its slowly permeable substratum. A temporary perched water table above the substratum is a hazard. A drainage program should first be studied carefully so that the benefits can be determined before the drainage system is installed. Shallow drains can be constructed to lower the water table slightly and thus prevent extreme fluctuation and resulting damage to deep-rooted crops. A drainage system installed with a good irrigation system can be an improvement.

The best method of irrigation in most areas is the border flooding system, but in areas where the late-season supply of irrigation water is not adequate, the corrugation system can be used to advantage. Proper irrigating will not cause the water table to rise appreciably, nor will it cause salts and alkali to rise into the root zone. Leveling is needed in some places, to make irrigation easier, but the depth of the cuts should be limited to less than 18 inches because of the high water table. Moderate to long runs can be used, depending on the head of water available and the width of the border.

This soil is easy to cultivate. Most tillage, such as plowing and leveling, should be done early in fall when the water table is at its lowest. Excessive cultivation should be avoided because it impairs tilth and reduces the intake of water. Crops respond to nitrogen and phosphorus.

Capability unit IIIw-4, irrigated

This unit consists of nearly level, moderately deep, somewhat poorly drained soils on alluvial flood plains and terraces. These soils are members of the Dressler series and the moderately deep variant of the Henningsen series.

These soils have a surface layer, 20 to 30 inches thick, of sandy loam, clay loam, or loam. This layer is underlain by coarse sand or gravel. Permeability is rapid to moderate in the surface layer and subsoil and very rapid in the substratum. The available water capacity is low to moderate, and fertility is moderate. Erosion is a slight hazard in some areas.

All crops that are suited to the climate can be grown, but alfalfa grown in rotation with small grain or row crops is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa, and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable. The choice of a specific crop or crop rotation depends on the availability of irrigation water.

Since the ground water moves laterally through the gravel and sand, the water table is not damaging but helps to alleviate droughtiness. Careful use of irrigation water is needed to prevent a serious rise in the water table. The furrow method of irrigation is preferred for row crops, but the border flooding method for all other crops. Some light leveling or smoothing makes irrigation easier, but the depth of the cuts should be less than 12 inches so that an adequate root zone remains above the gravel or sand. Moderate runs should be used. Frequent, light applications of irrigation water are needed.

These soils are generally easy to cultivate, but some difficulty can be expected in the gravelly areas. Crops respond well to nitrogen and phosphorus.

Capability unit IIIw-4P, irrigated

This unit consists of nearly level, very deep, poorly drained soils on alluvial terraces and flood plains. These soils are members of the Dressler series and the sand substratum variant of the Jubilee series.

These soils have a surface layer of sandy loam or clay loam. They are underlain by coarse sand or gravel at depths below 20 to 36 inches. Some areas are flooded by the Carson River. The water table fluctuates between depths of 20 and 36 inches during most of the irrigation season. The available moisture capacity is moderate, and inherent fertility is high. Erosion is not a hazard.

In Dressler soils, the subsoil has rapid to moderate permeability and the coarse textured to very coarse textured substratum has very rapid permeability. In the Jubilee soil, permeability is very rapid in the subsoil but slow at a depth below 40 inches because of underlying clay strata. After this soil has been drained, a perched water table above the clay strata can be expected.

Most crops that are suited to the climate can be grown, but grass-clover mixtures grown in long-term rotation with small grain are preferred. Alfalfa can be grown, but it is short lived because water damages its taproot. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable crop rotation, if the main crop is hay or pasture, is 6 to 10 years or more of grass-clover mixtures and 1 year of grain to reestablish the main crop. The choice of a specific species of grass or clover depends on the availability of late-season irrigation water.

Complete drainage of these soils is not desirable because of their low available water capacity. The water table should not be lowered below a depth of 5 feet. The best method of irrigation is the border flooding system, but in areas where the late-season supply of irrigation water is not adequate, the corrugation system can be used to good advantage. Some leveling is needed to make irrigation easier, but on the Jubilee soils, only surface smoothing should be done. The depth of the cuts should be limited to less than 12 inches because of the high water table and the coarse to very coarse texture of the substratum.

These soils are easy to cultivate. Continuous cultivation should be avoided because it impairs tilth and reduces the intake of water. Most tillage, such as plowing and leveling, should be done early in fall when the water table is at its lowest level. Crops respond well to nitrogen and phosphorus.

Capability unit IIIw-6P, irrigated

This unit consists of nearly level, very deep, poorly drained, slightly saline-alkali soils on flood plains. These soils are members of the Bishop and Kimmerling series.

These soils have a surface layer of loam or clay loam. Most areas are occasionally flooded by the Carson River. The water table fluctuates between depths of 20 and 36 inches during most of the irrigation season. In some areas permeability is moderately slow throughout the profile, but in other areas it is moderately slow in the subsoil and moderately rapid below the subsoil. The available water capacity and inherent fertility are high. Erosion is a slight hazard in some areas. Soil material is deposited in some areas during periods of flooding. This deposition is not damaging.

A grass-clover mixture grown in long-term rotation with small grain is a preferred cropping system. Alfalfa can be grown, but it is short lived because water damages its taproot. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable rotation, if the main crop is hay or pasture, is 6 to 10 years or more of grass-clover mixture and 1 year of grain to reestablish the main crop. The selection of specific kinds of grass and clover depends on their tolerance to salts and alkali and the availability of late-season water.

Poor drainage and the content of salts and alkali are severe limitations. Complete drainage of these soils would be difficult because of their position and lack of outlets, but limited drainage and a good irrigation system can improve the soils. Salts and alkali can be removed from the surface layer, but unless the water table can be lowered to a depth of about 5 feet, it is not likely that salts and alkali can be removed from the whole profile. The use of gypsum followed by leaching can lower the content of alkali in the surface layer, increase the intake of water, and thus promote better seedling emergence.

The border flooding system is the best method of irrigation because it spreads the water uniformly and removes salts from the surface layer. Leveling is needed to make irrigation easier in some places, but the cuts should be less than 18 inches in depth because of the high water table. The design of irrigation runs and borders should be governed by the availability of late-season irrigation water. Moderate to long runs can be used.

These soils are easy to cultivate. Excessive cultivation impairs tilth and reduces the intake of water. Plowing should be done early in fall when the water table is lowest. Crops respond to nitrogen and phosphorus.

Capability unit IIIw-9P, irrigated

This unit consists of nearly level, very deep, poorly drained soils on flood plains. These soils contain molybdenum. They are members of the Bishop series.

These soils have a surface layer of loam. The water table fluctuates between depths of 20 and 36 inches during most of the irrigation season. Permeability is moderately slow, and the available water capacity and inherent fertility are high. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas. In some places erosion is a slight hazard. Deep gullies in the eroded Bishop soil improve drainage. Erosion control measures, such as gully plugs, would restore the normally high water table.

Most crops that are suited to the climate can be grown, but grass grown in a long-term rotation with small grain is preferred. Clover grown on these soils contains appreciably more molybdenum than the grass, and consequently its use should be limited. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable crop rotation, if the main crop is hay or pasture, is 6 to 10 years or more of grass-clover mixtures and 1 year of grain to reestablish the main crop.

Complete drainage of these soils in their natural state would be difficult, but a limited drainage program and a good irrigation system can improve the present condition. A program designed to lower the water table must first be studied carefully to determine the benefits. In some places shallow drains that lower the water table slightly can be constructed. They also help to control extreme fluctuation in the height of the water table and thus prevent damage to deep-rooted crops. Good irrigation practices keep the water table at about its present level and thus avoid the rise of salts and alkali into the root zone.

The border flooding system is the best method of irrigation, but the corrugation system can be used to advantage where the supply of late-season irrigation water is not adequate. Leveling is needed to make irrigation easier in some places, but the cuts should be limited to less than 18 inches in depth because of the high water table. Moderate to long irrigation runs can be used, depending on the head of water available and the width of the border.

These soils are easy to cultivate. Excessive cultivation should be avoided, because it impairs tilth and reduces the intake of water. Most tillage, such as plowing and leveling, should be done early in fall when the water table is at its lowest. Crops respond well to nitrogen and phosphorus.

The amount of molybdenum in forage produced on these soils is sufficient to be toxic to livestock. Consequently, the livestock should be given injections of copper glycinate or should have available, in their salt, feed, or water, sufficient amounts of copper sulfate (bluestone).

Capability unit IIIs–4, irrigated

This unit consists of nearly level, very deep, well-drained to somewhat excessively drained soils on alluvial fans, terraces, and flood plains. These soils are members of the Calpine, McFaul, and Washoe series.

These soils have a surface layer of sand, gravelly sandy loam, or gravelly coarse sandy loam. They are underlain by coarse sand, gravel, or cobblestones at depths between 20 and 42 inches. Permeability is moderately slow to moderately rapid. The available water capacity and inherent fertility are moderate to low. In some areas erosion is a slight hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

All crops that are suited to the climate can be grown, but alfalfa grown in rotation with grain is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable.

These soils are easy to cultivate. Crops respond to nitrogen and phosphorus.

Irrigation does not result in water table problems, even when brushland is converted to irrigated cropland, but continued application of excessive amounts of irrigation water would make the water table higher in lower lying soils. The border flooding system is the best method of irrigation where the topography is suited to leveling, but the corrugation system is better in other areas. Light leveling is needed to remove slight irregularities and to increase irrigation efficiency, but the depth of the cuts should be limited to less than 6 inches because the substratum is very gravelly, cobbly, or sandy.

Capability unit IVe–4, irrigated

This unit consists of deep, well-drained soils on alluvial fans. These soils are members of the Calpine and Holbrook series.

These soils have a surface layer of stony coarse sandy loam or gravelly fine sandy loam. Permeability is moderately rapid. The available water capacity is moderate in the Calpine soil and low in the Holbrook soil. Inherent fertility is high in the Calpine soil and low in the Holbrook soil. Erosion is a slight to moderate hazard; rapid runoff during high-intensity rainstorms deposits soil material brought down from higher areas.

All crops that are suited to the climate can be grown. Alfalfa or permanent grass-legume pasture grown in rotation with grain is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable. The selection of a specific crop or crop rotation depends upon the availability of an adequate supply of irrigation water.

In some places these soils may be somewhat difficult to cultivate because of the gravel. Irrigation does not result in water table problems, even when brushland is converted to irrigated cropland.

The sprinkler system is the best method of irrigation, but the furrow system can be used with a small head of water. Erosion can be controlled in irrigated fields by placing irrigation ditches on the contour and installing sufficient drop structures in delivery ditches to maintain the minimum slope. The soils should not be leveled, because they are gravelly and cobbly. Smoothing makes irrigation easier in some places.

Capability unit IVw–1P, irrigated

This unit consists of James Canyon loam, 4 to 16 percent slopes, a very deep, poorly drained soil on alluvial fans. The water table fluctuates between depths of 20 and 36 inches during most of the growing season as a result of seepage from local springs, but it is at or near the surface early in spring. Permeability is moderate, and the available water capacity and inherent fertility are high. Erosion is a slight to moderate hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

Grass-clover mixtures grown in long-term rotation with small grain is the preferred cropping system. The selection of specific kinds of grasses and clover depends on the availability of late-season irrigation water.

This soil can be drained only if an elaborate drainage system is used, because most of the water is lateral seepage resulting from the normal faulting of artesian aquifers along the toe slopes of the Sierra Nevada. Careful use of irrigation water will keep the water table at its present level and will avoid rise of salts and alkali into the root zone.

The sprinkler system is the best method of irrigation, but with care, the corrugation system or controlled flooding can also be used. Leveling is needed in some places to make irrigation easier, but cuts should be limited to less than 18 inches in depth because of the high water table. Erosion can be controlled and water loss reduced by using small heads of water and short to moderate runs, by placing all irrigation ditches on the contour, and by lining supply ditches with concrete or routing them through a pipeline. Another method is installing drop structures in the ditches.

This soil is easy to cultivate. Plowing and leveling should be done in fall when the water table is lowest. Meadows that are grazed should be clipped periodically to keep weeds at a minimum. Droppings should be scattered to obtain maximum forage utilization. Crops respond to nitrogen and phosphorus.

Capability unit IVw–36P, irrigated

This unit consists of nearly level, moderately deep to very deep, poorly drained, slightly saline-alkali soils on flood plains and low alluvial terraces. These soils are members of the Cradlebaugh, Dangberg, Job, and Voltaire series.

These soils have a surface layer of loam, clay loam, silty clay, and clay. Most areas are flooded occasionally by the Carson River, but the floodwaters are not damaging. The water table fluctuates between depths of 18 and 36 inches during most of the irrigation season. A perched water table is on top of the hardpan in the moderately deep soils, and another water table is below the hardpan and under artesian pressure. Permeability is governed by the slowly permeable and very slowly permeable strata within the profile; the moderately deep soils have a hardpan that stops the movement of water and the growth of roots. Available water capacity is moderate to high, and inherent fertility is high. Erosion is a slight hazard in some places.

Only the grasses that are most tolerant of salts and alkali should be grown. Alta fescue or tall wheatgrass is preferred. Barley can be seeded when the stand of grass needs to be replaced.

Drainage of these soils is very difficult because of the slow to very slow permeability, but a good irrigation system and limited drainage can improve the soils. Lowering the water table can reduce the content of salts and alkali somewhat, but it is not likely that salts and alkali can be completely removed from the profile. Applications of gypsum may be used to advantage in establishing crops and increasing the intake of water.

The border flooding system is the best method of irrigation because it wets the surface uniformly and helps to remove salts from the surface. Leveling is needed to make irrigation easier in some areas, but the cuts should be limited to less than 18 inches in depth because of the poor drainage. Slick spots are common in fill areas that have been leveled. The design of irrigation runs and width of the border should be governed by the availability of late-season irrigation water. Long runs can be used.

Cultivation should be kept to a minimum so that salts and alkali are not brought to the surface. Crops respond to nitrogen and phosphorus.

Capability unit IVw–49, irrigated

This unit consists of Ophir gravelly sandy loam, somewhat poorly drained, 2 to 8 percent slopes, a very deep soil on alluvial fans. This soil contains molybdenum. In spring, depth to the water table is as little as 36 inches, but late in summer it is as much as 52 inches. Deep gullies have lowered the water table, but erosion is only a slight to moderate hazard in most places. Permeability is rapid, and the available water capacity and inherent fertility are low. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

Alfalfa or an alfalfa-grass mixture grown in rotation with small grain is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of an alfalfa-grass mixture and 1 year or 2 years of small grain is suitable.

This soil is easy to cultivate. It is neither feasible nor desirable to attempt drainage of this soil, because it is inherently droughty. Careful use of irrigation water is needed to keep the water table at its present level in the poorly drained, lower lying soils. The best methods of irrigation are the sprinkler and corrugation systems. Light leveling or smoothing is needed to make irrigation easier in some places, but the depth of cuts should not exceed 12 inches, to avoid exposing the underlying sand. Erosion can be controlled and water losses reduced by using small heads of water and short runs, placing ditches on the contour, routing supply ditches through a pipeline or lining them with concrete, or if this is not practical, providing them with drop structures. Crops respond to nitrogen and phosphorus.

The amount of molybdenum in forage produced on this soil is sufficient to be toxic to livestock. Consequently, the livestock should be given injections of copper glycinate or should have available in their salt, feed, or water a sufficient amount of copper sulfate (bluestone).

Capability unit IVw–49P, irrigated

This unit consists of nearly level to moderately sloping, very deep, poorly drained soils on alluvial fans. These soils are members of the Ophir series.

These soils have a surface layer of gravelly sandy loam. They contain molybdenum. During most of the growing season, the water table fluctuates between depths of 20 and 36 inches. It is highest early in spring and is often at or near the surface in winter and early in spring when plants are dormant. Permeability is rapid, and the available water capacity and inherent fertility are low. Erosion is a slight to moderate hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

Grass grown in long-term rotation with small grain is the preferred cropping system. Clover planted with the grass would make a more balanced hay, but its use as hay should be limited because it contains appreciably more molybdenum than grass contains. Among the suitable crops are oats, barley, canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. An example of a suitable crop rotation, if the main crop is hay or pasture, is 6 to 10 years or more of grass-clover mixtures and 1 year of grain to reestablish the main crop.

These soils are easy to cultivate. They should not be drained, because of their low available water capacity.

Good management of irrigation water keeps the water table at about its present level during the growing season. The sprinkler and corrugation systems are the best methods of irrigation, but the availability of an adequate, late-summer water supply should be determined before a sprinkler system is installed. Light leveling or smoothing is needed to make irrigation easier in some places, but the depth of cuts should not exceed 12 inches, because of the high water table and because of the risk of exposing the coarse-textured underlying material. Erosion can be controlled by using small heads of water and short runs, by placing all irrigation ditches on the contour, and by routing supply ditches through a pipeline or lining them with concrete, or, if this is not practical, providing them with drop structures. Crops respond to nitrogen and phosphorus.

The amount of molybdenum in the forage produced on this soil is sufficient to be toxic to livestock. Consequently, the livestock should be given injections of copper glycinate or should have available in their salt, feed, or water a sufficient amount of copper sulfate (bluestone).

Capability unit IVw-6L, irrigated

This unit consists of Ormsby gravelly loamy sand, slightly saline-alkali, a nearly level, very deep, somewhat poorly drained soil on alluvial terraces. This soil has a weakly cemented layer at a depth of about 24 inches. Permeability is moderately slow, and the available water capacity and inherent fertility are low. In some areas erosion is a slight hazard.

Grass or alfalfa-grass mixtures grown in rotation with barley is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if alfalfa is the main crop, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable. The selection of a specific crop depends on the availability of late-season irrigation water.

This soil is very easy to cultivate. It should not be left bare for prolonged periods, because it is susceptible to wind erosion. Windbreaks help to control wind erosion. Deep ripping that breaks the silica-cemented material helps to provide additional root zone and to improve permeability. Draining these soils should not be attempted, because of their droughtiness. Careful use of irrigation water holds to a minimum extremes in the rise and fall of the water table and can reduce the content of salts and alkali. The border flooding system is the best method of irrigation because it wets the surface uniformly and thus permits the removal of maximum amounts of salts. Leveling is needed to make irrigation easier in some places. Cuts should be restricted to less than 18 inches in depth because of the cemented material. A light application of gypsum can be used to lower the content of alkali in the surface layer, as this increases intake of water and promotes better emergence of seedlings. Crops respond to nitrogen and phosphorus.

Capability unit IVw-L, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained soils on alluvial fans and terraces. These soils are members of the Ormsby and Toll series.

These soils have a surface layer of gravelly loamy sand, loamy sand, or sand. The water table fluctuates between depths of 36 and 60 inches during most of the irrigation season. Permeability is generally rapid to moderately slow, but it is slow at a depth below 48 inches in the substratum of Toll sand, clay substratum, water table, 0 to 2 percent slopes. The available water capacity and inherent fertility are low. Erosion is a slight hazard in some places. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas.

All crops that are suited to the climate can be grown, but alfalfa grown in rotation with small grain is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and tall fescue. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable.

These soils are very easy to work. In places they benefit from subsoiling because it breaks up the cemented layer that retards the movement of water and the growth of roots. Drainage is not desirable, because it would lower the water table. Proper use of irrigation water keeps the water table from rising and thus prevents damage to deep-rooted crops. A border flooding system is the best method of irrigation if short runs are used, but a corrugation system is best if moderate runs are used. The quantity of water available should determine the irrigation method used. Light leveling or smoothing is needed to make irrigation easier in some places. The depth of the cuts does not have to be restricted. Windbreaks are needed to control wind erosion if the cropping system includes row crops. The fields should not be left bare for prolonged periods, because wind erosion is a hazard. Crops respond to nitrogen and phosphorus.

Capability unit IVs-4L, irrigated

This unit consists of nearly level to gently sloping, very deep, excessively drained to somewhat excessively drained soils on alluvial fans and terraces. These soils are members of the Mottsville and Toll series.

These soils have a surface layer of sand, sandy loam, or loamy coarse sand. In some places permeability is very rapid throughout the profile and in others it is rapid in the subsoil and very rapid in the substratum. The available water capacity and inherent fertility are low. Erosion is a slight to moderate hazard. Rapid runoff during high-intensity rainstorms deposits soil material brought down from upslope soils to these areas. In places, Toll sandy loam, 0 to 4 percent slopes, has a high water table caused by excessive irrigation.

All crops that are suited to the climate can be grown, but alfalfa grown in rotation with small grain is the preferred cropping system. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable. The growing of crops on these soils depends on the availability of irrigation water. Most of these soils are in brush.

These soils are easy to cultivate. They should not be left bare for prolonged periods, lest severe wind erosion take place. Windbreaks should be planted to protect the soils from wind erosion. A sprinkler system is the best method of irrigation. Frequent applications of small amounts of irrigation water are needed. Leveling is needed to prepare the soils for irrigation in some places. The depth of the cuts does not have to be limited. Crops respond to nitrogen and phosphorus.

Capability unit Vw–2, irrigated

This unit consists of nearly level, very deep, very poorly drained soils on flood plains. These soils are members of the Jubilee series. They are flooded occasionally by the Carson River.

These soils have a surface layer of loam or of clay that is slightly affected by salts and alkali. They receive seepage and irrigation-water runoff from higher areas. The water table fluctuates between depths of 1 foot and 2 feet during most of the growing season. Permeability is rapid in the subsoil and very rapid in the substratum. The available water capacity and natural fertility are moderate. Erosion is not a hazard.

Among the suitable crops are canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. If the main crop is hay or grain, it should be maintained as long as possible and then reestablished. At present these soils support meadow vegetation. If they are well managed, both the quality and quantity of vegetation can be expected to improve.

Controlled flooding, or contour flooding with provisions for removing the excess waste water, will keep the water table at its present level. Weeds should be clipped or sprayed periodically. Fertilizer, chiefly nitrogen, can be used to increase productivity. All droppings should be scattered to increase forage utilization. In places some cross fencing is needed so that the pastures can be rotated.

Capability unit Vw–3, irrigated

This unit consists of nearly level, moderately deep to deep, very poorly drained soils on low alluvial terraces and flood plains. These soils are members of the Dangberg and Voltaire series. They are occasionally flooded by the Carson River.

These soils have a surface layer of clay or silty clay that is slightly affected by salts and alkali. The water table fluctuates at depths between 1 foot and 2 feet during most of the growing season. Permeability is slow or very slow. Erosion is not a hazard. Soil material is deposited in some areas by floodwaters.

These soils support meadow vegetation. Among the suitable crops are canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. If the main crop is hay or grain, it should be maintained as long as possible and then reestablished.

Controlled flooding and contour flooding are the best methods of irrigation. Excessive quantities of water should not be used, because of the slow to very slow permeability. Drainage of the excess water should be provided.

Some improvement in both the quality and the quantity of forage can be expected if good management practices are used. Where practical, the meadows should be clipped or sprayed to control the weeds. All droppings should be scattered to increase forage utilization. Some cross fencing should be constructed so that pastures can be rotated.

Capability unit Vw–4, irrigated

This unit consists of nearly level, very deep, somewhat poorly drained to poorly drained soils on flood plains and low alluvial terraces. These soils are flooded by the Carson River. They are members of the Henningsen series and the sand substratum variant of the Jubilee series. The sand substratum variant of Jubilee soils occurs as long, narrow areas in association with areas of finer textured soils.

The surface layer of the soils in this unit is clay loam, gravelly loam, or loam. The underlying material is sand and gravel at a depth of less than 18 inches. Permeability is very rapid, and the available water capacity and inherent fertility are low. In some areas erosion is a slight hazard.

Where irrigation water is available, alfalfa-grass mixtures are grown in rotation with small grain. Among the suitable crops are barley, wheat, oats, alfalfa, intermediate wheatgrass, pubescent wheatgrass, and crested wheatgrass. An example of a suitable crop rotation, if the main crop is alfalfa, is 6 to 8 years of alfalfa and 1 year or 2 years of small grain. If the main crop is hay or pasture, 6 to 10 years of alfalfa-grass mixtures and 1 year or 2 years of small grain is suitable.

The soils are not easy to cultivate, because they contain gravel. Careful management is necessary to offset the droughtiness and low fertility. A border flooding system is the best method of irrigation, but a corrugation system can be used to advantage late in the season when the supply of water becomes inadequate. Frequent light applications of water are necessary. Short to moderate runs should be used. If additional acreage is placed under cultivation, it must be leveled before it can be irrigated. The cuts must be as shallow as possible to avoid exposing sand and gravel. The fields should not be leveled where deep cuts are needed. Crops respond mainly to nitrogen.

Where irrigation water is not available, these soils support native vegetation, consisting mainly of big sagebrush and grass. They are not used for range, because the total acreage in any one ranch is too small. Livestock make limited use of the available forage during periods when pastures are being irrigated.

Capability unit Vw–7, irrigated

This unit consists of nearly level to moderately sloping, very deep, somewhat poorly drained to poorly drained soils on alluvial terraces. These soils are members of the Brockliss series.

These soils have a surface layer of gravelly loamy sand or stony loamy sand. Permeability is rapid in the subsoil and very rapid in the substratum. The available water capacity and natural fertility are low. Erosion is a slight hazard.

Under intensive management where irrigation water is available, these soils can produce a fair amount of high-quality feed. In unirrigated areas they support stands of big sagebrush and bitterbrush and an understory of grasses.

Leveling or plowing these soils is difficult because of the stone content. The contour flooding system, in which small amounts of water are applied frequently, is the best method of irrigation. Droppings should be scattered periodically so that there is maximum use of forage. Pastures should be clipped periodically or sprayed to keep weeds at a mimimum. Crops respond to fertilizer.

Capability unit Vw-9, irrigated

This unit consists of nearly level, very deep, very poorly drained soils on flood plains or in basins. These soils are members of the Bishop series. Peat is also in this capability unit.

These soils have a surface layer of loam or peat. They contain molybdenum. The water table is within 24 inches of the surface during most of the growing season. Permeability is moderately slow, and the available water capacity and fertility are high. In some areas erosion is a slight hazard. The wetness is caused by seepage of ground water.

These soils are used for water-tolerant meadow. Among the suitable crops are canarygrass, creeping meadow foxtail, timothy, alsike clover, and strawberry clover. If the main crop is hay or grain, it should be maintained as long as possible and then reestablished.

Improvement in both the quantity and quality of vegetation can be expected if proper management practices are used. Irrigation water should not be applied until the plants need it. Controlled flooding, in runs about 1,200 feet long, keeps the water table at its present level. Drainage of excess waste water should be provided. The meadows should be clipped occasionally to control weeds. Droppings should be scattered to increase forage utilization. In some areas cross fencing is needed so that pastures can be rotated. The plants respond to nitrogen.

The amount of molybdenum in forage produced on these soils is sufficient to be toxic to livestock. Consequently, the livestock should be given injections of copper glycinate or should have copper sulfate available in their salt. The content of molybdenum does not affect productivity.

Capability unit VIw-6, irrigated

This unit consists of nearly level, moderately deep to very deep, poorly drained to very poorly drained, medium-textured to fine-textured soils that are affected by salts and alkali. These soils are members of the Cradlebaugh, Dangberg, Godecke, Settlemeyer, and Voltaire series. Also in this unit is the seeped variant of Voltaire soils. Most areas are periodically flooded by the Carson River. Permeability is moderately slow to very slow, and the available water capacity and fertility are moderate to high. Erosion is a slight hazard in some areas.

These soils are not suited to cultivated crops, but they are suited to salt-tolerant and alkali-tolerant grasses.

If good management practices are used, some improvement in the quality and quantity of forage can be expected. Controlled flooding or contour flooding, together with drainage of the excess water, can keep the water table at its present level and lessen the periods of ponding. These practices check the growth of water-tolerant weeds. The weeds should be clipped or sprayed periodically. Droppings should be scattered to increase forage utilization. Cross fencing is needed in some areas so that pastures can be rotated. Crops respond to nitrogen.

Capability unit VIc-K, nonirrigated

This unit consists of nearly level to strongly sloping, deep, well-drained soils on alluvial fans and terraces. These soils are members of the Borda, Indian Creek, McFaul, Prey, Reno, Springmeyer, and Washoe series and the heavy subsoil variant of the Prey series.

These soils have a medium-textured to coarse-textured surface layer that is gravelly, cobbly, or stony in places, and a moderately fine textured or fine textured subsoil. Runoff is slow to medium, and permeability is moderately slow to very slow. The available water capacity is low to moderate, and inherent fertility is moderate. Erosion is a slight to moderate hazard.

These soils should not be deep plowed. On most of the acreage, the available forage has been seriously depleted. Areas covered with large amounts of big sagebrush and rabbitbrush can be plowed and reseeded to suitable grasses. Some fire-protection measures should be provided to prevent destruction of the available forage.

Capability unit VIIe-1, nonirrigated

This unit consists of moderately steep to very steep, shallow to deep, well-drained to excessively drained soils on rolling foothills and mountain slopes. These soils are members of the Aldax, Borda, Indiano, and Springmeyer series. Gullied land and Rough broken land are also in this unit.

The soils have a moderately coarse textured to medium-textured, gravelly, stony, or cobbly surface layer. Runoff is medium to rapid, and permeability is slow to moderately rapid. The available water capacity and inherent fertility are moderate. Erosion is a moderate to severe hazard.

On most of the acreage, the available forage has been seriously depleted. What vegetation remains should be used for grazing, wildlife habitat, and watershed protection. These areas should not be disturbed, because erosion could become accelerated and difficult to control.

Capability unit VIIw-2, irrigated

This unit consists of nearly level to moderately sloping, very deep, very poorly drained, organic soils. These soils are members of the James Canyon, Jubilee, and Ophir series. They receive seepage from artesian springs, and the Jubilee soil receives seepage of excess irrigation water from higher areas. Permeability is moderately rapid to rapid, and the available water capacity and fertility are low to high. In some areas erosion is a moderate hazard. The Ophir soil contains molybdenum.

These soils provide periodic grazing, but they are not suited to cultivated crops. The native vegetation consists of coarse sedge and juncus. Improvements in the quality and quantity of vegetation cannot be expected, because the soils are saturated most of the year. Livestock should be closely watched in spring and early in summer. They should be fenced out of the wetter areas because they get bogged down and cannot get out without help. Forage grown on the Ophir soil contains enough molybdenum to be toxic to livestock.

Capability unit VIIw–6, nonirrigated

This unit consists of nearly level to gently sloping, shallow to very deep, somewhat poorly drained to moderately well drained soils that are affected by salts and alkali. These soils are members of the Cradlebaugh, Fettic, and Hussman series. Also in this unit are the thin solum variant of the Dangberg series, the pan variant of the Fettic series, and the gypsic variant of the Puddle series.

The surface layer of these soils is medium textured to fine textured. Most areas are flooded periodically by the Carson River. Permeability is moderate to very slow, and the available water capacity and fertility are low to high. In some places erosion is a moderate to slight hazard.

These soils are not suited to cultivated crops, but they provide limited grazing for livestock. Improving the quality and quantity of available forage is very difficult because of the high content of salts and alkali. The growth of grasses that are tolerant of salts and alkali cannot be encouraged, because the water table is too low. Irrigation is not feasible, because either water rights are not available or the soils are in higher positions than sources of irrigation water, which consequently, cannot reach them by gravity flow. The cover of brush or greasewood should not be removed, because other vegetation cannot be established.

Capability unit VIIw–L, irrigated

This unit consists of Sandy alluvial land, a nearly level to gently sloping, very poorly drained land type on flood plains. The areas are frequently flooded, and in some places they are gravelly. The soil materials below the surface are highly stratified and have widely varying textures. They were recently deposited by streams.

This land type is not suited to cultivated crops, but it is used periodically for grazing. It supports sparse stands of meadow vegetation, but improvement in the quantity of vegetation cannot be expected, because the soil material is unstable. Livestock usually can graze throughout the growing season, but grazing animals must be excluded from some areas during periods of flooding.

Capability unit VIIs–1, nonirrigated

This unit consists of very shallow to shallow, steep to very steep, well-drained to excessively drained, coarse-textured, very stony and very rocky soils on mountains. These soils are members of the Franktown, Glenbrook, and Toiyabe series. Permeability is moderately rapid to rapid, the available water capacity is very low, and fertility is low to very low. Erosion is a moderate to very severe hazard. The annual precipitation is 12 to 24 inches.

These soils are not suited to cultivated crops. They are used for range, woodland, wildlife, and water supply. Most of these soils support woodland that has a grazeable understory, but the Glenbrook soil supports only brush.

Because of the steepness, the grazing of livestock is almost minimal, but deer graze the available forage until deep snow drives them to lower elevations. The woodland should be protected from fire so that valuable water supply areas are not lost through erosion. Trees cannot regenerate naturally, because of the very low available water capacity of the soils. Planting trees is costly.

Capability unit VIIs–7, nonirrigated

This unit consists of shallow to moderately deep, moderately sloping to steep, well-drained, medium-textured to moderately coarse textured soils. These soils are members of the Holbrook, Indian Creek, and Springmeyer series. Permeability is moderately rapid to very slow, the available water capacity is low to moderate, and fertility is moderate to high. In some places the erosion hazard is moderate to severe. The annual precipitation is 12 to 14 inches.

These soils are not suited to cultivated crops, but they are used for limited grazing by livestock. In many areas the available forage has been seriously depleted. Because of the stoniness, it is not feasible to improve the available forage by seeding nor by clearing brush, because there are too few remnant grasses in the understory; nor by applying fertilizer, because of the small amount of rainfall and the limited amount of grass. Some improvement in forage production can be obtained through (1) proper rates of stocking to prevent overgrazing of available forage; (2) placing saltboxes away from watering places to better distribute grazing; (3) rotating and deferring grazing to allow time for plants to regain vigor; and (4) constructing fences where they are needed to regulate grazing.

Capability unit VIIs–8, nonirrigated

This unit consists of shallow to deep, gently sloping to very steep, well-drained, stony to very stony, moderately coarse textured soils on foothills. These soils are members of the Aldax, Millich, and Stodick series. Permeability is slow to moderately rapid, the available water capacity is very low to low, and fertility is low to moderate. Erosion is a slight to severe hazard. Annual precipitation is 8 to 16 inches.

These soils are used for range. They are not suited to cultivated crops. The Millich soils are used both for range and for timber production. Some areas of the Holbrook soils are used for homesites because of their location and scenic setting.

In many areas the available forage has been seriously depleted by past grazing and by fire. It is not feasible to increase the amount of available forage by seeding, because of the stoniness and the shallowness of the soil, nor by removing brush, because of the slope in many areas. Some improvement in forage production can be obtained by proper rates of stocking.

Deer also graze these areas. Their numbers vary from year to year, according to the number of fawns and according to the severity of winter snows at the higher elevations. Few, if any, deer come into these areas when the snowpack is light.

Capability unit VIIs–L, nonirrigated

This unit consists of shallow to very deep, nearly level to steep, somewhat excessively drained to excessively drained, sandy soils. These soils are members of the Cave Rock, Glenbrook, Mottsville, Quincy, and Toll series. Permeability is rapid to very rapid, and the available water capacity and fertility are very low to moderate. In some areas erosion is a severe hazard. The annual precipitation is 8 to 16 inches.

These soils are used for limited grazing by both livestock and deer. They are not suited to cultivated crops. Small tracts in many areas are used for homesites because of their location and scenic setting. The Mottsville soils are used for both range and woodland.

In many areas the available forage has been seriously depleted by past grazing and by fire. It is not feasible to increase the amount of available forage by seeding, because the soils are sandy and droughty; nor by removing brush, partly because of the wind erosion hazard and partly because removing brush would destroy bitterbrush and other important browse needed by deer. Some improvement in forage production can be obtained through proper rates of stocking. Deer also graze these areas. Their numbers vary from year to year, according to the severity of winter snows at the higher elevations. Fire protection is needed, not only for homes but also for preventing the needless destruction of valuable range for wildlife and livestock.

Capability unit VIIIs–8, nonirrigated

This unit consists of Rock land, a moderately sloping to very steep land type on foothills and mountains. There is little or no vegetation because of the lack of soil material. These areas are essentially inaccessible. They are suitable only for wildlife habitat, recreation, and water supply.

Estimated Yields

Table 2 lists average yields per acre that can be expected under a moderately high level of management on selected irrigated soils in the survey area. In the Carson Valley Area, this level of management is used in most cultivated fields but not in areas producing meadow vegetation. The estimates are based on data compiled by the Soil Conservation Service, the Nevada Agricultural Experiment Station, and the Nevada Cooperative Extension Service and on information obtained from some of the ranchers in the area.

Several important limitations should be kept in mind when using table 2.

1. The yield figures are conservative estimates.
2. The estimates are of average yields that may be expected over a period of years; the yield in any given year may be higher or lower than this average, depending on variations in the supply of irrigation water and in the length of the growing season. The soils that are known to have an inadequate supply of irrigation water are identified in the table.
3. There are variations in yields among areas of the same soil.
4. Past management of a soil affects its response to new management practices.
5. New crop varieties and improved farming practices are likely to affect future yields.
6. The availability of farm labor is also reflected in crop yields.

In table 2 the yields shown in the column headed "Alfalfa-grass mixture" may be expected to decrease slightly if alfalfa is grown by itself. Native meadow may include some introduced species of grass and clover. Pasture includes some stands of grass and clover that have been seeded. It may be either grazed or cut for hay.

Wildlife

The kind and number of wildlife species are determined by the suitability of the environment, or habitat. The suitability of the habitat is related to the use of the soils, the kind of plant cover, the topography, and, as in the case of waterfowl and pond fish, to such soil features as drainage and suitability for water impoundments.

Sustained use of the Carson Valley Area for wildlife depends upon a well-planned management program. The suitability of the soils as habitat for desirable kinds of wildlife can be determined through knowledge of the soils. This knowledge can serve as a basis for planning the development and maintenance of areas suitable for wildlife habitat. Table 3 shows the suitability of the soils in the survey area for several elements of wildlife habitat.

Grain crops, seeded grasses and legumes, and hedgerow cover make up the essential elements of habitat for ring-necked pheasants, California quail, mourning doves, cottontail rabbits, and other kinds of cropland wildlife.

Native browse and brush and native grasses and forbs make up the essential elements of habitat for mule deer, songbirds, chukar partridge, California quail, mourning doves, sage hens, and other kinds of rangeland wildlife.

Coniferous forest, native browse and brush, and native grasses and forbs make up the essential elements of habitat for mule deer, songbirds, blue grouse, and other woodland wildlife.

Marsh vegetation, shallow-water impoundments, seeded grasses and legumes, and grain crops are essential for ducks, geese, shorebirds, wading birds, songbirds, muskrats, and other wetland wildlife.

Deep-water ponds and reservoirs are essential for rainbow trout, bass, bluegills, and other pond fish.

TABLE 2.—*Estimated average yields per acre of principal crops on selected irrigated soils*

[These yields can be obtained under a moderately high level of management. Absence of a yield estimate indicates that the crop is not suited to the soil or that it is not commonly grown]

Soil	Alfalfa-grass mixture	Barley	Oats	Native meadow	Pasture
	Tons	*Tons*	*Tons*	*Tons*	*Tons*
Bishop loam, poorly drained, cool				1.50	3.5
Bishop loam, poorly drained, slightly saline-alkali, cool				1	3.50
Calpine gravelly coarse sandy loam, 0 to 2 percent slopes					2.25
Cradlebaugh clay loam	3.75	1.5	1.25		
Cradlebaugh soils, poorly drained, slightly saline-alkali	3	1.25	.75	1	3
Cradlebaugh soils, slightly saline-alkali	3.25	1.25	.75	1	2
Draper loam, overflow	4.25	1.75	1.5		
Dressler gravelly sandy loam, 0 to 2 percent slopes	3.25		1	1.25	3
Dressler sandy loam, 0 to 2 percent slopes	3.25		1	1.25	3
East Fork clay loam	4.25	1.75	1.5		
Gardnerville clay loam, gravel substratum	4	1.50	1.25		
Gardnerville clay loam[1]	4	1.25	1.25		
Gardnerville clay loam, slightly saline-alkali[1]	3.25	1	1		
Heidtman clay loam, clay substratum	4	1.50	1.25		3
Heidtman clay loam	4	1.50	1.25		3
Heidtman loam, slightly saline-alkali	3.25	1.25	1		2.50
Henningsen loam, moderately deep variant	4	1.75	1.5		
Holbrook gravelly fine sandy loam, 2 to 4 percent slopes[1]	2.5		.75		
Hussman clay	4.5	1.50	1.25		
Hussman clay, slightly saline-alkali	3.75	1.25	1		
James Canyon loam, 4 to 16 percent slopes			1	1.25	3
James Canyon loam, drained, 2 to 4 percent slopes[1]	3.5		.75		
Job loam	4	1.50	1.25		3
Job loam, clay substratum, water table, slightly saline-alkali	3.25	1.25	1		2.25
Job loam, slightly saline-alkali	3.25	1.25	1		2.25
Job loam, water table	3.75	1.50	1		3
Jubilee loam, poorly drained				1	2.25
Jubilee clay loam, sand substratum variant, deep				1	2.25
Kimmerling clay loam				1.50	3.5
Kimmerling clay loam, clay substratum				1.50	3.5
Ophir gravelly sandy loam, 2 to 8 percent slopes			.75	1	2.25
Ophir gravelly sandy loam, somewhat poorly drained, 2 to 8 percent slopes			.50	.50	1.5
Ormsby gravelly loamy sand[1]	3.25		1		
Ormsby loamy sand[1]	3.25		1		
Settlemeyer clay loam	3.75	1.50	1.25	1.25	
Settlemeyer clay loam, somewhat poorly drained	4	1.50	1.25		
Turria clay loam, water table	4.50	1.50	1.25		
Voltaire clay, slightly saline-alkali	3	1	.75	.75	
Voltaire silty clay	3.25	1	.75		
Washoe gravelly sandy loam[1]	4	1	.75		

[1] The supply of irrigation water is insufficient.

The meaning of the suitability ratings used in table 3 are as follows:

Well suited means that habitats generally are easily created, improved, or maintained; that the soil and climate have few or no limitations that affect management; and that satisfactory results can be expected.

Suited means that habitats can be created, improved, or maintained in most places; that the soil and climate have moderate limitations that affect management; and that moderate intensity of management and fairly frequent attention may be required for satisfactory results.

Poorly suited indicates that habitats can be created, improved, or maintained in most places; that the soil and climate have rather severe limitations; that habitat management is difficult and expensive and requires intensive effort; and that results are not always satisfactory.

Unsuited indicates that it is impractical or impossible to create, improve, or maintain habitats, and that unsatisfactory results are probable.

Wildlife sites

The soil series represented in the Carson Valley Area, and the land type Peat, have been grouped into 20 wildlife sites according to their suitability as elements of wildlife habitat. Each site is made up of soils that can provide about the same kind of food and cover. Only the soil typical of each series has been considered; separation of soils that contain salts and alkali into different sites has not been attempted. Gullied land, Rock land, Rough broken land, and Sandy alluvial land were not placed in a wildlife site.

Wildlife populations

A few mule deer find habitat in areas of alluvial fans, high terraces, foothills, and steep mountains along the northern, western, and southern edges of the Carson Valley Area. A limited number find habitat along the flood plains of the Carson River, where there is a relatively good cover of willow. Migratory herds of deer that summer in the Sierra Nevada use the northern and southern parts of the survey area when they migrate to winter range. In years of heavy snow in the mountains and foothills, it is not unusual for a herd to number 3,000 to 5,000 head.

In spring and fall migrating flocks of geese and ducks feed and rest in the marshy areas, wet meadows, and grainfields, but suitable nesting areas are limited to marshes, sloughs, and the Carson River. Furbearers are also common in these areas.

The habitat for both pheasant and quail is good in cultivated areas and the adjacent range. The hunting harvest is above average in irrigated areas. Mourning doves are plentiful from spring through fall, and they provide excellent hunting. Songbirds are numerous throughout the survey area.

Fishing for rainbow trout is good on the East Fork and West Fork of the Carson River but not on the main part of the River, where the water supply is sometimes inadequate for trout. Catfish are plentiful in the warm-water marsh adjacent to Walleys Hot Springs, and there are some in the lower reaches of the Carson River.

Engineering Uses of the Soils

Some soil properties are of particular interest to engineers, because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, irrigation and drainage systems, and sewage disposal systems. Among the soil properties most important to engineers are permeability, shear strength, compaction characteristics, drainage, shrink-swell potential, dispersion, grain size, plasticity, and reaction. Depth to the water table, depth to bedrock, available water capacity, and topography are also important.

Estimates of soil properties significant in engineering are given in table 4, interpretations relating to engineering uses of the soils are shown in table 5, and engineering test data on soil samples from the Carson Valley Area are given in table 6.

The estimates and interpretations of soil properties in these tables can be used in—

1. Planning and designing agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. They do not eliminate the need for sampling and testing at the site of specific engineering work 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.

Some of the terms used in this publication, for example, sand, silt, and clay, have a special meaning to soil scientists and a different meaning to engineers. Many used in describing soils are defined in the Glossary.

Engineering classification systems

Two systems of classifying soils are in general use among engineers. Most highway engineers classify soil materials according to the system used by the American Association of State Highway Officials (AASHO) *(1)*. This system is based on grain-size distribution, liquid limit, plasticity index, and field performance of soils in highways. In the AASHO system, soil materials are classified in seven principal groups. The groups range from A–1, which consists of gravelly soils having high bearing strength (the best soils for road subgrade), to A–7, which consists of clayey soils having low strength when wet (the poorest soils for road subgrade). Within each group, the relative engineering value of a soil is indicated by group index numbers that range from 0 for the best material to 20 for the poorest.

TABLE 3.—*Suitability of the soils*

Wildlife site and soil series	Elements of wildlife habitat				
	Grain crops	Native browse and brush, and native grasses and forbs	Coniferous forest, native browse and brush, and native grasses and forbs	Marsh vegetation	Shallow-water impoundments
Site 1. Aldax, Indiano	Unsuited	Suited	Poorly suited	Unsuited	Unsuited
Site 2. James Canyon, calcareous variant of James Canyon, Ophir.	Poorly suited	Unsuited	Unsuited	Poorly suited	Poorly suited
Site 3. Draper, Dressler, moderately deep variant of Henningsen, Job.	Well suited	Suited	Unsuited	Suited	Suited
Site 4. Bishop, Jubilee, sand substratum variant of Jubilee, Kimmerling, Voltaire.	Poorly suited	Unsuited	Unsuited	Well suited	Well suited
Site 5. Borda, Millich	Unsuited	Poorly suited	Suited	Unsuited	Unsuited
Site 6. Brockliss, Cave Rock, Holbrook, Mottsville.	Poorly suited	Well suited	Unsuited	Unsuited	Unsuited
Site 7. Calpine	Suited	Well suited	Unsuited	Poorly suited	Poorly suited
Site 8. Cashmere, Ormsby, Washoe	Suited	Poorly suited	Unsuited	Unsuited	Unsuited
Site 9. Cradlebaugh, Settlemeyer	Suited	Unsuited	Unsuited	Well suited	Well suited
Site 10. Dangberg	Poorly suited	Unsuited	Unsuited	Suited	Suited
Site 11. Thin solum variant of Dangberg, Fettic, Godecke, gypsic variant of Puddle.	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited
Site 12. East Fork, Heidtman, Hussman	Well suited	Suited	Unsuited	Well suited	Well suited
Site 13. Franktown, Toiyabe	Unsuited	Suited	Suited	Unsuited	Unsuited
Site 14. Gardnerville, Turria	Well suited	Poorly suited	Unsuited	Suited	Suited
Site 15. Glenbrook, Prey, heavy subsoil variant of Prey, Springmeyer.	Unsuited	Well suited	Unsuited	Unsuited	Unsuited
Site 16. Haybourne, McFaul, Reno, Toll	Unsuited	Poorly suited	Unsuited	Unsuited	Unsuited
Site 17. Henningsen	Suited	Poorly suited	Unsuited	Poorly suited	Poorly suited
Site 18. Indian Creek, Stodick	Unsuited	Poorly suited	Unsuited	Unsuited	Unsuited
Site 19. Pan variant of Fettic	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited
Site 20. Peat	Unsuited	Unsuited	Unsuited	Well suited	Well suited

for elements of wildlife habitat

Elements of wildlife habitat—Continued	Suitability for wildlife that find habitat in—				Suitability for pond fish	
Deep-water ponds	Cropland	Rangeland	Woodland	Wetland	Rainbow trout	Bass and bluegills
Unsuited	Unsuited	Suited	Poorly suited	Unsuited	Unsuited	Unsuited.
Poorly suited	Poorly suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Poorly suited	Well suited	Suited	Unsuited	Suited	Poorly suited	Poorly suited.
Suited	Poorly suited	Unsuited	Unsuited	Well suited	Suited	Suited.
Unsuited	Unsuited	Poorly suited	Suited	Unsuited	Unsuited	Unsuited.
Unsuited	Poorly suited	Well suited	Unsuited	Unsuited	Unsuited	Unsuited.
Poorly suited	Suited	Well suited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Unsuited	Suited	Poorly suited	Unsuited	Unsuited	Unsuited	Unsuited.
Suited	Suited	Unsuited	Unsuited	Well suited	Poorly suited	Suited.
Suited	Poorly suited	Unsuited	Unsuited	Suited	Poorly suited	Suited.
Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Unsuited	Poorly suited.
Suited	Well suited	Suited	Unsuited	Well suited	Poorly suited	Suited.
Unsuited	Unsuited	Suited	Suited	Unsuited	Unsuited	Unsuited.
Suited	Well suited	Poorly suited	Unsuited	Suited	Poorly suited	Suited.
Unsuited	Unsuited	Well suited	Unsuited	Unsuited	Unsuited	Unsuited.
Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited	Unsuited	Unsuited.
Poorly suited	Suited	Poorly suited	Unsuited	Poorly suited	Poorly suited	Poorly suited.
Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited	Unsuited	Unsuited.
Poorly suited	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited	Poorly suited.
Suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Suited.

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TABLE 4.—*Estimated*

[Dashes indicate that no

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Hardpan or bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Aldax: AdE, AlE, AnF For Indiano part of AnF, see Indiano series.	1–2	(1)	0–14 14	Stony fine sandy loam Andesite bedrock.	SM	A–2
Bishop:						
Bh	>6	1–2	0–13 13–26 26–49 49–60	Loam Sandy clay loam Cobbly sandy loam Clay	CL or ML SC or CL SM CH or MH	A–4 or A–6 A–4 or A–6 A–2 A–7
Bc, Bc2, Bm	>6	0–3	0–13 13–26 26–60	Loam Sandy clay loam Cobbly sandy loam	CL or ML SC or CL SM	A–4 or A–6 A–4 or A–6 A–2
Bn	>6	2–3	0–10 10–27 27–60	Loam Sandy clay loam Cobbly sandy loam	CL or ML SC or CL SM	A–4 or A–6 A–4 or A–6 A–2
Borda: BoC, BrF	2.5–4.5	(1)	0–10 10–34 34–50	Stony sandy loam Clay Clay loam	SM CH CL	A–2 or A–4 A–7 A–6
Brockliss: BsA, BtA, BwA	>6	1.5–4.5	0–23 23–60	Stony loamy sand Very stony coarse sand	SM SW	A–2 or A–1 A–1
Calpine: CaA, CcB	>6	(1)	0–19 19–60	Gravelly coarse sandy loam. Coarse sandy loam	SM SC or SM	A–2 A–4 or A–2
Cashmere: Cf	>6	(1)	0–40 40–62	Fine sandy loam Very gravelly and cobbly fine sand.	SM GP	A–4 or A–2 A–1
Cave Rock: CkC	>6	(1)	0–70	Loamy sand	SM	A–1
Cradlebaugh: Cm, Cn, Co, Cr, Cs, Ct, Cu.	>6	3–4	0–17 17–65	Clay loam Fine sandy loam	CL SM	A–6 A–4
Dangberg: Da, Db, Dc, De, Dg	2–3	1–3	0–25 25–43 43–53	Clay Silica-cemented hardpan Coarse sand	CH or MH — SW or SP	A–7 — A–1
Dangberg, thin solum variant: Dk	1.5–3	4–6	0–4 4–9 9–28 28–54	Clay loam Clay Clay loam Silica-cemented hardpan	CL CH CL —	A–6 A–7 A–6 —
Draper: Dl, Do	>6	4–6	0–48 48–60	Loam Very gravelly sand	ML or CL GP or GW	A–4 or A–6 A–1
Dressler:						
DrA, DsA	>6	2–4	0–20 20–60	Gravelly sandy loam Loamy sand	GM or SM SM or SP	A–2 A–1 or A–3
DtA, DwA, DwB	>6	2–4	0–20 20–60	Sandy loam Loamy sand	SM SM or SP	A–2 or A–4 A–1
East Fork:						
Ea	>6	4–6	0–63	Clay loam	CL	A–6
Ef	>6	4–6	0–9 9–63	Loam Clay loam	CL CL	A–4 or A–6 A–6
Fettic:						
Fc, Fe	>6	3.5–5.5	0–29 29–60	Clay Fine sandy loam	CH SM	A–7 A–4 or A–2

properties of the soils

estimates were made]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Potential for frost heave	Corrosivity to uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)							
			Inches per hour	*Inches per inch of soil*	*pH*				
75–95	70–95	25–35	2.0–6.3	0.08–0.10	6.6–7.3	None	Low	Moderate	Low.
100	95–100	55–70	0.63–2.0	0.16–0.18	7.9–8.4	None	Moderate	Moderate to high	High.
100	90–100	40–60	0.20–0.63	0.14–0.16	6.6–7.8	None	Moderate	Moderate to high	High.
90–95	80–90	20–35	2.0–6.3	0.07–0.09	6.6–7.3	None	Low	Moderate	High.
100	100	75–90	<0.06	0.14–0.16	6.6–7.3	Low	High	Moderate	High.
100	95–100	55–70	0.63–2.0	0.16–0.18	7.9–8.4	None	Moderate	Moderate to high	High.
100	90–100	40–60	0.20–0.63	0.14–0.16	6.6–7.8	None	Moderate	Moderate to high	High.
90–95	80–90	20–35	2.0–6.3	0.07–0.09	6.6–7.3	None	Low	Moderate	High.
100	95–100	55–70	0.63–2.0	0.16–0.18	7.9–9.0	Moderate	Moderate[2]	Moderate to high	High.
100	90–100	40–60	0.20–0.63	0.14–0.16	7.3–8.4	Low to moderate	Moderate[2]	Moderate to high	High.
90–95	80–90	20–35	2.0–6.3	0.07–0.09	6.6–7.3	Low	Low	Moderate	High.
65–80	60–70	30–45	2.0–6.3	0.07–0.09	6.1–6.5	None	Low	Moderate	Low.
95–100	95–100	70–90	0.06–0.20	0.14–0.16	6.6–8.4	Low	High	Moderate	High.
90–95	85–95	55–75	0.20–0.63	0.18–0.20	7.9–8.4	Low	Moderate	Moderate to high	High.
80–95	75–85	10–15	6.3–20.0	0.05–0.07	6.1–7.3	None	Low	Low	Moderate.
80–95	70–85	0–5	>20	0.03–0.05	6.1–7.3	None	Low	Low	Moderate.
75–95	65–80	20–30	2.0–6.3	0.07–0.09	5.6–6.5	None	Low	Moderate	Low.
90–100	85–95	25–40	0.63–2.0	0.10–0.12	5.6–6.5	None	Low	Moderate	Low.
95–100	90–100	30–45	2.0–6.3	0.13–0.15	6.6–7.3	None	Low	Moderate	Low.
15–50	5–20	0–5	>20	0.03–0.05	7.3–8.4	Low	Low	Low	Low.
95–100	85–100	10–20	6.3–20.0	0.06–0.08	6.1–6.5	None	Low	Low	Low.
100	100	60–75	0.20–0.63	0.18–0.20	8.5–9.6	Low	Moderate	Moderate to high	High.
100	100	35–50	2.0–6.3	0.13–0.15	7.9–9.8	Low to very high	Low	Moderate	High.
100	100	70–90	0.06–0.20	0.14–0.16	8.5–9.6	Moderate to very high.	High[2]	Moderate	High.
—	—	—	<0.06	—	—	—	—	—	—
90–100	80–95	0–5	>20	0.05–0.07	7.3–8.4	Low	Low	Low	High.
100	100	65–80	0.20–0.63	0.18–0.20	8.5–9.0	High to very high	Moderate[2]	Moderate to high	High.
100	100	75–90	0.06–0.20	0.14–0.16	9.1–9.6	High to very high	High[2]	Moderate	High.
100	100	65–80	0.20–0.63	0.18–0.20	9.1–9.6	High to very high	Moderate[2]	Moderate to high	High.
—	—	—	<0.06	—	—	—	—	—	—
100	100	55–70	0.63–2.0	0.16–0.18	6.1–7.3	None	Low to moderate.	High	High.
30–55	20–30	0–5	>20	0.03–0.05	6.1–7.3	None	Low	Low	High.
55–85	50–80	15–30	2.0–6.3	0.07–0.09	6.1–7.3	None	Low	Moderate	Moderate.
55–75	50–80	5–20	6.3–20.0	0.06–0.08	6.1–6.5	None	Low	Moderate	Moderate.
85–95	80–90	20–40	2.0–6.3	0.11–0.13	6.1–7.3	None	Low	Moderate	Moderate.
85–90	80–90	5–20	6.3–20.0	0.06–0.08	6.1–6.5	None	Low	Moderate	Moderate.
100	100	65–75	0.20–0.63	0.18–0.20	6.1–7.3	Low	Moderate	Moderate to high	Moderate.
100	100	55–70	0.63–2.0	0.16–0.18	6.1–6.3	Low to moderate	Moderate[2]	High	High.
100	100	65–75	0.20–0.63	0.18–0.20	6.6–7.3	Low to moderate	Moderate[2]	Moderate to high	High.
100	100	60–85	0.06–0.20	0.14–0.16	7.9–9.0	High to very high	High[2]	Moderate	High.
100	100	25–50	2.0–6.3	0.13–0.15	7.4–8.4	Low to moderate.	Low[2]	Moderate	High.

TABLE 4.—*Estimated properties*

Soil series and map symbols	Depth to— Hardpan or bedrock	Depth to— Seasonal high water table	Depth from surface (typical profile)	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Feet	*Feet*	*Inches*			
Fettic—Continued						
Ff	>6	3.5–5.5	0–4	Very fine sandy loam	ML	A–4
			4–29	Clay	CH	A–7
			29–60	Fine sandy loam	SM	A–4 or A–2
Fettic, pan variant: FpB	>6	(1)	0–5	Very fine sandy loam	ML	A–4
			5–10	Clay loam	CL	A–6
			10–36	Silica-cemented hard pan.	—	—
			36–51	Sandy clay loam	SC	A–6
Franktown: FrG	0.5–1	(1)	0–10	Very gravelly sandy loam.	GP or GM	A–1
			10	Fractured schist.		
Gardnerville:						
Ga, Gc, Gd, Ge, Gg	>6	4–7	0–16	Clay	CH	A–7
			16–58	Loamy sand	SM	A–1 or A–2
			58–67	Coarse sand	SP	A–1
Gh	>6	4–5	0–16	Clay	CH or MH	A–7
			16–58	Loamy sand	SM	A–1 or A–2
			58–67	Coarse sand	SP	A–1
Glenbrook:						
GkF, GlE	1–2	(1)	0–15	Sand	SW or SP	A–1
			15	Weathered granite.		
Godecke: Go	>6	4–7	0–18	Clay loam	CL	A–6
			18–36	Fine sandy loam	SM or SC	A–4
			36–55	Loamy fine sand	SM	A–2
Gullied land: Gu Properties highly variable; no estimates made.						
Haybourne:						
HaA, HaB	>6	(1)	0–6	Loam	CL or ML	A–4 or A–6
			6–25	Sandy loam	SM	A–4 or A–2
			25–52	Loamy sand	SM	A–1
HbB	>6	(1)	0–9	Sand	SP	A–3
			9–25	Sandy loam	SM	A–4 or A–2
			25–52	Loamy sand	SM	A–1
Heidtman:						
Hc	>6	3–5	0–47	Clay loam	CL	A–6
			47–60	Sand	SP	A–1
Hd	>6	3–5	0–35	Clay loam	CL	A–6
			35–60	Clay	CH	A–7
He	>6	3–5	0–5	Loam	CL or ML	A–6 or A–4
			5–60	Clay loam	CL	A–6 or A–7
Henningsen:						
Hf	>6	2–3	0–8	Clay loam	CL	A–6
			8–60	Very gravelly loamy coarse sand.	GW or GM	A–1
Hg, Hh	>6	2–5	0–13	Gravelly loam	GM or SM	A–4 or A–2
			13–60	Very gravelly loamy coarse sand.	GW or GM	A–1
Hk, Hl	>6	2–5	0–13	Loam	CL or ML	A–6 or A–4
			13–60	Very gravelly loamy coarse sand.	GW or GM	A–1

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Potential for frost heave	Corrosivity to uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)							
			Inches per hour	*Inches per inch of soil*	*pH*				
100	100	50–60	0.63–2.0	0.15–0.17	7.9–9.0	Low to moderate	Low[2]	High	High.
100	100	70–80	0.06–0.20	0.14–0.16	9.1–9.6	High to very high	High[2]	Moderate	High.
100	100	25–50	2.0–6.3	0.13–0.15	7.4–8.4	Moderate to high	Low[2]	Moderate	High.
95–100	95–100	50–70	0.63–2.0	0.15–0.17	7.9–9.0	Very high	Low[2]	High	High.
100	95–100	60–75	0.20–0.63	0.18–0.20	8.5–9.6	Moderate to high	Moderate[2]	Moderate to high	High.
—	—	—	<0.06	—	—	—	—	—	—
100	95–100	35–50	0.20–0.63	0.14–0.16	8.5–9.4	Moderate to high	Moderate[2]	Moderate	High.
40–70	30–50	5–15	2.0–6.3	0.05–0.07	5.6–6.5	None	Low	Low	Low.
100	100	60–75	0.06–0.20	0.14–0.16	6.6–7.3	Low	High	Moderate	High.
100	100	15–30	2.0–6.3	0.06–0.08	6.6–7.8	Low to moderate	Low	Moderate	High.
95–100	90–100	0–5	6.3–20.0	0.05–0.07	6.6–7.8	Low	Low	Low	High.
100	100	60–75	0.06–0.20	0.14–0.16	6.6–8.4	Moderate to high	High[2]	Moderate	High.
100	100	15–30	2.0–6.3	0.06–0.08	6.6–8.4	Moderate to high	Low	Moderate	High.
95–100	90–100	0–5	6.3–20.0	0.05–0.07	6.6–7.8	Low	Low	Low	High.
85–95	65–85	0–5	>20	0.05–0.07	6.1–7.3	None	Low	Low	Low.
100	100	60–75	0.06–0.20	0.18–0.20	8.5–9.4	High to very high	Moderate[2]	Moderate to high	High.
100	100	40–50	2.0–6.3	0.13–0.15	8.5–9.6	High to very high	Low[2]	Moderate	High.
100	100	15–30	0.63–2.0	0.09–0.11	8.5–9.6	High to very high	Low	Moderate	High.
95–100	95–100	55–65	0.63–2.0	0.16–0.18	6.1–7.3	Low	Moderate	High	Moderate.
95–100	95–100	30–45	2.0–6.3	0.11–0.13	6.1–7.3	None	Low	Moderate	Low.
100	100	15–20	6.3–20.0	0.06–0.08	6.6–7.3	None	Low	Low	Low.
95–100	95–100	0–5	>20	0.05–0.07	6.1–7.3	None	Low	Low	Low.
95–100	95–100	30–40	2.0–6.3	0.11–0.13	6.1–7.3	None	Low	Moderate	Low.
100	100	15–20	6.3–20.0	0.06–0.08	6.6–7.3	None	Low	Low	Low.
100	100	65–75	0.20–0.63	0.18–0.20	7.9–9.0	Moderate	Moderate[2]	Moderate to high	High.
100	90–100	0–5	>20	0.05–0.07	7.4–8.4	Low	Low	Low	High.
100	100	65–75	0.20–0.63	0.18–0.20	7.9–9.0	Low to moderate	Moderate[2]	Moderate to high	High.
100	100	75–85	0.06–0.20	0.14–0.16	7.9–9.0	Low to moderate	High[2]	Moderate	High.
100	100	60–70	0.63–2.0	0.16–0.18	8.5–9.0	Moderate to high	Moderate[2]	High	High.
100	100	65–75	0.20–0.63	0.18–0.20	8.5–9.0	Moderate to high	Moderate[2]	Moderate to high	High.
95–100	90–100	60–75	0.20–0.63	0.18–0.20	6.6–7.3	None	Moderate	Moderate to high	High.
30–50	20–35	0–10	>20	0.05–0.07	6.6–7.3	None	Low	Low	High.
60–80	55–70	30–45	2.0–6.3	0.11–0.13	6.6–7.3	None	Low	Low to moderate	Moderate to high.
30–50	20–35	0–10	>20	0.05–0.07	6.6–7.3	None	Low	Low	High.
90–100	85–100	50–70	0.63–2.0	0.16–0.18	6.6–7.3	None	Moderate	High	High.
30–50	20–35	0–10	>20	0.05–0.07	6.6–7.3	None	Low	Low	High.

TABLE 4.—*Estimated properties*

Soil series and map symbols	Depth to— Hardpan or bedrock	Depth to— Seasonal high water table	Depth from surface (typical profile)	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Feet	*Feet*	*Inches*			
Henningsen, moderately deep variant: Hm, Hn	>6	4–6	0–26	Clay loam	CL or ML	A–6 or A–4
			26–60	Gravel	GW or GP	A–1
Holbrook: HoB, HoC, HsD	>6	[1]	0–15	Gravelly fine sandy loam	SM or GM	A–2
			15–50	Very gravelly cobbly and stony sandy loam.	GM	A–1 or A–2
HrB	>6	4–6	0–15	Gravelly fine sandy loam	SM or GM	A–2
			15–50	Very gravelly cobbly and stony sandy loam.	GM	A–1 or A–2
Hussman: Hu, Hv, Hw, Hy	>6	4–6	0–60	Clay and silty clay	CH or MH	A–7
Indian Creek: IgD, IlB	1.5–2.5	[1]	0–5	Loam	SM	A–2 or A–4
			5–20	Clay	CH	A–7
			20–25	Silica-cemented hardpan	—	—
			25–64	Very gravelly and cobbly loamy coarse sand.	GM or GP	A–1 or A–2
Indiano: InF	2–6	[1]	0–13	Stony fine sandy loam	SM or SC	A–2 or A–4
			13–33	Clay loam	CL	A–6
			33–37	Weathered rhyolite.		
James Canyon: JaB, JaC, JcB, JcC	>6	2–6	0–31	Loam	ML or SM	A–4
			31–60	Gravelly loam	GM or SM	A–2 or A–4
JdB	>6	0–1	0–10	Peat	Pt	—
			10–30	Loam	ML or SM	A–4
			30–60	Gravelly loam	GM or SM	A–2 or A–4
James Canyon, calcareous variant: JeB	>6	1.5–3	0–17	Loam	ML or CL	A–4 or A–6
			17–36	Sandy clay loam	SC	A–6
			36–60	Loamy sand	SM	A–1 or A–2
JeC	>6	2–4	0–17	Loam	ML or CL	A–4 or A–6
			17–36	Sandy clay loam	SC	A–6
			36–60	Loamy sand	SM	A–1 or A–2
Job: Jg, Jk, Jl	>6	2–5	0–60	Loam	CL or ML	A–4 or A–6
Jh	>6	2–3	0–44	Loam	CL or ML	A–4 or A–6
			44–60	Clay	CH	A–7
Jubilee: Jm	>6	1–2	0–16	Clay	CH or MH	A–7
			16–45	Sandy loam	SM	A–4
			45–60	Coarse sand	SP	A–1
Jn, Jo	>6	1–3	0–5	Loam	ML or CL	A–4
			5–45	Sandy loam	SM	A–4
			45–52	Coarse sand	SP	A–1
Jp	>6	0–1	0–7	Peat	Pt	—
			7–37	Sandy loam	SM	A–4
			37–60	Coarse sand	SP	A–1
Jubilee, sand substratum variant: Js	>6	2–3	0–13	Clay loam	CL	A–6
			13–41	Coarse sand	SW or SP	A–1
			41–60	Clay	CH	A–7
Jt	>6	1.5–3	0–15	Loam	SM or ML	A–4 or A–6
			15–60	Sand	SW or SP	A–1

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Potential for frost heave	Corrosivity to uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)							
			Inches per hour	*Inches per inch of soil*	*pH*				
100	100	55–70	0.63–2.0	0.18–0.20	6.1–7.3	None	Moderate	Moderate	Moderate.
20–30	10–20	0–5	>20	0.03–0.05	6.6–7.3	None	Low	Low	High.
70–90	60–85	20–30	2.0–6.3	0.09–0.11	6.6–7.3	None	Low	Moderate	Low.
45–55	40–60	10–25	6.3–20.0	0.04–0.06	6.1–7.3	None	Low	Low	Low.
70–90	60–85	20–30	2.0–6.3	0.09–0.11	6.6–7.3	None	Low	Moderate	Low.
45–55	40–60	10–25	6.3–20.0	0.04–0.06	6.1–7.3	None	Low	Low	Low.
100	100	75–95	0.06–0.20	0.15–0.17	7.4–9.6	Low to very high	High[2]	Moderate	High.
70–90	60–85	30–45	0.63–2.0	0.16–0.18	6.1–7.3	None	Low	Moderate	Low.
90–100	85–95	70–80	<0.06	0.14–0.16	6.1–7.3	None	High	Moderate	High.
—	—	—	<0.06	....	......	....	....	....	....
40–50	30–45	0–15	6.3–20.0	0.04–0.06	7.4–8.4	Moderate	Low	Low	High.
70–90	65–90	25–40	2.0–6.3	0.08–0.10	6.1–6.5	None	Low	Moderate	Low.
85–100	80–90	60–75	0.20–0.63	0.18–0.20	6.1–6.5	None	Moderate	Moderate to high	Moderate.
85–95	85–95	40–60	2.0–6.3	0.16–0.18	6.1–7.3	None	Low	High	Moderate to high.
65–80	55–70	30–45	2.0–6.3	0.11–0.13	6.1–7.3	None	Low	Moderate	High.
—	—	—	0.63–2.0	0.40–0.50	5.6–6.5	None	High shrink-low swell.[3]	—	High.
85–95	85–95	40–60	2.0–6.3	0.16–0.18	6.1–7.3	None	Low	High	High.
65–80	55–70	30–45	2.0–6.3	0.11–0.13	6.1–7.3	None	Low	Moderate	High.
100	90–100	55–65	2.0–6.3	0.16–0.18	6.6–7.3	Low	Moderate	High	High.
100	90–100	35–50	0.63–2.0	0.14–0.16	7.9–9.0	Low	Moderate	Moderate	High.
100	90–100	15–30	6.3–20.0	0.06–0.08	6.6–7.3	Low	Low	Moderate	High.
100	90–100	55–65	2.0–6.3	0.16–0.18	7.4–9.5	Very high	Moderate[2]	High	High.
100	90–100	35–50	0.63–2.0	0.14–0.16	7.4–9.5	Very high	Moderate[2]	Moderate	High.
100	90–100	15–30	6.3–20.0	0.06–0.08	7.4–8.4	Very high	Low	Moderate	High.
100	100	50–65	0.63–2.0	0.16–0.18	7.9–9.0	Low	Moderate	High	High.
100	100	50–65	0.63–2.0	0.16–0.18	8.5–9.0	High	Moderate[2]	High	High.
100	100	65–85	0.06–0.20	0.14–0.16	7.9–9.0	Low to moderate	High[2]	Moderate	High.
100	100	70–80	0.06–0.20	0.14–0.16	6.6–7.8	Moderate to high	High[2]	Moderate	High.
100	100	35–50	2.0–6.3	0.11–0.13	6.1–7.3	Low	Low	Moderate	High.
100	85–100	0–5	>20	0.05–0.07	6.1–7.3	Low	Low	Low	High.
100	100	50–65	0.63–2.0	0.16–0.18	6.1–7.3	Moderate	Moderate[2]	High	High.
100	100	35–50	2.0–6.3	0.11–0.13	6.1–7.3	Moderate	Low[2]	Moderate	High.
100	85–100	0–5	>20	0.05–0.07	6.1–7.3	Low	Low	Low	High.
—	—	—	0.63–2.0	0.40–0.50	5.6–6.5	None	High shrink-low swell.[3]	—	High.
100	100	35–50	2.0–6.3	0.11–0.13	6.1–7.3	None	Low	Moderate	High.
100	85–100	0–5	>20	0.06–0.07	6.1–7.3	None	Low	Low	High.
100	95–100	60–75	0.20–0.63	0.18–0.20	6.1–7.3	None	Moderate	High to moderate	High.
100	75–85	0–5	>20	0.05–0.07	6.1–6.5	None	Low	Low	High.
100	100	75–95	0.06–0.20	0.14–0.16	6.6–7.8	None	High	Moderate	High.
190	100	45–60	0.63–2.0	0.16–0.18	6.6–7.3	None	Low	High	High.
100	80–95	0–5	>20	0.05–0.07	6.1–7.3	None	Low	Low	High.

TABLE 4.—*Estimated properties*

Soil series and map symbols	Depth to— Hardpan or bedrock	Depth to— Seasonal high water table	Depth from surface (typical profile)	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Feet	*Feet*	*Inches*			
Kimmerling:						
Kc, Ks, Kt	>6	2–3	0–60	Clay loam	CL	A–6
Km	>6	2–3	0–42	Clay loam	CL	A–6
			42–60	Clay	CH or MH	A–7
McFaul:						
McA, McB	>6	([1])	0–11	Sand	SM	A–1
			11–28	Gravelly sandy clay loam	SC	A–2 or A–6
			28–52	Sand	SP or SM	A–1
MfB	2–3	([1])	0–7	Loamy sand	SM	A–2
			7–28	Gravelly sandy clay loam	SC	A–2 or A–6
			28	Conglomerate bedrock.		
Millich: MhE, MhF	1–2	([1])	0–1	Very stony clay	CH	A–7
			1–17	Clay	CH	A–7
			17	Andesite bedrock.		
Mottsville: MlB, MlD, MoD, MoF, MtC. (For Toiyabe part of MtC, see Toiyabe series.)	>6	([1])	0–60	Loamy coarse sand	SW or SM	A–2
Ophir:						
OgA, OgB, OhC	>6	1.5–5	0–10	Gravelly sandy loam	SM	A–2 or A–1
				Gravelly loamy sand	SW or SM	A–1
OpB	>6	0–1	0–8	Peat	Pt	—
			8–52	Gravelly loamy sand	SW or SM	A–1
Ormsby:						
Or, Os	>6	2.5–4	0–16	Gravelly loamy sand	SM	A–1
			16–60	Gravelly coarse sand	SM or SP	A–1
Oy	>6	4–5	0–16	Loamy sand	SM	A–1
			16–60	Gravelly coarse sand	SM or SP	A–1
Peat: Pe. Properties highly variable; no estimates made.						
Prey:						
PgB, PhA	2–3	([1])	0–13	Gravelly loamy sand	SM	A–1
			13–30	Gravelly coarse sandy loam.	SM or SC	A–2
			30–42	Silica-cemented hardpan	—	—
			42–58	Loamy coarse sand	SM	A–1
PmD	2–3	([1])	0–12	Stony sandy loam	SM	A–2
			12–30	Sandy loam	SM or SC	A–2
			30–42	Silica-cemented hardpan	—	—
			42–58	Loamy coarse sand	SM	A–1
Prey, heavy subsoil variant: PnC	1–2	([1])	0–10	Stony loam	ML or GM	A–2 or A–4
			10–15	Gravelly clay loam	CL or SC	A–4 or A–6
			15–22	Silica-cemented hardpan	—	—
			22–60	Cobbly and gravelly sandy loam.	GM	A–2
Puddle, gypsic variant: Pu	>6	4–7	0–60	Silt loam	ML	A–4
Quincy: QuE	>6	([1])	0–60	Fine sand	SP	A–3
Reno:						
ReB, RnD	2–3	([1])	0–3	Gravelly sandy loam	SM	A–2
			3–24	Sandy clay	SC or CH	A–7
			24–32	Very gravelly coarse sand.	GP	A–1
			32–44	Silica-cemented hardpan.	—	—

of the soils—Continued

Percentage passing sieve—									
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Potential for frost heave	Corrosivity to uncoated steel
			Inches per hour	*Inches per inch of soil*	*pH*				
100	100	60–75	0.20–0.63	0.18–0.20	6.1–7.3	None to low	Moderate	Moderate to high	High.
100	100	60–75	0.20–0.63	0.18–0.20	6.1–7.3	None	Moderate	Moderate to high	High.
100	100	75–90	0.06–0.20	0.14–0.16	6.6–7.8	Low	High	Moderate	High.
90–100	85–100	15–25	6.3–20.0	0.05–0.07	6.1–6.5	None	Low	Low	Low.
65–80	60–70	25–40	0.20–0.63	0.10–0.12	6.1–6.5	None	Moderate	Moderate	Moderate.
95–100	90–100	0–10	>20	0.05–0.07	6.1–7.3	None	Low	Low	Low.
90–100	85–100	15–25	6.3–20.0	0.06–0.08	6.1–6.5	None	Low	Low	Low.
65–80	60–70	25–40	0.20–0.63	0.10–0.12	6.1–7.3	Low	Moderate	Moderate	Moderate.
85–95	80–90	50–80	0.06–0.20	0.06–0.08	5.6–6.0	None	Moderate	Low	Moderate.
85–95	80–90	50–80	0.06–0.20	0.14–0.16	6.1–6.5	None	High	Moderate	High.
80–100	75–90	5–10	>20	0.06–0.08	6.1–6.5	None	Low	Low	Low.
85–95	60–85	15–35	2.0–6.3	0.07–0.09	6.1–7.3	None	Low	Moderate	High.
85–95	60–85	5–15	>20	0.05–0.07	6.6–7.3	None	Low	Low	High.
—	—	—	0.63–2.0	0.40–0.50	5.6–6.5	None	High shrink-low swell.[3]	—	High.
85–95	60–85	5–15	>20	0.05–0.07	6.1–7.3	None	Low	Low	High.
80–90	60–85	10–20	6.3–20.0	0.05–0.07	7.4–9.0	Moderate to high	Low	Low	High.
80–90	60–85	5–10	0.63–2.0	0.04–0.06	7.4–9.0	Moderate to high	Low	Low	High.
95–100	85–100	20–25	2.0–6.3	0.06–0.08	7.4–8.4	Low	Low	Low	Moderate.
80–90	60–85	5–10	0.63–2.0	0.04–0.06	7.4–8.4	Low	Low	Low	High.
75–90	75–85	10–20	6.3–20.0	0.05–0.07	6.1–6.5	None	Low	Low	Low.
85–95	80–95	25–35	0.20–0.63	0.07–0.09	6.1–7.3	None	Moderate	Moderate	Low.
—	—	—	0.06–0.20	—	—	—	—	—	—
90–100	90–100	15–20	2.0–6.3	0.06–0.08	6.6–7.3	None	Low	Low	Low.
90–100	85–95	25–35	2.0–6.3	0.08–0.10	6.1–6.5	None	Low	Moderate	Low.
85–95	80–95	25–35	0.20–0.63	0.11–0.13	6.1–7.3	None	Moderate	Moderate	Low.
—	—	—	0.06–0.20	—	—	—	—	—	—
90–100	90–100	15–20	2.0–6.3	0.06–0.08	6.6–7.3	None	Low	Low	Low.
70–80	65–80	35–55	0.63–2.0	0.11–0.13	5.6–6.5	None	Moderate	Moderate to high	Low.
70–80	60–75	35–55	0.20–0.63	0.13–0.15	6.1–6.5	None	Moderate	Moderate	Moderate.
—	—	—	<0.06	—	—	—	—	—	—
50–70	40–50	15–30	0.63–2.0	0.08–0.10	6.1–6.5	None	Low	Moderate	Low.
100	100	85–95	0.63–2.0	0.18–0.20	7.9–8.4	Very high	Low[2]	High	High.
100	100	0–5	>20	0.05–0.07	6.6–7.8	None	Low	Low	Low.
85–95	60–75	25–35	2.0–6.3	0.08–0.10	6.1–6.5	None	Low	Moderate	Moderate.
90–100	85–95	45–60	0.06–0.20	0.15–0.17	6.1–7.3	None	High	Moderate	High.
20–60	10–40	0–5	>20	0.04–0.06	6.5–7.8	Low	Low	Low	High.
—	—	—	<0.06	—	—	—	—	—	—

TABLE 4.—*Estimated properties*

Soil series and map symbols	Depth to— Hardpan or bedrock	Depth to— Seasonal high water table	Depth from surface (typical profile)	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Feet	*Feet*	*Inches*			
Reno—Continued						
RgC2	2–3	(1)	0–1	Gravelly sandy loam	SM	A-2
			1–24	Clay	CH or MH	A-7
			24–28	Hardpan weakly cemented with silica.	SM	A-2
			28	Volcanic tuff.		
Rock land: Ro. Properties highly variable; no estimates made.						
Rough broken land: Ru. Properties highly variable; no estimates made.						
Sandy alluvial land: Sa. Properties highly variable; no estimates made.						
Settlemeyer: Sc, Se, Sg, Sk	>6	1.5–4	0–60	Clay loam	CL	A-6
Springmeyer:						
SlD, SnF, SpF	>6	(1)	0–10	Gravelly fine sandy loam	SM or SC	A-2
			10–35	Gravelly sandy clay loam	SC or GC	A-6 or A-4
SmB	>6	(1)	0–14	Loam	CL	A-4
			14–54	Gravelly sandy clay loam	SC	A-6
SoD	2–3	(1)	0–10	Stony fine sandy loam	SM or GC	A-2
			10–30	Gravelly sandy clay loam	SM or GC	A-6 or A-4
			30	Volcanic tuff.		
Stodick: StD	1–1.5	(1)	0–18	Very stony and gravelly clay loam.	CL or GC	A-6
			18	Conglomerate bedrock.		
Toiyabe: TaF	0.5–1.5	(1)	0–15	Loamy coarse sand	GP	A-1
			15	Granite bedrock.		
Toll:						
TlB, TlD, ToB	>6	(1)	0–54	Loamy sand	SM	A-1
			54–60	Coarse sand	SW or SP	A-1
TmA	>6	(1)	0–48	Loamy sand	SM	A-1
			48–60	Clay loam	CL	A-6
Turria:						
Tr, Tu	>6	(1)	0–12	Clay loam	CL	A-6
			12–50	Silt loam	ML or CL	A-4
Tt, Tw	6	4–6	0–12	Clay loam	CL	A-6
			12–50	Silt loam	ML or CL	A-4
Voltaire:						
Va	>6	1–2	0–60	Clay	CH or MH	A-7
Vc, Ve, Vr, Vs	>6	1–3	0–45	Silty clay	CH or MH	A-7
			45–60	Very fine sandy loam	ML or CL	A-4
Voltaire, seeped variant: Vt	>6	1–2	0–6	Clay loam	CL	A-6
			6–25	Silty clay	CH or MH	A-7
			25–44	Silt loam	ML or CL	A-4
Washoe: Wa, Wg	>6	(1)	0–42	Gravelly sandy clay loam	SC	A-6
			42	Very gravelly loamy coarse sand.	GP or GW	A-1

[1] No seasonal high water table.
[2] Onsite investigation needed because of volume changes resulting from crystallization and hydration of salts.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Potential for frost heave	Corrosivity to uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)							
			Inches per hour	*Inches per inch of soil*	*pH*				
75–90	70–80	25–35	2.0–6.3	0.08–0.10	6.1–6.5	None	Low	Moderate	Moderate.
90–100	85–95	50–70	0.06–0.20	0.14–0.16	6.1–7.3	None	High	Moderate	High.
70–80	60–75	25–35	<0.06	0.08–0.10	7.9–9.0	Low	Low	Moderate	High.
100	100	70–80	0.20–0.63	0.18–0.20	7.9–9.6	Low to very high.	Moderate [2]	Moderate to high	High.
65–85	65–75	25–35	2.0–6.3	0.09–0.11	6.1–7.3	Low	Low	Moderate	Moderate.
70–85	60–80	35–50	0.20–0.63	0.10–0.12	6.1–7.3	Low	Moderate	Moderate	High.
95–100	90–95	50–60	0.63–2.0	0.16–0.18	6.1–7.3	Low	Moderate	High	High.
80–90	75–85	35–45	0.20–0.63	0.10–0.12	6.1–7.3	Low	Moderate	Moderate	High.
60–70	55–65	20–30	2.0–6.3	0.09–0.11	6.1–7.3	Low	Low	Moderate	Moderate.
75–85	60–80	35–50	0.20–0.63	0.10–0.12	6.1–7.3	Low	Moderate	Moderate	High.
70–85	50–75	35–55	0.20–0.63	0.07–0.09	6.6–7.3	Low	Low	Moderate	High.
70–80	25–35	0–5	>20	0.06–0.08	5.1–6.0	None	Low	Low	Low.
100	100	15–25	6.3–20.0	0.06–0.08	6.6–7.3	None	Low	Low	Low.
95–100	90–95	0–5	>20	0.05–0.07	6.6–7.3	None	Low	Low	Low.
100	100	15–25	6.3–20.0	0.06–0.08	6.6–7.3	Low	Low	Low	High.
100	100	60–70	0.20–0.63	0.18–0.20	7.4–8.4	Moderate	Moderate [2]	Moderate to high	High.
100	100	65–80	0.20–0.63	0.18–0.20	6.6–7.3	Low	Moderate	Moderate to high	High.
100	100	55–75	0.63–2.0	0.18–0.20	6.6–7.8	Low	Moderate	High	High.
100	100	65–80	0.20–0.63	0.18–0.20	6.6–7.3	Low	Moderate	Moderate to high	High.
100	100	55–75	0.63–2.0	0.18–0.20	6.6–7.8	Low	Moderate	High	High.
100	100	80–90	0.06–0.20	0.14–0.16	8.5–9.5	High	High [2]	Moderate	High.
100	100	80–90	0.06–0.20	0.15–0.17	7.9–9.5	Moderate to very high.	High [2]	Moderate	High.
100	100	75–85	0.63–2.0	0.15–0.20	7.9–9.6	Moderate to very high.	Low [2]	High	High.
100	100	70–85	0.20–0.63	0.18–0.20	7.9–9.6	Very high	Moderate [2]	Moderate to high	High.
100	100	80–90	0.06–0.20	0.15–0.17	8.5–9.6	Very high	High [2]	Moderate	High.
100	100	75–85	0.63–2.0	0.18–0.20	7.9–9.6	Moderate	Moderate [2]	High	High.
80–90	70–90	35–50	0.20–0.63	0.10–0.12	6.1–7.3	None	Moderate	Moderate	Moderate.
30–50	15–30	0–5	6.3–20.0	0.04–0.06	6.1–7.3	Low	Low	Low	Moderate.

[3] Peat has property of shrinkage upon drying with little or no swelling upon wetting.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of— Sand and gravel	Suitability as source of— Road fill	Soil features affecting— Highway location	Soil features affecting— Farm ponds: Reservoir area	Soil features affecting— Farm ponds: Embankment
Aldax: AdE, AlE, AnF. For Indiano part of AnF, see Indiano series.	Poor: stony SM material to a depth of 10 to 20 inches; bedrock at a depth below 10 to 20 inches.	Fair: limited quantity of stony A-2 material; moderate frost heave potential if used in fills within frost depth.	Cuts and fills needed because of topography; bedrock at a depth of 10 to 20 inches; stones hinder hauling and grading operations.	Bedrock at a depth of 10 to 20 inches; fractured bedrock in some areas; slope may limit storage capacity.	Mostly SM borrow material; fair stability; moderate permeability when compacted; subject to piping.
Bishop: Bc, Bc2, Bh, Bm, Bn	Fair for sand at depths between 30 and 60 inches; suitable for road subbase; seasonal high water table affects availability. Fair for gravel, in small areas, at a depth below 30 inches; suitable for road subbase.	Fair for A-2 material between depths of 30 and 60 inches; seasonal high water table affects availability.	Seasonal high water table at a depth of 0 to 3 feet; flooding in many areas; plastic and moderately plastic A-4 or A-6 material to a depth of 10 to 30 inches; stratified A-2 and A-7 materials at a depth below 30 inches.	Seasonal high water table at a depth of 0 to 3 feet; moderately slow permeability between depths of 10 and 30 inches; slopes may restrict storage capacity.	A-4 or A-6 material at depths between 10 and 30 inches; fair stability; fair compaction characteristics; slow permeability; uppermost foot of material should be stripped and not used.
Borda: BoC, BrF	Unsuitable: mostly CH and CL material at a depth below 10 inches.	Poor: mostly plastic A-6 and A-7 materials; moderate to high shrink-swell potential.	Cuts and fills needed because of topography; mostly A-6 and A-7 materials; fractured bedrock at a depth of 2.5 to 4.5 feet in some areas.	Slow permeability at a depth below about 10 inches; fractured bedrock at a depth of 2.5 to 4.5 feet in some areas; slope may restrict storage capacity.	CL and CH material; fair stability; slow permeability when compacted, moderate to high shrink-swell potential.
Brockliss: BsA, BtA, BwA	Fair for sand: SM material in uppermost 2 feet. Fair to good for sand and gravel at a depth of 2 to 5 feet. Stones and cobblestones throughout; seasonal high water table at a depth of 1.5 to 4.5 feet.	Good: mostly A-1 and A-2 materials; stones and cobblestones hinder excavation and hauling operations.	Seasonal high water table at a depth of 1.5 to 4.5 feet: mostly nearly level to gently sloping; A-1 and A-2 materials; stones and cobblestones hinder grading operations.	Rapid to very rapid permeability; seasonal high water table at a depth of 1.5 to 4.5 feet.	Mostly SM material in uppermost 2 feet; fair stability; moderate permeability when compacted. Mostly cobbly and stony SW material at depths between 2 and 5 feet; good stability; rapid permeability when compacted.
Calpine: CaA, CcB	Poor: SM and SC materials; 20 to 40 percent fines.	Fair for A-2 and A-4 materials; moderate frost heave potential if used in fills within frost depth.	A-2 and A-4 materials; low frost heave potential. Stones in CcB may hinder hauling and grading operations.	Pervious; slopes may restrict storage capacity.	Fair stability; pervious when compacted; subject to piping.

interpretations

Soil features affecting—Continued: Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations	Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Not applicable.....	Not applicable.....	Low bearing strength; mostly SM material; hard bedrock at a depth of 10 to 20 inches.	Bedrock at a depth of 10 to 20 inches; stony material may hinder use of excavation equipment.	Severe: bedrock at a depth of 10 to 20 inches.	Very low available water capacity; gently sloping to steep; moderate erodibility.	D
Seasonal high water table at a depth of 0 to 3 feet; moderately slow permeability in sandy clay loam between depths of 10 and about 30 inches and generally moderately rapid permeability in material at a depth below 30 inches; nearly level; flooding and salinity in some areas.	Deep; high available water capacity; nearly level; seasonal high water table at a depth of 0 to 3 feet; salinity, alkalinity, and flooding in some areas.	Moderate bearing strength; fair shear strength; moderate shrink-swell potential; seasonal high water table at a depth of 0 to 3 feet.	Seasonal high water table at a depth of 0 to 3 feet.	Severe: permeability less than 0.63 inch per hour; seasonal high water table at a depth of 0 to 3 feet.	High available water capacity; seasonal high water table at a depth of 0 to 3 feet; flooding in some areas; slight erodibility.	B–C
Not applicable.....	Not applicable.....	Moderate bearing strength; mostly CL and CH materials; moderate to high shrink-swell potential.	Fractured bedrock at a depth of 2.5 to 4.5 feet in some areas; stony material.	Severe: permeability less than 0.63 inch per hour.	Moderate to high available water capacity; moderate to high erodibility.	D
Seasonal high water table at a depth of 1.5 to 4.5 feet; rapid to very rapid permeability; drainage difficult in some areas because of position with respect to river channels.	Deep; rapid to very rapid permeability; low available water capacity; seasonal high water table at a depth of 1.5 to 4.5 feet.	Low bearing strength; mostly SM material to a depth of about 2 feet; mostly SW material to a depth of 2 to 5 feet; seasonal high water table at a depth of 1.5 to 4.5 feet.	Seasonal high water table at a depth of 1.5 to 4.5 feet; stones and cobblestones hinder use of excavation equipment.	Slight where water table is below a depth of 4 feet. Moderate where water table is between depths of 2 and 4 feet. Severe where water table is at depths of less than 2 feet. Pollution of surface and ground water is a hazard in some areas.	Low available water capacity; slight erodibility; seasonal high water table at a depth of 1.5 and 4.5 feet.	C
Not applicable.....	Moderate available water capacity; rapid intake rate; nearly level to gently sloping.	Moderate bearing strength; low shrink-swell potential.	All features favorable in CcA. Stones in CcB may hinder use of excavation equipment.	Moderate: permeability of 0.63 inch to 2 inches per hour.	Moderate available water capacity; slight to moderate erodibility.	B

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Cashmere: Cf	Poor at depths above 40 inches; SM material; 30 to 40 percent fines. Good at a depth below 40 inches; suitable for road subbase.	Fair for A-2 and A-4 materials to a depth of 40 inches; moderate frost heave potential if used in fills within frost depth. Good for A-1 material at a depth below 40 inches.	Mostly A-2 or A-4 material to a depth of 40 inches; moderate frost heave potential; A-1 material at a depth below 40 inches.	Pervious	Fair stability; pervious when compacted; subject to piping.
Cave Rock: CkC	Fair for sand: suitable for road subbase. Unsuitable for gravel: mostly SM material.	Good for A-1 material.	All features favorable.	Pervious	Fair stability; pervious when compacted; subject to piping.
Cradlebaugh: Cm, Cn, Co, Cr, Cs, Ct, Cu.	Unsuitable in uppermost 17 inches. Poor for sand at a depth below 17 inches; SM material is 35 to 50 percent fines.	Poor: mostly A-6 material in uppermost 17 inches. Mostly A-4 material at a depth below 17 inches; 35 to 50 percent fines; moderate to high frost heave potential.	Seasonal high water table at a depth of 3 to 4 feet; mostly A-6 and A-4 materials; flooding.	Pervious at a depth below 17 inches; seasonal high water table at a depth of 3 to 4 feet; nearly level broad slopes may restrict storage capacity.	Mostly CL material in uppermost 17 inches; poor stability; slow permeability when compacted; mostly SM material at a depth below 17 inches; fair stability; slow permeability when compacted.
Dangberg: Da, Db, Dc, De, Dg.	Unsuitable: mostly CL, CH, or MH material. Good for sand below the hardpan at a depth of about 40 inches in some areas; suitable for road subbase.	Poor: mostly A-6 or A-7 material.	Seasonal high water table at a depth of 1.5 to 3 feet; mostly A-6 or A-7 material to a depth of about 2 feet over silica-cemented hardpan.	Seasonal high water table at a depth of 1.5 to 3 feet.	Mostly CL, CH, or MH material; poor stability; slow permeability when compacted.
Dangberg, thin solum variant: Dk.	Unsuitable: mostly CL, CH, or MH material. Good for sand below the hardpan at a depth of about 40 inches in some areas; suitable for road subbase.	Poor: mostly A-6 or A-7 material.	Seasonal high water table at a depth of 4 to 6 feet; mostly A-6 or A-7 material to a depth of about 2 feet over silica-cemented hardpan.	Seasonal high water table at a depth of 4 to 6 feet.	Mostly CL, CH, or MH material; poor stability; slow permeability when compacted.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Not applicable	Deep; moderate available water capacity; moderate intake rate; nearly level.	Low bearing strength.	All features favorable.	Slight: permeability of 2 to 6.3 inches per hour; pollution of surface and ground water is a hazard in some areas.	Moderate available water capacity; moderate erodibility.	B
Not applicable	Deep; moderately low available water capacity; rapid intake rate; moderate erodibility.	Moderate bearing strength.	All features favorable.	Slight where slopes are not more than 5 percent. Moderate where slopes are not more than 8 percent.	Moderately low available water capacity; moderate erodibility.	A
Seasonal high water table at a depth of 3 to 4 feet; moderately rapid permeability at a depth below 17 inches; salinity in subsoil and substratum; flooding.	Deep; high available water capacity; slow intake rate; seasonal high water table at a depth of 3 to 4 feet; slight erodibility; flooding; salinity in subsoil and substratum.	Moderate bearing strength; seasonal high water table at a depth of 3 to 4 feet; moderate shrink-swell potential; flooding.	Seasonal high water table at a depth of 3 to 4 feet; flooding.	Severe: permeability of less than 0.63 inch per hour; flooding.	High available water capacity; seasonal high water table at a depth of 3 to 4 feet; slight erodibility; flooding.	D
Slow permeability; seasonal high water table at a depth of 1.5 to 3 feet; salinity, and artesian pressures in some areas.	Hardpan at a depth of about 2 feet; moderate available water capacity; salinity and alkalinity; seasonal high water table at a depth of 1.5 to 3 feet; slight erodibility.	Moderate to high bearing strength; high shrink-swell potential; seasonal high water table at a depth of 1.5 to 3 feet.	Seasonal high water table at a depth of 1.5 to 3 feet; silica-cemented hardpan at a depth of about 2 feet.	Severe: permeability of less than 0.63 inch per hour; seasonal high water table at a depth of 1.5 to 3 feet.	Moderate available water capacity; seasonal high water table at a depth of 1.5 to 3 feet; slight erodibility.	D
Slow permeability; seasonal high water table at a depth of 4 to 6 feet; salinity, alkalinity, and artesian pressures in some areas.	Hardpan at a depth of about 2 feet; moderate available water capacity; salinity and alkalinity; seasonal high water table at a depth of 4 to 6 feet; slight erodibility.	Moderate to high bearing strength; high shrink-swell potential; seasonal high water table at a depth of 4 to 6 feet.	Seasonal high water table at a depth of 4 to 6 feet; silica-cemented hardpan at a depth of about 2 feet.	Severe: permeability of less than 0.63 inch per hour; seasonal high water table at a depth of 4 to 6 feet.	Moderate available water capacity; seasonal high water table at a depth of 4 to 6 feet; slight erodibility.	D

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Draper: Dl, Do	Unsuitable in uppermost 4 feet. Good at a depth below about 4 feet; suitable for road subbase.	Poor to a depth of about 4 feet; mostly A-4 or A-6 material; poor stability; high frost heave potential if used in fills within frost depth. Good for A-1 material at a depth below about 4 feet.	Seasonal high water table at a depth of 4 to 6 feet; mostly A-4 or A-6 material. Flooding on the Do mapping unit.	Moderately pervious; seasonal high water table at a depth of 4 to 6 feet.	Poor stability; slow to moderate permeability; subject to piping.
Dressler: DrA, DsA	Fair in uppermost 20 inches; suitable for road subbase. Good for sand at a depth below 20 inches; suitable for road subbase.	Good: mostly A-1, A-2, or A-3 material.	Seasonal high water table at a depth of 2 to 4 feet; mostly A-2 material to a depth of about 20 inches; A-1 or A-3 material at a depth below about 20 inches.	Pervious; seasonal high water table at a depth of 2 to 4 feet.	Good to fair stability; pervious when compacted; subject to piping in some areas.
DtA, DwA, DwB	Fair for sand in uppermost 20 inches; suitable for road subbase. Good for sand at a depth below 20 inches; suitable for road subbase. Unsuitable for gravel: mostly SM or SP material.	Fair for A-2 or A-4 material in the uppermost 20 inches; moderate frost-heave potential. Good for A-1 or A-3 material at a depth below 20 inches.	Seasonal high water table at a depth of 2 to 4 feet; mostly A-2 or A-4 material in uppermost 20 inches; mostly A-1 material at a depth below 20 inches.	Pervious; seasonal high water table at a depth of 2 to 4 feet.	Good to fair stability; pervious when compacted; subject to piping in some areas.
East Fork: Ea, Ef	Unsuitable: mostly CL material.	Poor: mostly A-6 material.	Seasonal high water table at a depth of 4 to 6 feet; mostly A-6 material.	Seasonal high water table at a depth of 4 to 6 feet; nearly level, broad slopes may restrict storage capacity.	Poor stability; slow permeability when compacted; moderate shrink-swell potential.
Fettic: Fc, Fe, Ff	Poor for sand: SM material at a depth below 29 inches; 25 to 50 percent fines. Unsuitable for gravel: mostly SM, ML, or CH material.	Poor in uppermost 20 inches; mostly A-7 material. Fair to poor at a depth below 20 inches: mostly A-2 or A-4 material; frost heave potential if used in fills within frost depths.	Seasonal high water table at a depth of 3.5 to 5.5 feet; mostly A-7 material to a depth of 29 inches; mostly A-2 or A-4 material at a depth below 29 inches.	Seasonal high water table at a depth of 3.5 to 5.5 feet; pervious at a depth below 29 inches.	Mostly CH material to a depth of 20 inches; poor stability; slow permeability when compacted; high shrink-swell potential. Mostly SM material at a depth below 20 inches; fair stability; moderate permeability when compacted; subject to piping.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Seasonal high water table at a depth of 4 to 6 feet; pervious at a depth below about 4 feet.	Deep; high available water capacity; moderate intake rate; seasonal high water table at a depth of 4 to 6 feet; slight erodibility. Flooding on the Do mapping unit.	Low bearing strength; low to moderate shrink-swell potential; seasonal high water table at a depth of 4 to 6 feet. Flooding on the Do mapping unit.	Seasonal high water table at a depth of 4 to 6 feet. Flooding on Do mapping unit.	Slight for Dl; pollution of surface and ground water is a hazard in some areas. Severe for Do: flooding.	High available water capacity; seasonal high water table at a depth of 4 to 6 feet; slight erodibility. Flooding on the Do mapping unit.	C
Seasonal high water table at a depth of 2 to 4 feet; moderately rapid to rapid permeability.	Deep; moderately low available water capacity; high intake rate; seasonal high water table at a depth of 2 to 4 feet; slight erodibility.	Low bearing strength; low shrink-swell potential; seasonal high water table at a depth of 2 to 4 feet.	Seasonal high water table at a depth of 2 to 4 feet.	Moderate: seasonal high water table at a depth of 2 to 4 feet; pollution of surface and ground water is a hazard in some areas.	Moderately low available water capacity; seasonal high water table at a depth of 2 to 4 feet; slight erodibility.	C
Seasonal high water table at a depth of 2 to 4 feet; moderately rapid permeability.	Deep; moderate available water capacity; rapid intake rate; seasonal high water table at a depth of 2 to 4 feet; slight erodibility.	Low bearing strength; low shrink-swell potential; seasonal high water table at a depth of 2 to 4 feet.	Seasonal high water table at a depth of 2 to 4 feet.	Moderate: seasonal high water table at a depth of 2 to 4 feet; pollution of surface and ground water is a hazard in some areas.	Moderate available water capacity; seasonal high water table at a depth of 2 to 4 feet; slight erodibility.	C
Seasonal high water table at a depth of 4 to 6 feet; moderately slow permeability; low to moderate salinity.	Deep; high available water capacity; slow intake rate; seasonal high water table at a depth of 4 to 6 feet; low to moderate salinity; slight erodibility.	Moderate bearing strength; moderate shrink-swell potential; seasonal high water table at a depth of 4 to 6 feet.	Seasonal high water table at a depth of 4 to 6 feet.	Severe: permeability of less than 0.63 inch per hour.	High available water capacity; seasonal high water table at a depth of 4 to 6 feet; slight erodibility.	C
Seasonal high water table at a depth of 3.5 to 5.5 feet; slow permeability in subsoil, and rapid permeability in substratum; high salinity.	Deep; high available water capacity; slow to moderate intake rate; seasonal high water table at a depth of 3.5 to 5.5 feet; high salinity; slight to moderate erodibility.	Moderate bearing strength; high shrink-swell potential; seasonal high water table at a depth of 3.5 to 5.5 feet.	Seasonal high water table at a depth of 3.5 to 5.5 feet.	Severe: permeability less than 0.20 inch per hour.	High available water capacity; seasonal high water table at a depth of 3.5 to 5.5 feet; slight to moderate erodibility.	D

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Fettic, pan variant: FpB	Unsuitable: mostly CL or SC material.	Poor: mostly A-6 material.	Seasonal high water table at a depth of 6 to 7 feet; mostly A-6 material to a depth of about 10 inches; silica-cemented hardpan between depths of 10 and 36 inches; A-6 material at a depth below 36 inches.	All features favorable.	Poor stability; slow permeability when compacted; moderate shrink-swell potential.
Franktown: FrG	Unsuitable: very stony material; many rock outcrops; thin layer of material available.	Poor: limited amount of stony A-1 material over bedrock.	Very steep to extremely steep; fractured schist bedrock at a depth of 0.5 to 1 foot; mostly A-1 material; many cobblestones and rock outcrops; high erodibility.	Bedrock at a depth of 0.5 to 1 foot; slope very severely restricts storage capacity.	Limited quantity of GP or GM material; many stones, cobblestones, and rock outcrops; rapid to moderate permeability when compacted.
Gardnerville: Ga, Gc, Gd, Ge, Gg, Gh.	Good for sand: some gravel available at a depth below about 16 inches.	Poor in uppermost 16 inches: mostly A-7 material. Good at a depth below 16 inches: mostly A-1 or A-2 material.	Seasonal high water table at a depth of 4 to 7 feet; mostly A-7 material to a depth of 16 inches; A-1 or A-2 material at a depth of 16 inches.	Pervious at a depth below about 16 inches; nearly level slopes may restrict storage capacity.	Mostly CH material in uppermost 16 inches; slow permeability; high shrink-swell potential. Mostly SM or SP material at a depth below 16 inches; moderate to rapid permeability when compacted; subject to piping.
Glenbrook: GkF, GlE	Fair for sand from soil material and decomposed granite; suitable for road subbase. Unsuitable for gravel: mostly SW or SP material.	Good for A-1 material from soil material and decomposed granite.	Cuts and fills needed because of topography; mostly A-1 material; weathered granite at a depth of 1 foot to 2 feet.	Pervious soil material and pervious weathered granite; slope may restrict storage capacity.	Limited quantity of SW or SP material; rapid permeability when compacted.
Godecke: Go	Fair for sand at a depth below 36 inches: suitable for road subbase. Unsuitable for gravel: mostly CL and SM material.	Good for A-2 material at a depth below 36 inches. A-4 material between depths of 18 and 36 inches; fair compaction characteristics; fair stability; moderate to high frost heave potential.	Seasonal high water table at a depth of 4 to 7 feet; mostly A-6 material in uppermost 18 inches; A-4 and A-2 materials at a depth below 18 inches.	Nearly level slope may restrict storage capacity; pervious at a depth below 18 inches.	CL material in uppermost 18 inches; moderate shrink-swell potential. Mostly SM or SC material at a depth below 18 inches; fair stability; moderate permeability when compacted; subject to piping.

interpretations—Continued

Soil features affecting—Continued						
Agricultural drainage	Irrigation	Foundations for low buildings [1]	Excavations	Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Seasonal high water table at a depth of 6 to 7 feet; slow permeability; high salinity.	Not applicable.....	High bearing strength, if in hardpan; seasonal high water table at a depth of 6 to 7 feet.	Seasonal high water table at a depth of 6 to 7 feet; silica-cemented hardpan between depth of 10 and 36 inches.	Severe: permeability of less than 0.20 inch per hour.	Very low available water capacity; seasonal high water table at a depth of 6 to 7 feet; slight to moderate erodibility.	D
Not applicable.....	Not applicable.....	High bearing strength; bedrock at a depth of 0.5 to 1 foot.	Very steep to extremely steep; bedrock at a depth of 0.5 to 1 foot.	Severe: bedrock at a depth of 0.5 to 1 foot; 45 to 80 percent slopes.	Very low available water capacity; very steep to extremely steep; high erodibility.	D
Seasonal high water table at a depth of 4 to 7 feet; rapid permeability at a depth below 16 inches. Moderate to high salinity in Gh.	Slow intake rate; moderate available water capacity; seasonal high water table at a depth of 4 to 7 feet. Moderate to high salinity in Gh.	Moderate bearing strength; high shrink-swell potential in uppermost 16 inches; seasonal high water table at a depth of 4 to 7 feet.	Seasonal high water table at a depth of 4 to 7 feet.	Severe: slow permeability.	Moderate available water capacity; seasonal high water table at a depth of 4 to 7 feet.	D
Not applicable.....	Not applicable.....	High bearing strength; decomposed granitic bedrock at a depth of 1 foot to 2 feet.	Strongly sloping to steep; boulders and hard bedrock in some local areas.	Severe: decomposed bedrock at a depth of less than 2 feet; most slopes greater than 10 percent.	Low available water capacity; moderate to high erodibility.	D
Seasonal high water table at a depth of 4 to 7 feet; high salinity; permeable at a depth below 18 inches.	High salinity; slow intake rate; moderately high available water capacity; nearly level.	Low bearing strength; moderate shrink-swell potential in uppermost 18 inches; seasonal high water table at a depth of 4 to 7 feet.	Seasonal high water table at a depth of 4 to 7 feet.	Severe if bottom of tile trench is in uppermost 18 inches because of slow permeability. Slight if bottom of tile trench is placed in pervious material at a depth below 18 inches.	Moderately high available water capacity; slight erodibility; seasonal high water table at a depth of 4 to 7 feet.	D

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Gullied land: Gu. Properties variable: onsite investigation required.					
Haybourne: HaA, HaB, HbB	Fair for sand at a depth below about 25 inches; suitable for road subbase. Unsuitable for gravel; mostly SM material.	Fair for A-4 or A-2 material between depths of 9 and 25 inches. Good for A-1 material at a depth below 25 inches.	Mostly A-4 or A-2 material between depths of 9 and 25 inches; moderate frost heave potential. Mostly A-1 material at a depth below 25 inches; wind erosion.	Pervious at a depth below about 9 inches.	Sandy material; moderate permeability when compacted; subject to piping.
Heidtman: Hc, Hd, He	Unsuitable: mostly ML, CL, and CH material. Good for sand and gravel at a depth below about 47 inches in some areas of Hc.	Poor: mostly A-6 material. Good for A-1 material at a depth below about 47 inches in some areas of Hc.	Mostly CL material below a depth of about 5 inches; seasonal high water table at a depth of 3 to 5 feet; flooding.	Seasonal high water table at a depth of 3 to 5 feet; slope may restrict storage capacity.	Mostly CL or CH material; plastic and clayey; moderate shrink-swell potential; fair to poor stability.
Henningsen: Hf, Hg, Hh, Hk, Hl.	Good: suitable for road subbase.	Good for A-1 material: seasonal high water table; seasonal flooding in some areas affects availability.	Seasonal high water table at a depth of 2 to 6 feet; flooding; mostly A-4 or A-6 material between depths of 8 and 24 inches; mostly A-1 material in subsoil and substratum.	Pervious material at a depth of about 1 foot to 1.5 feet; seasonal high water table at a depth of 2 to 6 feet.	Mostly GW or GM material in subsoil and substratum; stable but pervious when compacted. CL or ML material in uppermost 24 inches of Hm may supply material for impervious sections.
Henningsen, moderately deep variant: Hm, Hn.	Good: suitable for road subbase.	Good for A-1 material: seasonal high water table; seasonal flooding in some areas affects availability.	Seasonal high water table at a depth of 2 to 6 feet; flooding; mostly A-4 or A-6 material between depths of 8 and 24 inches; mostly A-1 material in subsoil and substratum.	Pervious material at a depth of about 2 feet; seasonal high water table at a depth of 2 to 6 feet.	Mostly GW or GM material in subsoil and substratum; stable but pervious when compacted; CL or ML material in uppermost 24 inches may supply material for impervious sections.
Holbrook: HoB, HoC, HrB, HsD.	Poor to unsuitable for sand: mostly SM or GM material. Fair to good for gravel; suitable for road subbase.	Good for A-1 material. Stones in HsD may hinder loading and hauling operations.	Cuts and fills needed because of topography and slope (as much as 16 percent); mostly A-1 and A-2 materials. Seasonal high water table at a depth of 4 to 6 feet in HrB; many stones in HsD.	Pervious	Mostly GM material; good compaction characteristics; good stability; moderate permeability when compacted.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Not applicable.....	Moderately low available water capacity; moderate to rapid intake rate; wind erosion.	Low bearing strength.	All features favorable.	Slight: pollution of surface water and ground water is a hazard in some areas.	Moderately low available water capacity.	B
Moderate to high salinity; seasonal high water table at a depth of 3 to 5 feet. Moderately slow permeability in Hc and He; slow permeability in Hd.	Slow intake rate; high available water capacity; moderate to high salinity; flooding.	Moderate bearing strength; moderate shrink-swell potential; seasonal high water table at a depth of 3 to 5 feet; flooding.	Seasonal high water table at a depth of 3 to 5 feet; flooding.	Severe: flooding; seasonal high water at a depth of 3 to 5 feet. Moderately slow permeability in Hc and He, slow permeability in Hd.	High available water capacity; seasonal high water table at a depth of 3 to 5 feet; flooding.	C
Permeable at a depth below about 8 to 24 inches; seasonal high water table at a depth of 2 to 6 feet; flooding.	Moderately low to low available water capacity; seasonal high water table at a depth of 2 to 6 feet; flooding.	Moderate bearing strength; seasonal high water table at a depth of 2 to 6 feet; flooding.	Seasonal high water table at a depth of 2 to 6 feet; flooding.	Severe: flooding; seasonal high water table at a depth of 2 to 6 feet.	Moderately low to low available water capacity; seasonal high water table at a depth of 2 to 6 feet.	C
Permeable at a depth below about 8 to 24 inches; seasonal high water table at a depth of 2 to 6 feet; flooding, except in some areas.	Moderately low to low available water capacity; seasonal high water table at a depth of 2 to 6 feet; flooding, except in some areas.	Moderate bearing strength; seasonal high water table at a depth of 2 to 6 feet; flooding, except in some areas.	Seasonal high water table at a depth of 2 to 6 feet; flooding, except in some areas.	Severe: flooding, except in some areas; seasonal high water table at a depth of 2 to 6 feet.	Moderately low to low available water capacity; seasonal high water table at a depth of 2 to 6 feet; flooding, except in some areas.	C
Not applicable to HoB, HoC, and HsD. Seasonal high water table at a depth of 4 to 6 feet in HrB.	Low available water capacity; rapid intake rate; slopes of as much as 8 percent. Not applicable for HsD, because of high stone content.	High bearing strength; seasonal high water table at a depth of 4 to 6 feet in HrB.	All features favorable in HoB and HoC. Considerable stone in HsD. Seasonal high water table at a depth of 4 to 6 feet in HrB.	Slight: all features favorable for HoB, HoC, and HsD. Seasonal high water table at a depth of 4 to 6 feet in HrB. Pollution of ground and surface water is a hazard in some areas.	Low available water capacity; slight erodibility.	B

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Hussman: Hu, Hv, Hw, Hy . . .	Unsuitable: mostly CH or MH material.	Poor: mostly plastic A-7 material.	Seasonal high water table at a depth of 4 to 6 feet; mostly A-7 material.	Seasonal high water table at a depth of 4 to 6 feet.	Mostly CH or MH material; high shrink-swell potential; poor compaction characteristics; poor stability.
Indian Creek: IgD, IIB........	Fair: many cobblestones and some gravel and sand below hardpan.	Good for A-1 or A-2 material below hardpan in substratum: mostly plastic A-7 material in subsoil.	Hardpan at a depth of 1.5 to 2.5 feet; plastic A-7 material in subsoil; cuts and fills needed in some areas because of slope and topography. Many cobblestones and stones in the IIB unit.	Topography in some areas may restrict storage capacity; pervious below the hardpan.	Mostly plastic CH material; high shrink-swell potential; poor stability; poor compaction characteristics.
Indiano: InF................	Unsuitable: mostly CL material.	Mostly A-6 material in subsoil; stones and cobblestones hinder loading and hauling operations; accessibility is a problem in some areas.	Cuts and fills needed because of slope and topography; weathered bedrock at a depth of 2 to 4 feet.	Slope and topography may restrict storage capacity; weathered bedrock at a depth of 2 to 4 feet.	Mostly CL material; moderate shrink-swell potential; fair compaction characteristics.
James Canyon: JaB, JaC, JcB, JcC	Poor to unsuitable for sand: mostly SM, ML, and GM material. Fair to poor for gravel at a depth below about 30 inches.	Poor: mostly A-4 material.	Seasonal high water table at a depth of 2 to 6 feet; mostly A-4 material; high frost-heave potential.	Pervious: seasonal high water table at a depth of 2 to 6 feet.	Mostly ML or SM material; fair to poor stability; fair to poor compaction characteristics. GM or SM material in substratum at a depth below about 30 inches.
JdB.....................	Poor to unsuitable for sand: mostly SM, ML, and GM material. Fair to poor for gravel at a depth below about 30 inches; excavating is difficult because of the high water table and the hydrostatic pressure.	Poor: mostly A-4 material.	Seasonal high water table within 1 foot of the surface; hydrostatic pressure; mostly A-4 material; organic surface layer.	Permeable; seasonal high water table within 1 foot of the surface.	Mostly ML or SM material; fair to poor stability; fair to poor compaction characteristics; subject to piping. GM or SM material in substratum at a depth below 30 inches.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings [1]	Excavations			
Slow permeability; seasonal high water table at a depth of 4 to 6 feet. Excessive salinity in the Hv, Hw, and Hy units.	Slow intake rate; high available water capacity. Excessive salinity in the Hv, Hw, and Hy units.	Moderate bearing strength; high shrink-swell potential; seasonal high water table at a depth of 4 to 6 feet.	Seasonal high water table at a depth of 4 to 6 feet.	Severe: slow permeability.	High available water capacity; seasonal high water table at a depth of 4 to 6 feet.	D
Not applicable.....	Not applicable.....	Moderate bearing strength and high shrink-swell potential in clayey subsoil; but high bearing strength in hardpan and in the underlying coarse material.	Hardpan at a depth of 1.5 to 2.5 feet.	Severe: very slow permeability.	Moderately low available water capacity; slight to moderate erodibility.	D
Not applicable.....	Not applicable.....	Moderate bearing strength and high shrink-swell potential in clayey subsoil; weathered bedrock at a depth of 2 to 4 feet.	Weathered bedrock at a depth of 2 to 4 feet; stones and cobblestones hinder use of excavation equipment.	Severe: slopes of 30 to 40 percent; moderately slow permeability.	Moderate available water capacity; moderate erodibility.	C
Seasonal high water table at a depth of 2 to 6 feet; permeable; hydrostatic pressures in most areas.	High available water capacity; rapid intake rate; seasonal high water table at a depth of 2 to 6 feet; slopes of 2 to 16 percent.	Low bearing strength; seasonal high water table at a depth of 2 to 6 feet.	Seasonal high water table at a depth of 2 to 6 feet.	Moderate for JaB, JcB, and JcC: seasonal high water table at a depth of 2 to 6 feet. Severe for JaC: slopes of more than 10 percent.	High available water capacity; seasonal high water table at a depth of 2 to 6 feet.	B
Seasonal high water table within 1 foot of the surface; hydrostatic pressure; permeable.	Not applicable.....	Low bearing strength; seasonal high water table within 1 foot of the surface.	Seasonal high water table within 1 foot of the surface.	Severe: seasonal high water table within 1 foot of the surface.	Seasonal high water table within 1 foot of the surface.	C

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
James Canyon, calcareous variant: JeB, JeC.	Fair for sand at a depth below 36 inches. Unsuitable for gravel: mostly SM and SC material.	Fair to poor: mostly A-6 material to a depth of about 36 inches. A-1 or A-2 material at a depth below about 36 inches.	Seasonal high water table at a depth of 1.5 to 4 feet; mostly A-6 material.	Moderate permeability; seasonal high water table at a depth of 1.5 to 4 feet.	Mostly SC material to a depth of about 36 inches; fair stability; fair compaction characteristics; slow permeability when compacted. SM material at a depth below about 36 inches.
Job: Jg, Jh, Jk, Jl.	Unsuitable: mostly ML or CL and CH material.	Poor: mostly A-4 and A-6 material.	Seasonal high water table at a depth of 2 to 5 feet; mostly A-4 or A-6 material; flooding in most areas.	Seasonal high water table at a depth of 2 to 5 feet; nearly level slopes may restrict storage capacity.	Mostly CL or ML material; poor stability; poor compaction characteristics; subject to liquefaction and piping in some areas.
Jubilee: Jm, Jn, Jo, Jp.	Fair for sand at a depth below about 40 inches. Unsuitable for gravel: mostly SP and SM material.	Poor: mostly A-4 material to a depth of about 40 inches; A-1 material at a depth below 40 inches; flooding; seasonal high water table.	Seasonal high water table at a depth of 0 to 3 feet; mostly A-4 material; flooding.	Seasonal high water table at a depth of 0 to 3 feet; permeable; nearly level slopes restrict storage capacity.	Mostly SM material; fair stability; fair compaction characteristics; moderate permeability when compacted; subject to piping.
Jubilee, sand substratum variant; Js, Jt.	Fair for sand at a depth of 15 to 40 inches; stratified with fine-grained material in some areas. Unsuitable for gravel: mostly SW or SP, SM, or ML and CH material.	Good: mostly A-1 material; stratified with or underlain by A-4, A-6, or A-7 material in places.	Seasonal high water table at a depth of 1.5 to 3 feet; mostly A-1 material below the surface layer; flooding.	Seasonal high water table at a depth of 1.5 to 3 feet; permeable; nearly level slopes restrict storage capacity.	Mostly SW or SP material below a depth of 13 inches; fair to good stability; fair to good compaction characteristics; rapid permeability when compacted.
Kimmerling: Kc, Km, Ks, Kt.	Unsuitable: mostly CL and CH or MH material.	Poor: mostly A-6 or A-7 material.	Seasonal high water table at a depth of 2 to 3 feet; mostly A-6 or A-7 material; flooding.	Seasonal high water table at a depth of 2 to 3 feet; nearly level slopes restrict storage capacity.	Mostly CL, CH, or MH material; moderate to high shrink-swell potential; fair to poor stability; fair to poor compaction characteristics.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Seasonal high water table at a depth of 1.5 to 4 feet; pervious at a depth below about 36 inches. High salinity in the **JeC** unit.	Seasonal high water table at a depth of 1.5 to 4 feet; moderate intake rate; high available water capacity; slopes of 2 to 8 percent.	Moderate bearing strength; mostly A-6 material; moderate shrink-swell potential; seasonal high water table at a depth of 1.5 to 4 feet.	Seasonal high water table at a depth of 1.5 to 4 feet.	Moderate for **JeC**: seasonal high water table at a depth of 2 to 4 feet; slopes of 4 to 8 percent. Severe for **JeB**: seasonal high water table at a depth of 1.5 to 3 feet.	High available water capacity; seasonal high water table at a depth of 1.5 to 4 feet.	C
Seasonal high water table at a depth of 2 to 5 feet. Slow permeability below a depth of 44 inches and salinity in the **Jh** unit.	Seasonal high water table at a depth of 2 to 5 feet; flooding in most areas.	Low bearing strength; moderate shrink-swell potential; seasonal high water table at a depth of 2 to 5 feet; flooding in most areas.	Seasonal high water table at a depth of 2 to 5 feet; flooding in most areas.	Severe: flooding in most areas; seasonal high water table at a depth of 2 to 5 feet.	Seasonal high water table at a depth of 2 to 5 feet; high available water capacity; flooding in most areas.	C
Seasonal high water table at a depth of 0 to 3 feet. Permeable in subsoil and substratum. Moderate salt concentrations in the **Jm**, **Jn**, and **Jo** units.	Seasonal high water table at a depth of 0 to 3 feet; moderately high available water capacity; flooding. Salinity in the **Jm**, **Jn**, and **Jo** units.	Low bearing strength; seasonal high water table at a depth of 0 to 3 feet; flooding.	Seasonal high water table at a depth of 0 to 3 feet; flooding.	Severe: flooding; seasonal high water table at a depth of 0 to 3 feet.	Seasonal high water table at depth of 0 to 3 feet; flooding.	C
Seasonal high water table at a depth of 1.5 to 3 feet; pervious.	Seasonal high water table at a depth of 1.5 to 3 feet; low available water capacity; flooding.	Low bearing strength; seasonal high water table at a depth of 1.5 to 3 feet; flooding.	Seasonal high water table at a depth of 1.5 to 3 feet; flooding.	Severe: flooding; seasonal high water table at a depth of 1.5 to 3 feet.	Seasonal high water table at a depth of 1.5 to 3 feet; low available water capacity; flooding.	C
Seasonal high water table at a depth of 2 to 3 feet; moderately slow permeability; slight salinity in some areas.	Seasonal high water table at a depth of 2 to 3 feet; moderately slow permeability; high available water capacity; flooding.	Moderate bearing strength; moderate to high shrink-swell potential;flooding.	Seasonal high water table at a depth of 2 to 3 feet; flooding.	Severe: flooding; slow permeability.	Seasonal high water table at a depth of 2 to 3 feet; flooding.	D

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of— Sand and gravel	Suitability as source of— Road fill	Soil features affecting— Highway location	Soil features affecting— Farm ponds: Reservoir area	Soil features affecting— Farm ponds: Embankment
McFaul: McA, McB	Fair for sand at a depth below about 28 inches. Unsuitable for gravel: mostly SP or SM material.	Fair: mostly A-2 or A-6 material between depths of 11 and 28 inches; A-1 material below a depth of 28 inches.	A-2 or A-6 material between depths of 11 and 28 inches; A-1 material at a depth below 28 inches; some small areas contain stones.	Permeable at a depth of about 28 inches.	SC material between depths of 11 and 28 inches; fair stability; fair compaction characteristics; slow permeability. SP or SM material below a depth of 28 inches; rapid permeability; subject to piping.
MfB	Poor in uppermost 28 inches: mostly gravelly SC material.	Fair: mostly A-2 or A-6 material to a depth of about 28 inches; bedrock at a depth of about 28 inches.	Mostly A-2 or A-6 material to a depth of about 28 inches; hard conglomerate bedrock at a depth of about 28 inches.	Conglomerate bedrock at a depth of 28 inches is highly pervious in some areas.	Mostly SC material; fair compaction characteristics; fair stability; slow permeability when compacted.
Millich: MhE, MhF	Unsuitable: mostly fine-grained material over bedrock.	Poor: mostly A-7 material over bedrock.	Cuts and fills needed on slopes up to 60 percent; andesite bedrock at a depth of 1 foot to 2 feet; mostly stony A-7 material.	Andesite bedrock at a depth of 1 foot to 2 feet; the steeper slopes may restrict storage capacity.	Mostly CH material; considerable stones; fair to poor compaction characteristics; fair to poor stability; high shrink-swell potential; limited quantity available.
Mottsville: MIB, MID, MoD, MoF, MtC. For Toiyabe part of MtC, see Toiyabe series.	Fair for sand; suitable for road subbase. Unsuitable for gravel; mostly SW or SM material.	Good: mostly A-2 material; rocks and boulders in MoD, MoF, and MtC may hinder excavation and hauling operations. All features favorable in MIB and MID.	Rocks and boulders in MoD, MoF, and MtC may hinder use of equipment; cuts and fills may be needed in MoF because of the slope.	Pervious	Mostly SW or SM material; fair to good compaction characteristics; fair to good stability; rapid permeability when compacted. Rocks and boulders in MoD, MoF, and MtC.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings [1]	Excavations			
Not applicable	Moderately low available water capacity; slopes of as much as 8 percent.	High bearing strength; moderate shrink-swell potential.	All features favorable.	Severe: moderately slow permeability.	Moderately low available water capacity; slight to moderate erodibility.	C
Not applicable	Not applicable	High bearing strength; moderate shrink-swell potential; conglomerate bedrock at a depth of about 28 inches.	Conglomerate bedrock at a depth of about 28 inches.	Severe: bedrock at a depth of about 28 inches.	Low available water capacity; moderate erodibility.	C
Not applicable	Not applicable	Moderate bearing strength; high shrink-swell potential; bedrock at a depth of 1 foot to 2 feet.	Andesite bedrock at a depth of 1 foot to 2 feet.	Severe: bedrock at a depth of 1 foot to 2 feet.	Low available water capacity; moderate to high erodibility.	D
Not applicable	Low available water capacity; rapid intake rate; slopes of as much as 15 percent. Not applicable for MoD, MoF, and MtC.	Low to moderate bearing strength.	Rock and boulders in Mod, MoF, and MtC hinder use of excavation equipment. All features favorable in MIB and MID.	Slight for MIB. Moderate for MtC: slopes of as much as 8 percent. Severe for MID, MoD, and MoF: slopes of more than 10 percent. Pollution of surface and ground water is a hazard in some areas.	Low available water capacity; slight to moderate erodibility.	A

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Ophir: OgA, OgB, OhC, OpB.	Fair to good: suitable for road subbase.	Good: mostly A-1 material.	Seasonal high water table from near the surface to a depth of about 5 feet; mostly A-1 material.	Seasonal high water table from near the surface to a depth of about 5 feet; pervious.	Mostly SW or SM material; good compaction characteristics; good stability; rapid permeability when compacted.
Ormsby: Or, Os, Oy..........	Fair for sand: suitable for road subbase. Poor for gravel at a depth below 16 inches.	Good: mostly A-1 material.	Seasonal high water table at a depth of 2.5 to 5 feet; mostly A-1 material.	Seasonal high water table at a depth of 2.5 to 5 feet; pervious.	Mostly SM or SP material; fair stability; fair compaction characteristics; rapid to moderate permeability when compacted; subject to piping in some areas.
Peat: Pe Properties variable; onsite investigation required.					
Prey: PgB, PhA, PmD........	Poor: sand at a depth of about 42 inches; suitable for road subbase. Unsuitable for gravel: mostly SM or SC material.	Fair to good: mostly A-2 material.	Mostly A-2 material; hardpan can be easily chiseled and cut with equipment; cuts and fills needed on slopes up to about 16 percent. Stones in PmB may hinder use of equipment.	Pervious below the hardpan.	Mostly SM or SC material; fair stability; fair compaction characteristics; slow to moderate permeability when compacted.
Prey, heavy subsoil variant: PnC.	Fair below the hardpan.	Good for A-2 material below the hardpan; stones may hinder loading and hauling operations.	Indurated hardpan at a depth of 1 foot to 2 feet; mostly A-4 or A-6 material; stones may hinder use of equipment; cuts and fills needed in some areas on slopes up to about 8 percent.	Pervious below the hardpan.	Mostly CL or SC material; fair stability; slow permeability when compacted.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Seasonal high water table from near the surface to a depth of 5 feet; hydrostatic pressures; pervious.	Low available water capacity; rapid intake rate; seasonal high water table from near the surface to a depth of 5 feet.	Low to moderate bearing strength; seasonal high water table from near the surface to a depth of 5 feet.	Seasonal high water table from near the surface to a depth of about 5 feet; hydrostatic pressures.	Severe: seasonal high water table from near the surface to a depth of of about 5 feet; pollution of surface and ground water is a hazard in some areas.	Low available water capacity; seasonal high water table from near the surface to a depth of about 5 feet.	C
Seasonal high water table at a depth of 2.5 to 5 feet; pervious. Salinity in Or and Os.	Moderately low available water capacity; rapid intake rate; seasonal high water table at a depth of 2.5 to 5 feet. Salinity in Or and Os.	Low bearing strength; seasonal high water table at a depth of 2.5 to 5 feet.	Seasonal high water table at a depth of 2.5 to 5 feet.	Moderate for Or and Os: seasonal high water table at a depth of 2.5 feet. Slight for Oy: seasonal high water table at a depth of 4 to 5 feet.	Moderately low available water capacity; seasonal high water table at a depth of 2.5 to 5 feet.	B–C
Not applicable	Not applicable	Moderate to high bearing strength; hardpan at a depth of about 30 inches.	Hardpan at a depth of about 30 inches. Stones in PmD may hinder use of equipment.	Severe: hardpan at a depth of about 30 inches.	Moderately low available water capacity; slight to moderate erodibility.	D
Not applicable	Not applicable	Moderate bearing strength; moderate shrink-swell potential; hardpan at a depth of about 1 foot to 2 feet.	Hardpan at a depth of 1 foot to 2 feet; stones may hinder use of equipment.	Severe: hardpan at a depth of 1 foot to 2 feet.	Low available water capacity; moderate erodibility.	D

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
	Sand and gravel	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Puddle, gypsic variant: Pu. . . .	Unsuitable: mostly ML material.	Very poor: mostly A-4 material; very poor compaction characteristics; high frost-heave potential.	Seasonal high water table at a depth of 4 to 7 feet; mostly A-4 material; highly gypsiferous.	Seasonal high water table at a depth of 4 to 7 feet; highly gypsiferous; moderate permeability.	Mostly ML material; high salinity; highly gypsiferous; very poor compaction characteristics; very poor stability; subject to piping.
Quincy: QuE.	Poor: mostly fine sand.	Good to fair: mostly A-3 material; poor stability.	Cuts and fills needed on slopes up to 30 percent; rock in deep cuts in areas where soil blankets mountain slopes; mostly A-3 material; subject to severe soil blowing.	Highly pervious. . . .	Mostly SP material; fair compaction characteristics; poor stability; rapid permeability when compacted; subject to piping.
Reno: ReB, RgC2, RnD.	Poor: mostly SC or CH material.	Poor: mostly A-7 material.	Cuts and fills may be needed on slopes up to 16 percent; hardpan at a depth of 2 to 3 feet; mostly A-7 material. Tuff bedrock at a depth of about 30 inches in RgC2.	All features favorable.	Mostly SC, CH, or MH material; fair to poor stability; fair to poor compaction characteristics; slow permeability when compacted.
Rock land: Ro. Properties variable; onsite investigation required.					
Rough broken land: Ru. Properties variable; onsite investigation required.					
Sandy alluvial land: Sa. Properties variable; onsite investigation required.					
Settlemeyer: Sc, Sd, Sg, Sk.	Unsuitable: mostly CL material.	Poor: mostly A-6 material; seasonal high water table and flooding may hinder loading and hauling operations.	Seasonal high water table at a depth of 1.5 to 4 feet; mostly A-6 material; flooding.	Seasonal high water table at a depth of 1.5 to 4 feet; nearly level; slopes may restrict storage capacity.	Mostly CL material; moderate shrink-swell potential; fair to poor stability; fair to poor compaction characteristics; slow permeability when compacted.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Not applicable	Not applicable	Low bearing strength; high salinity; highly gypsiferous; seasonal high water table at a depth of 4 to 7 feet.	Seasonal high water table at a depth of 4 to 7 feet.	Moderate: permeability of 0.63 inch to 2 inches per hour.	High available water capacity; moderate erodibility.	D
Not applicable	Not applicable	Low bearing strength.	All features favorable.	Slight where slopes are not more than 5 percent. Moderate where slopes are not more than 10 percent. Severe where slopes are more than 10 percent. Pollution of surface and ground water is a hazard in some areas.	Low available water capacity; subject to severe soil blowing.	A
Not applicable	Not applicable	Moderate bearing strength; high shrink-swell potential; hardpan at a depth of 2 to 3 feet.	Hardpan at a depth of 2 to 3 feet. Tuff bedrock at at a depth of about 30 inches in RgC2.	Severe: hardpan at a depth of 2 to 3 feet.	Moderate to low available water capacity; moderate erodibility.	D
Seasonal high water table at a depth of 1.5 to 4 feet; slow permeability. High salinity in Sg and Sk.	High available water capacity; slow intake rate; seasonal high water table at a depth of 1.5 to 4 feet; flooding. High salinity in Sg and Sk.	Moderate bearing strength; moderate shrink-swell potential; seasonal high water table at a depth of 1.5 to 4 feet; flooding.	Seasonal high water table at a depth of 1.5 to 4 feet; flooding.	Severe: moderately slow permeability; flooding.	High available water capacity; seasonal high water table at a depth of 1.5 to 4 feet; flooding.	D

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of— Sand and gravel	Suitability as source of— Road fill	Soil features affecting— Highway location	Soil features affecting— Farm ponds: Reservoir area	Soil features affecting— Farm ponds: Embankment
Springmeyer: SlD, SmB, SnF, SoD, SpF.	Unsuitable: mostly SM, SC, and GC material with 35 to 50 percent fines.	Fair to poor: mostly A-4 to A-6 material. Stones in SnF, SoD, and SpF hinder loading and hauling operations.	Cuts and fills needed on slopes up to 45 percent; mostly A-6 or A-4 material. Stones in SnF, SoD, and SpF hinder use of equipment. Tuff bedrock at a depth of about 30 inches in SoD.	All features favorable in SlD, SmB, and SoD. Slopes in SnF and SpF may restrict storage capacity.	Mostly SM, SC, or GC material; fair stability; moderate to slow permeability when compacted.
Stodick: StD	Unsuitable: limited quantity of mostly CL or GC material with 35 to 55 percent fines.	Poor: mostly stony A-6 material; very limited quantity.	Conglomerate bedrock at a depth of 1 foot to 1.5 feet; mostly A-6 material; many stones.	Bedrock is fractured and pervious in some areas.	Mostly CL or GC material; fair stability; good compaction characteristics; slow permeability when compacted.
Toiyabe: TaF	Poor to unsuitable: limited quantity; bedrock at a depth of 0.5 foot to 1.5 feet.	Poor: mostly A-1 material; limited quantity available; bedrock at a depth of 0.5 foot to 1.5 feet.	Cuts and fills needed because of slope; granite bedrock at a depth of 0.5 foot to 1.5 feet; rock outcrop.	Slopes restrict storage capacity; granite bedrock at a depth of 0.5 foot to 1.5 feet.	Mostly GP material; fair stability; rapid permeability when compacted; limited quantity available.
Toll: TlB, TlD, TmA, ToB	Fair to good for sand in TlB, TlD, and ToB. Fair to poor for sand in TmA. Unsuitable for gravel: mostly SW or SP and SM material.	Good: mostly A-1 material. A-6 material at a depth of about 48 inches in TmA.	Mostly A-1 material.	Pervious	Mostly SM material; fair stability; fair compaction characteristics; moderate permeability; subject to piping.
Turria: Tr, Tt, Tu, Tw	Unsuitable: mostly ML or CL material.	Poor: mostly A-4 material; poor compaction characteristics; moderate to high frost heave potential.	Mostly A-4 material. Seasonal high water table at a depth of 4 to 6 feet in Tt and Tw.	Moderate permeability in subsoil and substratum.	Mostly CL material; poor stability; poor compaction characteristics; subject to piping.
Voltaire: Va, Vc, Ve, Vr, Vs	Unsuitable: mostly CH or MH and ML or CL material.	Poor: mostly A-7 material.	Seasonal high water table at a depth of 1 foot to 3 feet; flooding; mostly A-7 material.	Seasonal high water table at depth of 1 foot to 3 feet; nearly level slopes may restrict storage capacity.	Mostly CH or MH material; high shrink-swell potential; poor compaction characteristics; poor stability; slow permeability.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings[1]	Excavations			
Not applicable	High available water capacity; moderate intake rate. Slopes of 2 to 4 percent in SmB.	Moderate bearing strength; moderate shrink-swell potential. Tuff bedrock at a depth of about 30 inches in SoD.	All features favorable in SlD, SmB, and SoD. Stones in SnF, SoD, and SpF hinder use of equipment. Tuff bedrock at a depth of about 30 inches in SoD.	Severe: moderately slow permeability. Slopes of more than 10 percent in SlD, SnF, SoD, and SpF.	High available water capacity; moderate to high erodibility.	C
Not applicable	Not applicable	High bearing strength; conglomerate bedrock at a depth of 1 foot to 1.5 feet.	Conglomerate bedrock at a depth of 1 foot to 1.5 feet; stones hinder use of equipment.	Severe: bedrock at a depth of 1 foot to 2 feet; slopes of more than 10 percent in most areas.	Low available water capacity.	D
Not applicable	Not applicable	Low to moderate bearing strength; bedrock at a depth of 0.5 foot to 1.5 feet.	Granite bedrock at a depth of 0.5 foot to 1.5 feet; rock outcrops.	Severe: bedrock at a depth of 0.5 foot to 1.5 feet.	Low available water capacity; moderate to high erodibility.	C
Not applicable	Moderate available water capacity; rapid intake rate; slopes of as much as 16 percent.	Low bearing strength.	All features favorable.	Slight for TlB, TmA, and ToB. Severe for TlD: slopes of more than 10 percent.	Moderate available water capacity; moderate erodibility.	A
Low salinity; moderate permeability. Seasonal high water table in Tt and Tw.	High available water capacity; slow intake rate; low salinity.	Low bearing strength; moderate shrink-swell potential.	All features favorable in Tr and Tu. Seasonal high water table at a depth of 4 to 6 feet in Tt and Tw.	Moderate: permeability of 0.63 inch to 2 inches per hour.	High available water capacity.	C
Seasonal high water table at a depth of 1 foot to 3 feet; slow permeability; high salinity.	High available water capacity; slow permeability; high salinity; seasonal high water table at a depth of 1 foot to 3 feet; flooding.	Moderate bearing strength; high shrink-swell potential; seasonal high water table at a depth of 1 foot to 3 feet; flooding.	Seasonal high water table at a depth of 1 foot to 3 feet; flooding.	Severe: slow permeability; flooding.	High available water capacity; seasonal high water table at a depth of 1 foot to 3 feet; flooding.	D

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TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—		
				Farm ponds	
	Sand and gravel	Road fill	Highway location	Reservoir area	Embankment
Voltaire, seeped variant: Vt	Unsuitable: mostly CH or MH and ML or CL material.	Poor: mostly A-7 material.	Seasonal high water table at a depth of 1 foot to 3 feet; flooding; mostly A-7 material.	Seasonal high water table at depth of 1 foot to 3 feet; nearly level slope may restrict storage capacity.	Mostly CH or MH material; high shrink-swell potential; poor compaction characteristics; poor stability; slow permeability.
Washoe: Wa, Wg	Poor to unsuitable for sand; mostly SC material in the uppermost 42 inches.	Fair above a depth of about 42 inches. Mostly gravelly and sandy material. Good below a depth of about 42 inches: mostly A-1 material.	Mostly gravelly and sandy A-6 material; cobblestones in some areas hinder use of equipment.	All features favorable.	Mostly SC material; fair to good stability; fair to good compaction characteristics; slow permeability when compacted.

[1] Engineers and others should not apply specific values to the estimates given for bearing strength of these soils.

interpretations—Continued

Soil features affecting—Continued				Degree and kind of limitation for septic tank filter fields	Watershed hydrology	Hydrologic group
Agricultural drainage	Irrigation	Foundations for low buildings [1]	Excavations			
Seasonal high water table at a depth of 1 foot to 3 feet; slow permeability; high salinity.	High available water capacity; slow permeability; high salinity; seasonal high water table at a depth of 1 foot to 3 feet; flooding.	Moderate bearing strength; high shrink-swell potential; seasonal high water table at a depth of 1 foot to 3 feet; flooding.	Seasonal high water table at a depth of 1 foot to 3 feet; flooding.	Severe: slow permeability; flooding.	High available water capacity; seasonal high water table at a depth of 1 foot to 3 feet; flooding.	D
Not applicable.....	Moderate available water capacity; moderate intake rate; slopes of as much as 4 percent on terrace breaks and along drainage channels.	High bearing strength; moderate shrink-swell potential.	Cobblestones in some areas may hinder use of excavation equipment.	Severe: permeability of less than 0.63 inch per hour.	Moderate available water capacity; slight to moderate erodibility.	C

TABLE 6.—*Engineering*

[Tests performed by the Nevada Department of Highways in accordance with standard

Soil name and location	Parent material	SCS report No.	Depth from surface	Moisture-density data [1] Maximum dry density	Moisture-density data [1] Optimum moisture
			In.	*Lb. per cu. ft.*	*Pct.*
Bishop loam, cool:		S59–Nev–3			
50 feet S. and 1,245 feet W. of N. quarter corner, sec. 31, T. 12 N., R. 20 E. (Modal profile)	Alluvium (flood plains).	11–1	0–13	120	18
		11–2	13–26	110	14
Fettic very fine sandy loam:		S60–Nev–3			
150 feet S. and 1,400 feet E. of W. quarter corner, sec. 19, T. 14 N., R. 20 E.	Alluvium.	5–2	3–8	(5)	(5)
		5–5	23–31	(5)	(5)
Gardnerville clay loam:		S59–Nev–3			
900 feet S. and 300 feet E. of center of sec. 8, T. 13 N., R. 20 E. (Modal profile)	Alluvium (toe slopes of fans).	1–2	2.5–8	103	16
		1–5	16–24	123	12
Indian Creek very cobbly loam:		S60–Nev–3			
1,520 feet W. and 1,500 feet N. of SE. corner, sec. 12, T. 11 N., R. 20 E. (Modal profile)	Alluvium (old terraces).	2–5	11–19	(5)	(5)
		2–9	36–51	121	11
Ormsby gravelly loamy sand:		S59–Nev–3			
1,000 feet N. and 75 feet W. of S. quarter corner ,sec. 6, T. 13 N., R. 20 E. (Modal profile)	Alluvium (terraces).	7–2	7–16	128	8
		7–4	24–35	125	8
Prey gravelly sand:		S60–Nev–3			
1,100 feet E. and 2,200 feet N. of S. quarter corner, sec. 6. T. 14 N., R. 20 E. (Modal profile)	Alluvium.	3–3	5–13	128	6
		3–9	35–52	122	10
Prey stony loam, heavy subsoil variant:		S60–Nev–3			
400 feet W. and 810 feet S. of E. quarter corner, sec. 14, T. 14 N., R. 19 E.	Alluvium.	4–3	3–10	132	8
		4–8	22–36	123	10
Reno gravelly sandy loam:		S59–Nev–3			
4,600 feet S. and 900 feet W. of NE. corner, sec. 2, T. 12 N., R. 20 E. (Modal profile)	Alluvium (old terraces).	3–2	5–19	110	14
		3–6	32–44	130	9
Turria loam:		S59–Nev–3			
1,300 feet S. and 750 feet W. of N. quarter corner, sec. 10, T. 13 N., R. 20 E. (Modal profile)	Alluvium (fans).	6–3	5–9	(5)	(5)
		6–6	20–32	112	14
Washoe cobbly sandy loam:		S59–Nev–3			
300 feet E. and 75 feet S. of center of sec. 28, T. 12 N., R. 20 E. (Modal profile)	Alluvium (terraces).	9–5	11–20	132	9
		9–8	42–53	123	8

[1] Based on AASHO Designation T 99–57 *(1)*.

[2] Mechanical analysis according to AASHO Designation: T 88 *(1)* Results by this procedure differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in determining the textural classes for soil.

test data

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

Fragments discarded in field sampling (estimated)	Percentage passing sieve [2, 3] —						Liquid limit	Plasticity index	Classification	
	1½-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)			AASHO	Unified [4]
Pct.							*Pct.*			
...	...	...	100	99	88	62	42	13	A-7-6(7)	ML
...	...	100	99	97	86	59	40	14	A-6(6)	ML-CL
...	...	...	...	100	98	77	54	32	A-7-6(19)	CH
...	...	...	100	99	97	48	36	8	A-4(3)	SM
...	...	...	...	100	79	46	61	29	A-7-5(9)	SM-SC
...	...	100	99	98	67	25	28	7	A-2-4(0)	SM-SC
...	...	100	99	98	95	89	66	43	A-7-6(20)	CH
60	100	77	53	43	16	5	44	12	A-2-7(0)	SP-SM
...	...	100	90	84	39	11	18	([6])	A-1-b(0)	SW-SM
...	...	100	95	90	44	13	17	([6])	A-1-b(0)	SM
3	...	100	96	92	63	18	17	([6])	A-2-4(0)	SM
...	...	100	98	92	58	17	21	([6])	A-2-4(0)	SM
10	100	95	90	83	63	34	22	4	A-2-4(0)	SM-SC
...	100	87	70	59	46	32	26	([6])	A-2-4(0)	SM
15	100	99	97	95	86	55	50	26	A-7-6(11)	CL
...	100	82	47	35	15	3	24	([6])	A-1-a(0)	GP
...	...	...	...	100	98	50	40	16	A-6(5)	SM-SC
...	...	...	...	100	97	53	27	5	A-4(4)	ML-CL
20	100	97	87	75	44	23	31	15	A-2-6(0)	SC
35	...	100	94	84	23	8	23	6	A-1-b(0)	SW-SC

[3] Laboratory test data not corrected for amount discarded in field sampling.

[4] Soil Conservation Service and Bureau of Public Roads have agreed that any soil having a plasticity index within 2 points of the A-line is to be given a borderline classification. ML-CL is an example of a classification so obtained.

[5] Data not obtained because of insufficient material in sample.

[6] Nonplastic.

The group index number is given in parentheses after the symbol, for example, A–7–6(7).

Some engineers prefer to use the Unified classification system established by the Corps of Engineers, U. S. Army *(8)*. In this system the soils are identified as coarse grained (eight classes), fine grained (six classes), and highly organic (one class). The symbols used to identify coarse-grained material are GW, GP, GM, GC, SW, SP, SM, and SC; those used to identify fine-grained material are ML, CL, OL, MH, CH, and OH; and the symbol used to identify highly organic material is Pt. Soils on the borderline between two classifications are given a joint classification, for example, ML-CL.

The system of classification used by the U. S. Department of Agriculture is primarily for agricultural use, but the textural classification is also important in engineering. In this system soils are classified according to the proportions of the different sizes of mineral particles.

The textural classes range from sand (fragments 0.05 to 2.0 millimeters in size) to clay (particles less than 0.002 in size). A soil that is at least 40 percent clay particles, for example, is called clay. Beginning with the largest, particle sizes are designated as cobblestones, gravel, sand, silt, and clay.

Estimated properties

Table 4 shows estimates of some of the soil properties that are important in engineering work. The data are based on laboratory data, on test data from comparable soils in adjacent areas, and on field experience in this survey area. The data on percentages passing the various sizes of sieves are based on material less than 3 inches in size.

Permeability, as used in the table, indicates the rate at which water moves downward through undisturbed and uncompacted soil material. It does not indicate lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other features resulting from the use of the soils have not been considered.

The available water capacity is the amount of capillary water held in a soil in a form that plants can use readily.

Reaction refers to the degree of acidity or alkalinity of a soil. The pH value and relative terms used to describe reaction are defined in the Glossary.

Salinity is indicated by the electrical conductivity of saturated soil extract, which is expressed in millimhos per centimeter at 25° C. It affects the suitability of a soil for crops, the stability of a soil when used as construction material, and the corrosivity of a soil to other materials.

Shrink-swell potential indicates the volume change to be expected with a change in moisture content. The shrinking and swelling of soils can cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to structures constructed in, on, or with such materials.

Potential for frost heave indicates the susceptibility to formation of ice lenses within the soil during periods of freezing temperatures. These lenses cause the soil to expand and lift upward. The combination of soil heaving and accumulation of excess moisture in the soil as the ice thaws results in loss of soil strength.

Corrosivity to uncoated steel refers to chemical action that will dissolve or weaken untreated steel used as structural material. Structural materials may corrode when buried in soil, and any given material may corrode more rapidly in some kinds of soils than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are those that are entirely within one kind of soil or soil horizon.

Engineering interpretations

Table 5 lists, for each soil in the Carson Valley Area, interpretations of features that affect suitability for specific engineering structures. These interpretations are based on the estimates of properties in table 4, on available test data, including that in table 6, and on field experience. Detrimental or undesirable features are emphasized, but important desirable features are also listed.

A septic tank filter field is part of the soil absorption system for disposal of sewage on the site. It is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the natural soil. The ratings used to describe the degree of limitation for this use are slight, moderate, and severe. These ratings are based on soil depth, slope, permeability, depth to the water table, and hazard of flooding.

Slight means that the soil properties are favorable for this use, that the limitations are minor and easily overcome, and that good performance and low maintenance can be expected. It also means that the soil has all the following features. Permeability is more than 1 inch per hour. The depth to a seasonal high water table is more than 4 feet. The depth to a hardpan or to bedrock is more than 6 feet. The slope is less than 4 percent.

Moderate means that the soil properties are moderately favorable for this use, that the limitations can be overcome or modified with special planning, design, or maintenance, and that during some seasons of the year the performance of the filter field may be somewhat less desirable than it would be in soils that have a slight limitation. It also means that the soil has one or more of the following features. Permeability is 1 to 0.63 inch per hour. The depth to a seasonal high water table is between 2 and 4 feet. The depth to a hardpan or to bedrock is between 4 and 6 feet. The slope is 4 to 8 percent.

Severe means that the soils have one or more unfavorable properties, that the limitations are difficult and costly to modify or overcome, and that major soil reclamation, special design, or intensive maintenance is required. It also means that the soil has one or more of the following features. Permeability is less than 0.63 inch per hour. The depth to a seasonal high water table is less than 2 feet. The depth to a hardpan or bedrock is less than 4 feet. The slope is more than 8 percent.

The hydrologic group indicates the ability of the soils to take in water during periods of sustained rainfall.

Ratings are based on the whole soil profile and its underlying unconsolidated parent material. To obtain uniformity, it is assumed that the soils have natural drainage and uniform vegetation.

Group A consists of soils that have a high infiltration rate even when thoroughly wetted and are chiefly deep, well-drained to excessively drained sand, gravel, or both. Such 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 are chiefly moderately deep to deep, moderately well drained to well drained, and moderately fine textured to moderately coarse textured. Such 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 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 permanently high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious materials. Such soils have a very slow rate of water transmission.

Engineering test data

To help evaluate the soils for engineering purposes, samples from 10 profiles representing nine of the principal soil series in the Carson Valley Area were tested in accordance with standard procedures. The results of these tests are given in table 6.

Table 6 gives moisture-density data for the tested soils. If a soil material is compacted at successively higher moisture content and the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases as the moisture content increases. The highest dry density obtained in the compaction test is termed maximum dry density, and the corresponding moisture content is the optimum moisture. Moisture-density data are important in earthwork because, as a rule, soil is most stable if it is compacted to about the maximum dry density when it is approximately at the optimum moisture content.

In the columns headed "Percentages passing sieve" are shown the percentages, by weight, of soil particles that pass sieves of specified sizes. For example, particles of silt, which are larger than 0.002 millimeter, and particles of clay, which are smaller than 0.002 millimeter, pass through the No. 200 sieve, but particles of sand and other larger particles do not. The clay fraction was determined by the hydrometer method rather than by the pipette method.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic. As the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil material passes from semisolid to plastic. The liquid limit is the moisture content at which the material passes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is plastic.

Formation and Classification of the Soils

This section discusses the factors of soil formation and the classification of the soils of the Carson Valley Area by higher categories.

Factors of Soil Formation

The factors that determine the kind of soil that forms at any given point are the composition of the parent material, the climate under which the soil material accumulated or weathered, the relief and drainage, the plants and animals on and in the soil, and the length of time that the forces of soil development have acted on the soil material.

Climate and vegetation are the active factors of soil formation. They alter the accumulated soil material and bring about the development of genetically related horizons. Relief, mainly by its effect on temperature and runoff, modifies the effect of climate and vegetation. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil. Usually, a long time is required for the development of distinct horizons.

Parent materials

The parent materials of soils in the Carson Valley Area are alluvium and residuum. In the following paragraphs the parent materials are discussed in order of the topographic position on which the soils formed.

Alluvium, recently deposited by the Carson River and its forks, is the parent material of soils that formed on the flood plains, in basins, and on low terraces. This alluvium was derived from a wide variety of igneous rocks and some metamorphic rocks, mainly granite, tuff, tuff breecia, andesite, basalt, rhyolite, slate, gneiss, sandstone, and conglomerate. Dominantly loamy material was deposited in quiet backwater areas near the center of the valley and in the extreme northern part of the valley. Soils of the Bishop, Cradlebaugh, Draper, Dressler, East Fork, Fettic, Heidtman, Job, Jubilee, Kimmerling, and Settlemeyer series and the moderately deep variant of Henningsen soils formed in this material. Clayey, gravelly, or sandy materials were deposited near valley inlets along both forks of the Carson River. Soils of the Dangberg, Hussman, and Voltaire series formed in the clayey material, and those of the Brockliss, Henningsen, and Ormsby series and the sand substratum variant of Jubilee soils formed in the gravelly or sandy materials. Except for texture, few differences between soils of flood plains and those of low terraces are attributable to differences in parent material.

A hardpan weakly cemented with silica formed in the Cradlebaugh, Godecke, and Ormsby soils. A strongly cemented hardpan formed in soils of the Dangberg series, in its thin solum variant, and in the pan variant of Fettic soils, because of the strong alkalinity caused by a soil solution high in content of sodium. The pH value in the surface layer rose to more than 10 because the salts had been leached out of the surface layer and sodium had become dominant. Because of the high pH value, the silica dissolved and moved downward to the ground water, where soluble salts were dominant and the pH was lower than in the surface layer. Because of the lower pH, the silica precipitated out of solution and gradually a hardpan was formed.

The parent material of soils that formed on intermediate and high terraces was deposited by glacial streams that carried a heavy bedload of gravelly and cobbly material. This material is considerably coarser than that more recently deposited by the Carson River on most of the low terraces and flood plains. Soils of the Calpine, Indian Creek, Prey, Reno, Springmeyer, Stodick, and Washoe series and the heavy subsoil variant of Prey soils formed in this material.

Differences in these soils reflect some differences in parent material, as well as the effect of the other factors of soil formation. For example, a silica-cemented hardpan formed in the well drained to moderately well drained soils of the Gardnerville, Indian Creek, Prey, and Reno series and the heavy subsoil variant of Prey soils because the parent material was high in content of bases, and, as a result, strongly alkaline. At a high pH value, the silica dissolved in water that moved downward in the soil and was precipitated as the water evaporated or was taken up by plants.

The parent material of soils that formed on alluvial fans was deposited recently in some places and a relatively long time ago in other places. Some of the alluvium was derived from weathered granite. The sandy soils of the Mottsville, Ophir, and Toll series formed in this material. Some of the alluvium was derived from weathered gneiss and slate. The gravelly or cobbly and loamy soils of the Holbrook and James Canyon series formed in this material. Other alluvium was derived from recently deposited, finer textured materials and is loamy. The calcareous variant of James Canyon soils formed in this material. The alluvium deposited a relatively long time ago consists of somewhat stratified, loamy and sandy materials. Soils of the Cashmere, Gardnerville, and Turria series, and the pan variant of Fettic soils, formed in the loamy material; those of the Cave Rock, Haybourne, and McFaul series formed in the sandy material.

The parent material of soils that formed on foothills and mountains is residuum weathered from granite, gneiss, slate, basalt, andesite, andesitic tuff, and rhyolite. The andesite, andesitic tuff, and rhyolite readily weather to clay. Soils of the Glenbrook and Toiyabe series formed in residuum weathered from granite, and those of the Franktown series formed in residuum weathered from gneiss and slate. Soils of the Borda, Millich, and Aldax series formed in residuum weathered from basalt, andesite, and adesitic tuff. Soils of the Indiano series formed in residuum weathered from rhyolite and in alluvium derived from this material.

Although a minor source of parent materials, volcanic ash and other pyroclastic materials have had an important effect on formation of soils of the Cradlebaugh, Dangberg, Gardnerville, Godecke, Indian Creek, Ormsby, Prey, and Reno series, on the thin solum variant of Dangberg soils, and on the pan variant of Fettic soils. All of these soils have been cemented to some extent by lime and silica.

Climate

Climate affects soil formation through its influence on vegetation, on weathering, and on runoff and erosion. The main climatic factors that affect soil formation are precipitation and temperature.

The climate of the survey area is essentially continental and representative of that at intermediate elevations in western Nevada. The summers are short and often hot, and the winters are moderately cold. At Minden the average temperature is 69° F. in July and 32° in January. The average annual temperature is 49°, and the average daily range in temperature is 43° in summer and 26° in winter. The length of the frost-free season averages 107 days at Minden and 129 days at Woodfords. Precipitation throughout the survey area varies, depending on the elevation and location. Most of the precipitation comes during winter in the form of snow. Mountain areas receive considerably more rainfall than other areas. Precipitation averages 7 inches at Minden and 16 inches at Woodfords.

The vegetation increases in density as the available moisture increases. In the better drained soils of the uplands, the amount of water available to plants, as well as the depth to which the soils are leached, is affected by total precipitation, temperature, and to some extent, exposure. In several soils of the flood plains, low terraces, and alluvial fans, the amount of water available is also affected by a high water table, and consequently, the vegetation is considerably thicker than on other soils.

Where the soil is dry in the hot summers, and cold and saturated in fall and winter, humus builds up because the activity of micro-organisms is greatly reduced and plant material decomposes more slowly. Soils in these areas have a dark-colored surface layer, but otherwise, a weakly developed profile.

Except in areas that receive runoff from higher areas, water erosion is not a hazard. As precipitation increases, the hazard of water erosion increases rapidly. In this survey area, only the steeper areas at higher elevations receive large amounts of precipitation.

Precipitation affects the rate of weathering because water is the medium in which chemical reactions take place and is the main source of hydrogen, the principal agent of weathering. If there is not enough water to carry away the end products of chemical reactions and if the depth of moisture penetration is limited, weathering is slowed and may be temporarily stopped.

In soils that receive 7 to 10 inches of precipitation, the A horizon is generally less than 6 inches thick and is slightly darker colored than the soil materials below. The content of organic matter is about 1 percent, and lime and other soluble minerals have been leached out to a depth of 30 inches or more. Among these soils are those of the Indian Creek and Reno series.

In soils that receive 10 to 16 inches of precipitation, the A horizon is thicker, is darker colored, and has substantially more organic matter than soils that receive less precipitation. Soluble minerals have been leached out of the profile, and consequently, reaction is neutral to slightly acid. Among these soils are those of the Prey, Mottsville, and Springmeyer series.

In soils that receive 16 inches or more of rainfall, the A horizon is dark colored. There is exchangeable hydrogen in the soil solution, and reaction is slightly acid to medium acid. The vegetation is forest. Among these soils are those of the Toiyabe series.

High summer temperature accelerates the formation of soils because it hastens the weathering soil materials. Generally, the speed of chemical reaction doubles for each rise of 10° C. in temperature.

The formation of Turria, Gardnerville, Washoe, Reno, Indian Creek, Springmeyer, and other soils in the survey area has been accelerated by relatively high temperatures but slowed by scanty rainfall.

Relief and drainage

Relief in the Carson Valley Area is characterized mainly by steep mountain slopes, steep rolling foothills, terraces, alluvial fans, flood plains, and basins. Among the minor relief features are scattered, partly stabilized sand dunes, truncated glacial moraines, and U-shaped glacial valleys.

Among the soils that formed on the steep slopes of mountains, which rise abruptly from the valley floor, are the Franktown and Toiyabe soils. These soils have somewhat excessive to excessive drainage. The formed in residuum, and they reflect the influence of parent materials. Erosion is a moderate to severe hazard.

Among the soils that formed on foothills are those of the Aldax, Borda, Glenbrook, Indiano, Millich, and Stodick series. These soils are well drained to excessively drained. They formed in residuum and in alluvium derived from the residuum. They have gentle to very steep slopes, and erosion is a slight to severe hazard.

Among the soils that formed on high terraces are Indian Creek and Reno soils and the heavy subsoil variant of Prey soils. These soils are well drained and moderately well drained. They are nearly level to sloping. Among the soils that formed on intermediate terraces are those of the Calpine, Prey, Springmeyer, Stodick, and Washoe series. These soils are well drained. They are nearly level to sloping. Some of the Springmeyer soils formed on the very steep side slopes of the high terraces.

Among the soils that formed on smooth, low terraces are those of the Brockliss, Dangberg, Draper, Dressler, East Fork, Fettic, Godecke, Hussman, and Ormsby series, the thin solum variant of Dangberg soils, and the gypsic variant of Puddle soils. These soils are somewhat poorly drained to poorly drained. They are nearly level.

Among the soils that formed on alluvial fans are those of the Cave Rock, Cashmere, Gardnerville, Haybourne, Holbrook, James Canyon, McFaul, Mottsville, Ophir, Toll, and Turria series, the calcareous variant of James Canyon soils, and the pan variant of Fettic soils. Generally, these soils are well drained to excessively drained, but in areas where ground water has been released through faulting, they are poorly drained to moderately well drained. Runoff from higher areas deposits sediments and washes away soil materials on many of these soils.

The soils that formed on flood plains are dark colored or relatively dark colored and loamy and sandy. Among these are soils of the Bishop, Cradlebaugh, Heidtman, Henningsen, Job, Jubilee, Kimmerling, and Settlemeyer series, the moderately deep variant of Henningsen soils, and the sand substratum variant of Jubilee soils. Drainage is somewhat poor where either sloughs or fairly deep, permanent channels of the river have formed, and poor to very poor in areas adjacent to shallower reaches of the river and in areas of ground water release.

The soils that formed in basins are dark colored and high in organic-matter content. Among these are the clayey, poorly drained Voltaire soils.

A common indicator of degree of drainage is the color of the soils. For example, in Kimmerling soils, which have poor drainage, the hue is 10YR in the surface layer and 5Y in the subsoil, and the chroma is 1 or 2 in the surface layer and 1 in the subsoil.

Some soils that are saturated with water at some depth and that contain an ample supply of organic matter have bright colors as the result of the reduction of iron oxides. In these soils the hues are 2.5Y, 5Y, 5GY, or 5BG, all of which are yellower than 10YR, or neutral (N), and the chromas are less than 2. Some soils have reddish mottles in places where ferric oxide precipitated when the water table lowered, and as a result, aeration and supply of oxygen improved. Among the many soils mottled in this manner are those of the Fettic, East Fork, Hussman, Dressler, and Ormsby series. Other soils that have poor or very poor drainage are severely gleyed and have yellowish hues.

Many of the poorly drained and very poorly drained soils on flood plains and low terraces are affected by salts and alkali. In these soils the water table is high and the ground water contains salts. Excessive amounts of salts and alkali accumulate where ground water rises to the surface and evaporates, or the soils have a cover of greasewood and other plants that add alkali as they grow. Among the soils in which this occurs are the saline-alkali Cradlebaugh, Job, Heidtman, and Hussman soils. Some soils contain salts or alkali because they are adjacent to hot springs. Among the soils adjacent to springs are those of the pan variant of Fettic soils, the calcareous variant of James Canyon soils, and the gypsic variant of Puddle soils.

Plants and animals

Plants and, to a lesser extent, animals have affected soil formation in the Carson Valley Area. The plants draw moisture and nutrients from the soil, intercept runoff, reduce erosion, and improve aeration and permeability. The remains of dead plants replenish the content of organic matter in the soil.

Because the growth of aerobic micro-organisms has been inhibited by the permanent high water table in James Canyon peat and Ophir peat, the content of organic matter is more than 20 percent and the carbon-nitrogen ratio is more than 15:1. Soils that are affected by excess salts and alkali are also a poor environment for micro-organisms.

A luxuriant stand of water-tolerant grasses and other aquatic plants grows on the poorly drained to very poorly drained soils of the flood plains, basins, low terraces, and alluvial fans. Consequently, these soils are darker colored than other soils in the survey area, and except for forested soils, contain more organic matter. Most of them are 4 to 7 percent organic matter.

The native vegetation on flood plains and low terraces, where the water table is generally high, consists mainly of phreatophytes, which are deep-rooted plants that obtain moisture from ground water or the layer of soil material just above the water table. These plants cover 10 to 30 percent of the surface, depending on the content of salts and alkali in the soils. In most places they furnish a considerable amount of organic matter and protect the soils from erosion, as well as provide shade.

In areas where drainage has improved as the channel of the Carson River deepened, the original plant cover has been replaced by saltgrass, or by greasewood and an understory of saltgrass. These plants now cover 2 to 30 percent of the surface, depending on the content of salts and alkali in the soil.

The cover on the better drained soils of the uplands varies in species, composition, and density of native plants. At present many grasses have been depleted by grazing livestock and wildlife.

The plants growing on soils that receive 7 to 10 inches of rainfall are predominantly big sagebrush, rabbitbrush, and desert peach, but there is a limited understory of Indian ricegrass and needlegrass. These plants provide little organic matter, but they do protect the soil from wind erosion.

Plants growing on soils that receive 10 to 16 inches of rainfall make a somewhat denser cover. They consist predominantly of big sagebrush, antelope bitterbrush, Mormon-tea, and rabbitbrush, and there is an understory of needlegrass, squirreltail, Sandberg bluegrass, and Great Basin wildrye. The soils under this kind of cover have a dark-colored A horizon, more than 6 inches thick, that has an organic-matter content between 1 and 3 percent, which was provided by these plants. The plant cover on Borda soils, which are in this rainfall zone, is predominantly pinyon pine, but there is some Jeffrey pine, big sagebrush, and antelope bitterbrush and an understory of desert needlegrass, squirreltail, and Sandberg bluegrass. These soils have an A horizon that has an organic-matter content of 1.5 to 3 percent and that is grayish brown to brown when dry and brown to dark brown when moist. Low sagebrush is predominant on the soils that have a subsoil of dense clay or that are shallow over conglomerate. Sagebrush provides little shade or protection from erosion, and it contributes only a small amount of organic matter. Indian Creek soils have a subsoil of dense clay, and Stodick soils are shallow over conglomerate. These soils have an A horizon, less than 6 inches thick, that has an organic-matter content of less than 2 percent. They have a pavement of gravel, cobblestones, or stones that reduces the hazard of erosion.

Jeffrey pine grows at higher elevations, where average annual rainfall is more than 16 inches. These soils have an A horizon that is 2 to 5 percent organic matter and more than 5 inches thick. The carbon-nitrogen ratio is more than 15:1. The reaction is more acid and the base saturation is lower than in other soils of the survey area, which indicates the extent of leaching that has taken place.

Time

The soils of the Carson Valley Area vary considerably in age. The time required for a soil to form in unconsolidated sediments begins when the last sediments are laid down, and that required for a soil to form over igneous and metamorphic rocks begins when the rock has weathered to permeable material. Generally, the age, or maturity, of a soil is indicated by the thickness and the distinctness of the subsurface horizons. Most soils in this area do not have distinct subsurface horizons, but they do have a fairly distinct A horizon. A few, such as those of the Indian Creek and Reno series, have strongly defined B2t and Csi horizons. The effect of time on soil formation can be modified greatly by the other factors of soil formation, particularly relief and drainage and parent material.

Generally, immature, or young, soils formed on the flood plains along the Carson River, on some of the low terraces, and on some alluvial fans. At most, these soils have a developed A1 horizon that varies in thickness and is generally darker colored than the underlying C horizon. The thickness and color of this horizon are governed by drainage, rainfall, and vegetation.

The soils that formed on intermediate terraces and some alluvial fans have an A1 horizon that varies in thickness, depending on rainfall and density of vegetation. They have been in place long enough for clay, lime, and silica to move downward. There has been enough structural development for the formation of a B2t horizon, which has a somewhat higher color chroma because of the precipitation of ferric oxide. The A and B horizons are neutral or slightly acid, and the base saturation is less than 100 percent.

Among the soils that generally have a more strongly developed profile than would be expected according to the time the parent material has been in place are those of the Dangberg, Fettic, and Godecke series and the thin solum variant of Dangberg soils. This development has taken place because the clay particles, which are dispersed because of the large quantities of sodium in the soil, moved downward in considerably smaller amounts of water and in considerably less time than would be required if the sodium had not been present.

The soils on high terraces are older than any other soils in the survey area. Among these soils are those of the Indian Creek and Reno series and the heavy subsoil variant of Prey soils. These soils have stronger profile development and considerably more distinct horizons than those on intermediate terraces and alluvial fans. The heavy subsoil variant of Prey soils formed in gravelly and cobbly soil material that contained only a small amount of clay, but it has been in place long enough that many of the pebbles are strongly weathered and the content of clay is almost four times that of the original parent material. Its strongly silica-cemented hardpan has probably restricted the thickness of the B2t horizon. The Indian Creek and Reno soils formed in loamy material underlain unconformably by glacial outwash. They have been in place long enough for the development of an abrupt textural boundary between the A2 and B2t horizons and strong structure in the B2 horizon.

For the most part, the rocks underlying the soils in mountain and foothill areas make up the oldest formations in the survey area, but as a rule, the soils are relatively immature and younger than soils in gently sloping areas. In the very steep areas, erosion has been the main factor retarding soil formation. Among the factors affecting erosion are the kind and density of plant cover, the length and steepness of slopes, the amount of water the soil can absorb and retain for a given time, and the frequency, amount, and distribution of rainfall. The erosion hazard at higher elevations is severe because of the large amounts of rain, the shallowness of the soils, and the slope.

An exception is Borda soils, which formed on relatively short, but steep slopes in the foothills. These soils are mature, and their development is comparable with that of the oldest soils in the survey area. The volcanic parent rock readily weathered to clay. The plant cover was probably dense enough to reduce the erosion hazard, and consequently, a distinct B2t horizon formed that has prismatic structure. The reaction is slightly acid to neutral.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another, and understand their behavior and their response to the whole environment.

Two systems of classifying soils above the series level have been used in the United States in recent years. The older system was adopted in 1938 *(2)* and revised later *(5)*. The system currently used by the National Cooperative Soil Survey was adopted in 1965 and is under continual study *(7)*. Readers interested in the development of the system should refer to the available literature *(4)*.

The current system consists of six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are measurable or observable, but the properties are selected so that soils of similar genesis are grouped together. Placement of some series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 7 shows the classification of the soil series in the Carson Valley Area according to the current system and by great soil groups according to the 1938 system. The categories of the current system are defined briefly in the following paragraphs.

ORDER.—Soils are grouped into orders according to properties that seem to have resulted from the same processes acting to about the same degree on the parent material. Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The Entisols, Inceptisols, Aridisols, and Mollisols are represented in the Carson Valley Area.

Entisols are recent soils in which there has been little, if any, horizon development. This order is represented in the Carson Valley Area by soils of the Glenbrook, Job, Ormsby, Quincy, Toiyabe, and Toll series.

Inceptisols occur mostly on young, but not recent, land surfaces. This order is represented by the seeped variant of Voltaire soils.

Aridisols are primarily soils of dry places. This order is represented by soils of the Borda, Dangberg, the thin solum variant of Dangberg, Gardnerville, Godecke, Haybourne, Indian Creek, McFaul, Prey, the gypsic variant of Puddle, Reno, Stodick, Turria, and Washoe series.

Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and base saturation of more than 50 percent. This order is represented by soils of the Aldax, Bishop, Brockliss, Calpine, Cashmere, Cave Rock, Cradlebaugh, Draper, Dressler, East Fork, Fettic, the pan variant of Fettic, Franktown, Heidtman, Henningsen, the moderately deep variant of Henningsen, Holbrook, Hussman, Indiano, James Canyon, the calcareous variant of James Canyon, Jubilee, the sand substratum variant of Jubilee, Kimmerling, Millich, Mottsville, Ophir, the heavy subsoil variant of Prey, Settlemeyer, Springmeyer, and Voltaire series.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that indicate genetic similarity. The suborders have a narrower climatic range than the order. The criteria for suborders reflect either the presence or absence of waterlogging, or soil differences resulting from climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in kind and sequence of genetic horizons. The great group is not shown in table 7, because the name of the great group is the same as the last word in the name of the subgroup.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) concept of the group, and other groups, called intergrades, that have properties of one great group but also one or more properties of another great group.

FAMILIES.—Families are established within subgroups primarily on the basis of properties important to plant growth. Some of these properties are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of horizons.

SERIES.—The series has the narrowest range of characteristics of the categories in the classification

TABLE 7.—*Classification of soil series by higher categories*

Series	Family	Subgroup	Order	Great soil group (1938 classification)
Aldax	Loamy-skeletal, mixed, frigid	Aridic Lithic Haploxerolls	Mollisols	Lithosols.
Bishop	Fine-loamy, mixed, calcareous, mesic	Cumulic Haplaquolls	Mollisols	Humic Gley soils.
Borda	Fine, montmorillonitic, frigid	Xerollic Paleargids	Aridisols	Brown soils.
Brockliss	Sandy-skeletal, mixed, mesic	Torriorthentic Haploxerolls	Mollisols	Alluvial soils.
Calpine	Coarse-loamy, mixed, frigid	Aridic Haploxerolls	Mollisols	Chestnut soils.
Cashmere	Coarse-loamy, mixed, mesic	Aridic Haploxerolls	Mollisols	Calcisols.
Cave Rock	Sandy, mixed, mesic	Pachic Ultic Haploxerolls	Mollisols	Prairie soils.
Cradlebaugh	Fine-loamy, mixed, calcareous, mesic	Duric Haplaquolls	Mollisols	Humic Gley soils.
Dangberg	Fine, montmorillonitic, mesic	Aquic Haplic Nadurargids	Aridisols	Solonetz soils.
Dangberg, thin solum variant.	Fine, montmorillonitic, mesic	Aquic Haplic Nadurargids	Aridisols	Solonetz soils.
Draper	Fine-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols	Alluvial soils.
Dressler	Coarse-loamy, mixed, mesic	Aquic Haploxerolls	Mollisols	Alluvial soils.
East Fork	Fine-loamy, mixed, mesic	Aquic Fluventic Haploxerolls	Mollisols	Alluvial soils.
Fettic	Fine-silty, mixed, mesic	Aquic Natrixerolls	Mollisols	Solonetz soils.
Fettic, pan variant	Fine-loamy, mixed, calcareous, mesic	Duric Natraquolls	Mollisols	Solonetz soils.
Franktown	Loamy-skeletal, mixed, frigid	Lithic Haploxerolls	Mollisols	Lithosols.
Gardnerville	Clayey over sandy or sandy-skeletal, montmorillonitic, mesic.	Durixerollic Natrargids	Aridisols	Sierozems.
Glenbrook	Mixed, mesic, shallow	Xeric Torripsamments	Entisols	Lithosols.
Godecke	Fine-loamy, mixed, mesic	Durixerollic Natrargids	Aridisols	Solonetz soils.
Haybourne	Coarse-loamy, mixed, mesic	Xerollic Camborthids	Aridisols	Sierozems.
Heidtman	Fine-loamy, mixed, mesic	Aquic Fluventic Haploxerolls	Mollisols	Alluvial soils.
Henningsen	Sandy-skeletal, mixed, mesic	Aquic Haploxerolls	Mollisols	Alluvial soils.
Henningsen, moderately deep variant.	Coarse-loamy, over sandy-skeletal, mixed, mesic.	Aquic Haploxerolls	Mollisols	Alluvial soils.
Holbrook	Loamy-skeletal, mixed, mesic	Aridic Haploxerolls	Mollisols	Alluvial soils.
Hussman	Fine, montmorillonitic, mesic	Aquic Fluventic Haploxerolls	Mollisols	Alluvial soils.
Indian Creek	Fine, montmorillonitic, mesic	Xerollic Durargids	Aridisols	Sierozems.
Indiano	Fine-loamy, mixed, mesic	Aridic Argixerolls	Mollisols	Brown soils.
James Canyon	Fine-loamy, mixed, noncalcareous, mesic	Cumulic Haplaquolls	Mollisols	Humic Gley soils.
James Canyon, calcareous variant.	Fine-loamy, mixed, mesic	Haplic Calciaquolls	Mollisols	Solonchak soils. [1]
Job	Coarse-loamy, mixed, calcareous, mesic	Aquic Xerofluvents	Entisols	Alluvial soils.
Jubilee	Coarse-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols	Humic Gley soils.
Jubilee, sand substratum variant.	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols	Humic Gley soils.
Kimmerling	Fine-loamy, mixed, noncalcareous, mesic	Cumulic Haplaquolls	Mollisols	Humic Gley soils.
McFaul	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Xerollic Haplargids	Aridisols	Brown soils.
Millich	Clayey, montmorillonitic, frigid	Aridic Lithic Argixerolls	Mollisols	Chestnut soils.
Mottsville	Sandy, mixed, mesic	Torriorthentic Haploxerolls	Mollisols	Alluvial soils.
Ophir	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols	Humic Gley soils.
Ormsby	Mixed, mesic	Aquic Durorthidic Xeropsamments.	Entisols	Alluvial soils.
Prey	Coarse-loamy, mixed, mesic	Haploxerollic Durargids	Aridisols	Chestnut soils.
Prey, heavy subsoil variant.	Fine-loamy, mixed, mesic	Aridic Durixerolls	Mollisols	Prairie soils.
Puddle, gypsic variant	Coarse-silty, gypsic, mesic	Aquic Calciorthids	Aridisols	Solonchak soils. [2]
Quincy	Mixed, mesic	Typic Torripsamments	Entisols	Regosols.
Reno	Fine, montmorillonitic, mesic	Abruptic Xerollic Durargids	Aridisols	Sierozems.
Settlemeyer	Fine-loamy, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols	Humic Gley soils.
Springmeyer	Fine-loamy, mixed, mesic	Aridic Argixerolls	Mollisols	Chestnut soils.
Stodick	Loamy-skeletal, mixed, mesic, shallow	Xerollic Haplargids	Aridisols	Sierozems.
Toiyabe	Mixed, frigid, shallow	Typic Xeropsamments	Entisols	Lithosols.
Toll	Mixed, mesic	Xeric Torripsamments	Entisols	Alluvial soils.
Turria	Fine-loamy, mixed, mesic	Xerollic Haplargids	Aridisols	Sierozems.
Voltaire	Fine-loamy, mixed, calcareous, mesic	Fluventic Haplaquolls	Mollisols	Humic Gley soils.
Voltaire, seeped variant	Fine-loamy, mixed, calcareous, mesic	Typic Halaquepts	Inceptisols	Alluvial soils.
Washoe	Loamy-skeletal, mixed, mesic	Xerollic Haplargids	Aridisols	Brown soils.

[1] Soils of this series have a higher content of calcium carbonate than have other soils in this area that are classified as Solonchaks.
[2] Soils of this series have a higher content of gypsum than have other soils in this area that are classified as Solonchaks.

system. It is explained in the section "How This Survey Was Made."

Additional Facts About the Area

Among the early visitors to the Carson Valley Area were trappers of the Hudson's Bay Company and the Rocky Mountain Fur Company and, in 1843 and 1844, John Fremont, who mapped large areas of northern Nevada, including Carson Valley. The first settlers arrived during the Gold Rush of 1849. Many travelers wintered or stopped to rest and recuperate in Carson Valley. In 1851 the first town, Mormon Station, was established; in 1855 Mormon Station was renamed Genoa. During this period Carson Valley was part of Weber County, Utah.

In 1965, the population of the survey area was about 2,500 persons, of whom about 680 were in Gardnerville and 350 in Minden. Farming and ranching, the logging industry, the tourist trade, and small businesses provide employment.

Most of the land is privately owned, but some is owned by the Federal Government and administered by the Bureau of Land Management, the Bureau of Indian Affairs, and the Forest Service.

The area is served by buslines and trucklines, but not by railroad or by airlines. Scheduled railroad and air services are available at Reno, and chartered air service at the Douglas-Tahoe Airport. Roads include one U.S. highway, State highways, and many paved farm roads.

Among the recreational facilities in the survey area are a swimming pool, play areas, and excellent hunting and fishing facilities, and in nearby areas skiing, fishing, boating, swimming, and water skiing facilities.

Physiography, Relief, and Drainage

The Carson Valley Area is in the western part of the Great Basin section of the Basin and Range province *(3)*. It is elongated, approximately 20 miles long from north to south, and 8 miles wide. Carson Valley is narrow and sloping in the extreme southern part; it widens and levels out as it extends northward, but narrows again in the extreme northern part between the low granitic foothills that join the Carson Range and the Pine Nut Mountains.

This area is characterized by five major topographic features. Most prominent are the steep slopes of the Carson Range, which rise abruptly from the valley floor along the western side. Along the eastern side are the Pine Nut Mountains. Both of these essentially parallel mountain ranges have sharp, rugged features and complex structure. The sharp, rugged features of the Pine Nut Mountains are obscured in places by the prominent, steep foothills. The most prominent feature on the northern, eastern, and southern sides of the valley is the terraces. In many areas terrace relief is accentuated by the local movement of alluvial material, essentially parallel to the major fault along the eastern side of the Carson Range. The high terraces are dissected by several relatively shallow, narrow to broad drainage channels. Below some of the foothills and dissecting older high terraces are nearly level to steep alluvial fans that have slopes ranging from short and convex to long and smooth. These fans are dissected by many shallow channels and several broad, deep channels. In the valley, mainly along the western side, are low, nearly level flood plains and basins.

Among minor relief features in the survey area are scattered, partly stabilized sand dunes superimposed on alluvial fans in the northeastern corner of the survey area, truncated glacial moraines near Woodfords, and U-shaped glacial valleys in the Carson Range.

Peaks in the Carson Range, a part of the Sierra Nevada, range from 8,000 to 10,000 feet in elevation, and those in the Pine Nut Mountains from 7,000 to more than 9,500 feet. The elevation of the valley ranges from 5,400 feet above sea level, near Woodfords, to 4,625 feet, where the Carson River flows out of the area. Only the lower elevations to about 7,000 feet in the Carson Range and those to about 6,000 feet in the Pine Nut Mountains are within this survey area.

The Carson River is the only perennial stream in Carson Valley. It rises in the Sierra Nevada and is fed by water from melting snow and mountain springs. It flows northward along the western edge of the valley and then swings eastward to flow out of the survey area in the northeastern corner. The river drains a watershed of about 800 square miles, of which about 66 square miles is on the West Fork above Woodfords, and 344 square miles is on the East Fork above Gardnerville. Eventually, the water flows into Carson Sink, which is north of Fallon and about 130 miles northeast of the survey area.

Among the small streams in the western and southern parts of the survey area are Indian Creek, James Canyon Creek, Daggett Creek, Sheridan Creek, Jobs Creek, and Luther Creek. These creeks are tributaries of the Carson River.

Climate [2]

The Carson Valley Area lies between two mountain ranges that have a marked influence on the climate. The two ranges are the Carson Range at the western edge of the survey area, which affects the climate mainly in winter, and the Pine Nut Mountains at the eastern boundary, which affect the climate mainly in summer. The Carson Range is part of the Sierra Nevada. It rises from the valley floor to an elevation of about 10,000 feet within a distance of 10 miles. The Pine Nut Mountains generally rise to elevations of 7,000 to 9,500 feet. On the valley floor, the highest elevation is approximately 5,400 feet (near Woodfords, Calif.) and the lowest is approximately 4,625 feet (northern part of Douglas County, Nev.)

The climate of the survey area is essentially continental. The summers are short and often hot, and the winters are moderately cold. The percentage of possible sunshine averages 78 for the year and 90 for the summer, but the abundant sunshine is somewhat offset by the shortness of the growing season.

[2] By E. ARLO RICHARDSON, State climatologist, U.S. Weather Bureau, Salt Lake City, Utah.

TABLE 8.—*Temperature and precipitation data, Minden, Nevada*

[Data from the station at Minden, Nevada, elevation 4,700 feet; based on records for the period 1900–1960]

Month	Temperature				Precipitation			
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Average snowfall
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—	
	°F.	*°F.*	*°F.*	*°F.*	*In.*	*In.*	*In.*	*In.*
January	44.0	17.6	61.3	—3.7	1.72	0.15	2.31	5.2
February	49.5	22.2	64.4	6.5	1.42	.10	3.21	4.3
March	57.4	25.7	69.3	11.3	.94	.15	1.58	2.2
April	65.3	31.0	77.9	19.1	.56	(1)	1.33	.6
May	72.8	37.4	84.8	25.9	.52	0	1.50	(1)
June	81.5	42.6	92.9	32.5	.35	0	1.19	(1)
July	90.2	48.0	97.0	39.6	.30	0	1.10	0
August	88.6	45.7	96.7	35.6	.21	0	.69	(1)
September	80.7	39.3	93.9	28.4	.23	0	.70	(1)
October	69.4	31.2	84.2	18.9	.49	(1)	1.41	.1
November	56.7	23.6	70.7	9.8	1.03	(1)	2.65	.6
December	47.2	19.2	61.8	4.9	1.60	.09	3.46	6.4
Year	66.9	32.0			9.37			19.4

[1] Trace.

TABLE 9.—*Temperature and precipitation data, Woodfords, California*

[Data from the station at Woodfords, California, elevation 5,671 feet; based on records for the period 1937–52]

Month	Temperature				Precipitation	
	Average daily maximum	Average daily minimum	Record highest	Record lowest	Average total	Average snowfall
	°F.	*°F.*	*°F.*	*°F.*	*In.*	*In.*
January	42.7	21.0	67	—10	3.60	22.6
February	45.6	23.4	71	— 6	2.57	22.7
March	50.2	25.9	70	2	2.51	21.0
April	59.2	32.7	79	12	1.05	5.4
May	66.7	39.1	86	17	.72	1.3
June	74.2	44.8	95	24	.46	.3
July	84.9	52.7	96	37	.34	0
August	83.9	51.5	98	32	.30	(1)
September	76.5	45.8	92	24	.25	.1
October	64.3	37.8	82	14	1.53	.9
November	51.9	28.6	78	0	2.78	6.0
December	45.5	24.7	70	0	3.95	19.2
Year	62.1	35.7	98	—10	20.06	99.5

[1] Trace.

TABLE 10.—*Probabilities of low temperatures in spring and fall*

[All data from Minden, Nevada; based on records for the period 1900–1960]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 50 later than	April 9	April 27	May 7	May 25	June 13
1 year in 20 later than	April 6	April 24	May 4	May 23	June 10
1 year in 10 later than	April 3	April 20	May 1	May 19	June 28
2 years in 10 later than	March 29	April 17	April 28	May 16	June 5
3 years in 10 later than	March 26	April 14	April 26	May 13	June 3
4 years in 10 later than	March 24	April 11	April 24	May 12	June 2
5 years in 10 later than	March 21	April 9	April 22	May 10	May 31
Fall:					
1 year in 50 earlier than	October 25	October 10	September 25	September 13	September 4
1 year in 20 earlier than	October 28	October 14	September 28	September 16	September 6
1 year in 10 earlier than	November 1	October 17	September 30	September 18	September 8
2 years in 10 earlier than	November 3	October 20	October 3	September 21	September 10
3 years in 10 earlier than	November 5	October 22	October 5	September 23	September 12
4 years in 10 earlier than	November 7	October 24	October 6	September 25	September 13
5 years in 10 earlier than	November 8	October 26	October 8	September 27	September 14

The Sierra Nevada effectively reduces the moisture content of storms that sweep in from the Pacific Ocean. Winter is by far the wettest part of the year; more than half the annual precipitation is received during the period November through February.

Temperature and precipitation data based on records at Minden, Nev., and Woodfords, Calif., are given in tables 8 and 9. The probabilities of low temperatures in spring and fall are given in table 10.

According to data in tables 8 and 9, total precipitation averages 20.06 inches a year at Woodfords, California, and 9.37 inches a year at Minden, Nevada, but variations of about 25 percent are common from year to year. The annual precipitation is greater than these amounts about 42 percent of the time, and less than these amounts about 58 percent of the time. For example, the annual precipitation at Minden can be expected to be—

	Percent of time
Less than 5.5 inches	10
6.5 inches	25
8 inches	50
10.5 inches	25
More than 13 inches	10

In winter, because the Sierra Nevada is a barrier to the flow of air toward the east there is considerable difference between the amount of precipitation received at the higher elevations and the amount received at the lower elevations. For example, from November through March, precipitation averages 36 inches at Twin Lakes (elevation, 7,829 feet), 16.41 inches at Woodfords (elevation, 5,671 feet), and only 6.71 inches at Minden (elevation, 4,700).

The summer showers are a product of the moist air from the Gulf of Mexico that sometimes flows as far north as the Carson Valley Area. The blocking effect of the Pine Nut Mountains to the flow of air toward the northwest is strong but not nearly so pronounced as that of the Carson Range to the flow of air toward the east in winter. During the period July through September, precipitation averages 1.34 inches at Twin Lakes, 0.49 inch at Woodfords, and 0.74 inch at Minden. An average of only 12 thunderstorms a year has been recorded.

Snowfall in the higher parts of the mountains, where the average precipitation is 46 inches a year, averages 367 inches a year. It is the main source of irrigation water for farms in the valley. Snowfall averages nearly 100 inches a year at Woodfords and 19.4 inches a year at Minden.

The two mountain ranges also affect the temperature. Cold air flows down the mountain slopes, accumulates on the valley floor, and produces temperatures in winter as low as -24° F. and temperatures in summer below those that normally occur in nearly level areas. Warm days and cool nights prevail in summer, but the daily range in temperature is high. The average daily range at Minden is 26° in January and 43° in August.

The length of the growing season, or frost-free period, ranges from an average of 129 days at Woodfords to only 107 days at Minden. Most forage crops grown in the area are only nipped by frost at a temperature of 32° but cannot survive temperatures below 28°.

The prevailing winds are from the south. Records of windspeed are not kept for the Carson Valley Area itself, but data kept at Reno can be applied. These records show that a maximum windspeed of about 65 miles per hour can be expected during periods of strong winds, but the windspeed is ordinarily 6 to 7 miles per hour.

Water Supply

About 45,000 acres in the Carson Valley Area is irrigated with water from the Carson River and its main tributaries, the East Fork and the West Fork. About 6,000 acres, mostly on alluvial fans, is irrigated with water from local creeks, such as James Canyon Creek, Daggett Creek, Sheridan Creek, Jobs Creek, Luther Creek, and Indian Creek. Other sources of irrigation water are several drilled wells that supply water late in the growing season and several small, privately owned reservoirs. Five of these reservoirs are within the survey area. They store water for use when the flow of the Carson River declines.

In most years the need for water is greater than the available supply. The supply of water in the Carson River is dependent on melting snow and mountain springs. In years of heavy snowfall, an adequate supply of water is available throughout the growing season, but in years of light snowfall, only a small amount of water is available for irrigation after July 1.

Forecasts of water supply during the irrigation season can be obtained from the Water Supply Outlook reports issued by the Soil Conservation Service and the Nevada Department of Conservation and Natural Resources. Each year, these reports are available on the first of March, April, and May.

Several pumping stations and approximately a hundred regulatory diversion dams in the river channels and sloughs are used to divert the river water. Most of the diversion dams are small and serve one user, but some, such as the one in Allerman Ditch, are large and serve several users.

At present the water rights (riparian rights in California) on the Carson River are being adjudicated, and the delivery of water to individual users is administered by a Federal Court-appointed watermaster. The acreages under water rights are defined, and the minimum flow at which water can be supplied to all the acreage under water rights is regulated by court order. If the flow is below the level at which all users can be served, only those farmers who have the earlier rights can be served. Construction of the Washoe Project, proposed by the Bureau of Reclamation, would make more irrigation water available in the survey area.

In the more than one hundred years that water in the Carson River has been used to irrigate land in Carson Valley, harmful amounts of salts have accumulated only in the soils that are not adequately drained. Salts are not likely to accumulate under continued use of the river water if adequate drainage is provided, although 100 percent of the dissolved solids could be sodium. The content of dissolved solids, the percentage of sodium, and the content of boron are all within reasonable limits. The results of analysis of the water in selected streams are shown in table 11, and those of chemical analysis of Carson River water are shown in table 12.

The water supply for domestic use at Minden and Gardnerville comes from wells. For domestic use at Woodfords and Genoa, it comes from creeks, springs, and privately owned wells. For domestic use and for livestock on the ranches and farms, it comes from privately owned wells, local creeks, the Carson River and its tributaries, and sloughs.

Floods

Flooding in Carson Valley is caused either by rainstorms or by melting snow. Usually, flooding caused by rainstorms is characterized by extremely high streamflow, occurs between November and March, and is of short duration. Flooding caused by melting snow is not characterized by high streamflow, occurs between March and June, and is of long duration.

Since 1860, more than a dozen major floods in Carson Valley have been recorded, but the worst occurred in 1955, when damage to property in the Carson River Basin amounted to more than a million dollars. The damage necessitated clearing of channels and ditches, repairing of diversion structures, roads, and bridges, and in some places, removal or leveling of flood-deposited silt and sand. Except in the places where water cut into the banks of the rivers and sloughs, only small amounts of soil were lost.

Localized flooding in summer is caused by high-intensity storms. It occurs around the margins of the irrigated areas and rarely affects areas adjacent to the river. Damage results largely from deposits of debris on fields and the filling of irrigation ditches and canals.

Farming

Farming began with the arrival of settlers and spread wherever water was available. Alfalfa was introduced about 1860. A few farms, chiefly in the northern part of the valley, were established by the early 1900's.

In 1959 there were 125 commercial farms and ranches in the survey area. Most of the farms and ranches were operated by the owners. An average-size farm was 230 acreas, of which 200 acres were irrigated. Nineteen of the ranches were more than 500 acres in size and occupied most of the irrigable land. One of the largest ranches in Douglas County is mostly within the survey areas. It is 30,000 acres in size and has 7,800 acres of irrigated land.

At present about 45,000 acres of cropland and meadow is irrigated. The number of acres irrigated changes little from year to year, even though the supply of irrigation water varies. In years when the water supply is ample, all the irrigated acreage receives water at regular intervals throughout the year, and even in years when the water supply is short, it receives water at least once.

Raising of livestock is an important farm enterprise. Most of the livestock are trucked to feeder markets in nearby communities, but some are butchered locally.

The raising of beef cattle is a major enterprise. The 23,000 head of cattle on local farms and ranches in 1959 were mostly Herefords or Hereford crosses of good quality. Of the 25 major producers, several have large herds. The valley provides grazing for the cattle on most of the ranches and farms, but some of the major producers use both private and public lands in nearby areas for grazing.

Among the other livestock raised in the survey area in 1959 were 1,580 milk cows, mainly Holsteins, on many farms throughout the valley. Sheep were raised,

TABLE 11.—*Analysis of water in selected streams in 1952*

[Analysis obtained from data compiled by the Bureau of Reclamation, Department of Interior, and Soil Conservation Service]

Name of stream; location and date of sample	Electrical conductivity (EcX10[6])	Reaction	Dissolved solids	Sodium	
				Present	Possible
	Mmhos. per cm. at 25°C.	*pH*	*Tons per acre-foot*	*Percent*	*Percent*
East Fork Carson River; NW¼ sec. 25, T. 12 N., R. 20 E:					
July sample	148	7.7	0.07	14.6	100
September sample	135	8.1	.13	12.4	53.0
West Fork Carson River; NW¼ sec. 35, T. 11 N., R. 19 E.:					
July sample	54	7.5	.05	....	....
September sample	62	7.8	.03	6.6	80.0
Carson River at Cradlebaugh Bridge; sec. 30, T. 14 N., R. 20 E.:					
July sample	135	7.4	.13	....	....
September sample	260	7.9	.25	....	....
Carson River east of Carson City; sec. 35, T. 15 N., R. 20 E.:					
July sample	100	....	....	12.0	100
September sample	397	8.5	.36	40.9	100
Big Ditch; sec. 2, T. 12 N., R. 19 E.:					
July sample	149	7.5	.14	....	....
September sample	185	8.3	.18	27.7	100
Martin Slough; sec. 30, T. 13 N., R. 19 E.:					
July sample	281	7.5	.27	....	....
September sample	323	8.3	.26	25.9	100

TABLE 12.—*Chemical analysis of water in the Carson River*

Name of river; location and date of sample	Sodium		Electrical conductivity Ecx10[6]	Ca	Mg	Na	CO_3	HCO_3	Cl	SO_4
	Present	Possible								
	Pct.	*Pct.*	*Mmhos. per cm. at 25°C.*	*E.p.m.*[1]	*E.p.m.*[1]	*E.p.m.*[1]	*E.p.m.*[1]	*E.p.m.*[1]	*E.p.m.*[1]	*E.p.m.*[1]
East Fork Carson River at Horseshoe Bend–										
December 1951 sample	30	([2])	200	1.40	....	0.60	....	1.45	0.15	0.40
November 1952 sample	23	71	207	1.60	....	.48	....	1.40	.15	.53
April 1952 sample	18	([2])	136	1.12	....	.25	....	1.25	.05	.07
West Fork Carson River at gaging station at Woodfords:										
April 1952 sample	35	([2])	45	.26	0.11	.20	0	.52	0	.05
Carson River below junction of forks:										
April 1952 sample	31	([2])	340	2.32	....	1.08	....	2.30	.30	.80
December 1951 sample	17	([2])	155	1.28	....	.27	....	1.30	.10	1.5

[1] Equivalent per million: A unit chemical equivalent weight of an ion per million unit weights of solution; equivalents per million and milliequivalents per liter are numerically identical if the specific gravity of the solution is 1.0.
[2] Nearly 100 percent.

385-225 O - 71 - 9

not only by two major producers, but also in small flocks on many farms. Also raised were 1,318 hogs and pigs, mostly for local use; 309 horses, kept mostly for riding stock; and a few mules and burros on sheep ranches.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonym: clay coating.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

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 when dry or moist; does 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.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Erosion pavement. A layer of gravel or stones on the ground surface that remains after the fine particles are removed by wind or water. Desert pavements result from exposure to dry winds.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants. when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry 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 sediments, that borders a stream and is subject to flooding unless protected artificially.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

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 substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Irrigation efficiency. The ratio of the water consumed by crops on an irrigated farm to the water diverted from a river or other natural source into the farm canals.

Leached soil. A soil from which the soluble materials have been removed or in which these have been moved from one part of the profile to another.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural drainage. Drainage that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time. If Podzolic, they commonly have mottling below 6 to 16 inches in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods; they are light gray and generally mottled from the surface downward, but some have few or no mottles.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Permeability. The quality that enables a soil horizon to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil variant. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stones. Rock fragments greater than 10 inches in diameter if rounded, and greater than 15 inches along the longer axis if flat.

Stone line. A concentration of coarse rock fragments in soils that generally represents an old weathering surface. In a cross section, the line may be one stone or more thick. The line generally overlies material that weathered in place, and it is ordinarily overlain by sediment of variable thickness.

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 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 solum below plow depth.

Subsoiling. The tillage of the soil below the normal plow depth, usually to shatter a hardpan or claypan.

Substratum. Technically the part of the soil below the solum.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. 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."

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 6.
Estimated yields, table 2, page 76.
Wildlife sites, table 3, page 78.

Engineering uses of the soils, tables 4, 5, and 6, pages 80 through 115.

Map symbol	Mapping unit	Described on page	Capability unit Irrigated Symbol	Irrigated Page	Nonirrigated Symbol	Nonirrigated Page
AdE	Aldax stony fine sandy loam, 16 to 45 percent slopes	5	None	----	VIIe-1	73
AlE	Aldax very stony fine sandy loam, 4 to 45 percent slopes	7	None	----	VIIs-8	74
AnF	Aldax-Indiano very stony association, 16 to 45 percent slopes	7				
	Aldax part	--	None	----	VIIs-8	74
	Indiano part	--	None	----	VIIe-1	73
Bc	Bishop loam, cool	8	Vw-9	73	None	----
Bc2	Bishop loam, cool, eroded	8	IIIw-9P	68	None	----
Bh	Bishop loam, clay substratum, cool	8	Vw-9	73	None	----
Bm	Bishop loam, poorly drained, cool	8	IIIw-9P	68	None	----
Bn	Bishop loam, poorly drained, slightly saline-alkali, cool	8	IIIw-6P	68	None	----
BoC	Borda gravelly sandy loam, 4 to 16 percent slopes	9	None	----	VIc-K	73
BrF	Borda stony sandy loam, 16 to 45 percent slopes	9	None	----	VIIe-1	73
BsA	Brockliss gravelly loamy sand, 0 to 2 percent slopes	10	Vw-7	72	None	----
BtA	Brockliss stony loamy sand, 0 to 8 percent slopes	9	Vw-7	72	None	----
BwA	Brockliss stony loamy sand, water table, 0 to 4 percent slopes	10	Vw-7	72	None	----
CaA	Calpine gravelly coarse sandy loam, 0 to 2 percent slopes	10	IIIs-4	69	None	----
CcB	Calpine stony coarse sandy loam, 2 to 8 percent slopes	11	IVe-4	69	None	----
Cf	Cashmere fine sandy loam	11	IIs-4	63	None	----
CkC	Cave Rock loamy sand, 2 to 8 percent slopes	12	None	----	VIIs-L	75
Cm	Cradlebaugh clay loam	13	IIw-3	62	None	----
Cn	Cradlebaugh clay loam, poorly drained, slightly saline, strongly alkali	14	VIw-6	73	None	----
Co	Cradlebaugh clay loam, poorly drained, strongly saline-alkali	14	VIw-6	73	None	----
Cr	Cradlebaugh soils, poorly drained, slightly saline-alkali	14	IVw-36P	70	None	----
Cs	Cradlebaugh soils, slightly saline-alkali	13	IIIw-36	66	None	----
Ct	Cradlebaugh soils, slightly saline, strongly alkali	14	VIw-6	73	None	----
Cu	Cradlebaugh soils, strongly saline-alkali	14	None	----	VIIw-6	74
Da	Dangberg clay	14	IVw-36P	70	None	----
Db	Dangberg clay, strongly alkali	15	VIw-6	73	None	----
Dc	Dangberg clay, strongly saline-alkali	15	VIw-6	73	None	----
De	Dangberg clay, water table	15	Vw-3	72	None	----
Dg	Dangberg clay, water table, strongly alkali	15	VIw-6	73	None	----
Dk	Dangberg clay, thin solum variant	16	None	----	VIIw-6	74
Dl	Draper loam	16	IIw-2	62	None	----
Do	Draper loam, overflow	17	IIw-2	62	None	----
DrA	Dressler gravelly sandy loam, 0 to 2 percent slopes	18	IIIw-4	67	None	----
DsA	Dressler gravelly sandy loam, water table, 0 to 2 percent slopes	18	IIIw-4P	67	None	----
DtA	Dressler sandy loam, 0 to 2 percent slopes	17	IIIw-4	67	None	----
DwA	Dressler sandy loam, water table, 0 to 2 percent slopes	18	IIIw-4P	67	None	----
DwB	Dressler sandy loam, water table, 2 to 4 percent slopes	18	IIIw-14P	65	None	----
Ea	East Fork clay loam	18	IIw-2	62	None	----
Ef	East Fork loam	19	IIw-2	62	None	----
Fc	Fettic clay, strongly saline	20	None	----	VIIw-6	74
Fe	Fettic clay loam	20	None	----	VIIw-6	74
Ff	Fettic very fine sandy loam	19	None	----	VIIw-6	74
FpB	Fettic very fine sandy loam, pan variant, 2 to 4 percent slopes	20	None	----	VIIw-6	74

U. S. GOVERNMENT PRINTING OFFICE : 1971 O - 385-225

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit: Irrigated Symbol	Irrigated Page	Nonirrigated Symbol	Nonirrigated Page
FrG	Franktown very stony and rocky complex, 45 to 80 percent slopes	21				
	Franktown part	----	None	----	VIIs-1	74
	Inclusions of rubble land and rock outcrops	----	None	----	VIIIs-8	75
Ga	Gardnerville clay	22	IIw-35	63	None	----
Gc	Gardnerville clay, slightly saline-alkali	22	IIIw-356	66	None	----
Gd	Gardnerville clay loam	22	IIw-3	62	None	----
Ge	Gardnerville clay loam, deep water table	23	IIw-3	62	None	----
Gg	Gardnerville clay loam, gravel substratum	23	IIw-3	62	None	----
Gh	Gardnerville clay loam, slightly saline-alkali	23	IIIw-36	66	None	----
GkF	Glenbrook rocky sand, 30 to 60 percent slopes	23	None	----	VIIs-1	74
GlE	Glenbrook sand, 8 to 30 percent slopes	23	None	----	VIIs-L	75
Go	Godecke clay loam	24	VIw-6	73	None	----
Gu	Gullied land	24	None	----	VIIe-1	73
HaA	Haybourne loam, 0 to 2 percent slopes	25	IIs-4	63	None	----
HaB	Haybourne loam, 2 to 4 percent slopes	25	IIIe-4	64	None	----
HbB	Haybourne sand, 0 to 4 percent slopes	25	IIIe-4	64	None	----
Hc	Heidtman clay loam	25	IIw-2	62	None	----
Hd	Heidtman clay loam, clay substratum	26	IIw-2	62	None	----
He	Heidtman loam, slightly saline-alkali	26	IIw-6	63	None	----
Hf	Henningsen clay loam, water table	27	Vw-4	72	None	----
Hg	Henningsen gravelly loam	26	Vw-4	72	None	----
Hh	Henningsen gravelly loam, water table	27	Vw-4	72	None	----
Hk	Henningsen loam	27	Vw-4	72	None	----
Hl	Henningsen loam, water table	27	Vw-4	72	None	----
Hm	Henningsen clay loam, moderately deep variant	28	IIIw-4	67	None	----
Hn	Henningsen loam, moderately deep variant	27	IIIw-4	67	None	----
HoB	Holbrook gravelly fine sandy loam, 2 to 4 percent slopes	28	IIIe-4	64	None	----
HoC	Holbrook gravelly fine sandy loam, 4 to 8 percent slopes	29	IVe-4	69	None	----
HrB	Holbrook gravelly fine sandy loam, water table, 2 to 4 percent slopes	29	IIIe-4	64	None	----
HsD	Holbrook very stony fine sandy loam, 4 to 16 percent slopes	29	None	----	VIIs-7	74
Hu	Hussman clay	29	IIw-35	63	None	----
Hv	Hussman clay, slightly saline-alkali	30	IIIw-356	66	None	----
Hw	Hussman clay loam, strongly saline-alkali	30	None	----	VIIw-6	74
Hy	Hussman silty clay loam, slightly saline-alkali, overflow	30	IIIw-36	66	None	----
IgD	Indian Creek gravelly fine sandy loam, 4 to 16 percent slopes	31	None	----	VIc-K	73
IlB	Indian Creek very cobbly loam, 0 to 4 percent slopes	30	None	----	VIIs-7	74
InF	Indiano stony fine sandy loam, 30 to 45 percent slopes	31	None	----	VIIe-1	73
JaB	James Canyon loam, 2 to 4 percent slopes	32	IIIw-1P	65	None	----
JaC	James Canyon loam, 4 to 16 percent slopes	33	IVw-1P	69	None	----
JcB	James Canyon loam, drained, 2 to 4 percent slopes	32	IIw-1	61	None	----
JcC	James Canyon loam, drained, 4 to 8 percent slopes	33	IIIw-1	65	None	----
JdB	James Canyon peat, 2 to 8 percent slopes	33	VIIw-2	73	None	----
JeB	James Canyon loam, calcareous variant, 2 to 4 percent slopes	33	IIIw-1P	65	None	----
JeC	James Canyon loam, calcareous variant, 4 to 8 percent slopes	34	IIIw-1	65	None	----
Jg	Job loam	34	IIw-2	62	None	----
Jh	Job loam, clay substratum, water table, slightly saline-alkali	35	IVw-36P	70	None	----
Jk	Job loam, slightly saline-alkali	35	IIw-6	63	None	----
Jl	Job loam, water table	35	IIIw-2	65	None	----
Jm	Jubilee clay, slightly saline-alkali	36	Vw-2	72	None	----
Jn	Jubilee loam	35	Vw-2	72	None	----
Jo	Jubilee loam, poorly drained	36	IIIw-2	65	None	----
Jp	Jubilee peat	36	VIIw-2	73	None	----
Js	Jubilee clay loam, sand substratum variant, deep	37	IIIw-4P	67	None	----

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit: Irrigated Symbol	Irrigated Page	Nonirrigated Symbol	Nonirrigated Page
Jt	Jubilee loam, sand substratum variant	37	Vw-4	72	None	----
Kc	Kimmerling clay loam	38	IIIw-2	65	None	----
Km	Kimmerling clay loam, clay substratum	38	IIIw-3P	67	None	----
Ks	Kimmerling clay loam, slightly saline-alkali	38	IIIw-6P	68	None	----
Kt	Kimmerling loam	37	IIIw-2	65	None	----
McA	McFaul sand, 0 to 2 percent slopes	39	IIIs-4	69	None	----
McB	McFaul sand, 2 to 8 percent slopes	39	None	----	VIc-K	73
MfB	McFaul sand, moderately deep, 2 to 4 percent slopes	39	None	----	VIc-K	73
MhE	Millich very stony sandy loam, 4 to 30 percent slopes	40	None	----	VIIs-8	74
MhF	Millich very stony sandy loam, 30 to 60 percent slopes	40	None	----	VIIs-8	74
MlB	Mottsville loamy coarse sand, 2 to 4 percent slopes	41	IVs-4L	71	None	----
MlD	Mottsville loamy coarse sand, 4 to 16 percent slopes	40	None	----	VIIs-L	75
MoD	Mottsville very bouldery loamy coarse sand, 2 to 16 percent slopes	41	None	----	VIIs-L	75
MoF	Mottsville very bouldery loamy coarse sand, 16 to 45 percent slopes	41	None	----	VIIs-L	75
MtC	Mottsville-Toiyabe association, 4 to 8 percent slopes	41	None	----	VIIs-L	----
OgA	Ophir gravelly sandy loam, 0 to 2 percent slopes	42	IVw-49P	70	None	----
OgB	Ophir gravelly sandy loam, 2 to 8 percent slopes	42	IVw-49P	70	None	----
OhC	Ophir gravelly sandy loam, somewhat poorly drained, 2 to 8 percent slopes	42	IVw-49	70	None	----
OpB	Ophir peat, 2 to 4 percent slopes	42	VIIw-2	73	None	----
Or	Ormsby gravelly loamy sand	43	IVw-L	71	None	----
Os	Ormsby gravelly loamy sand, slightly saline-alkali	44	IVw-6L	71	None	----
Oy	Ormsby loamy sand	44	IVw-L	71	None	----
Pe	Peat	44	Vw-9	73	None	----
PgB	Prey gravelly loamy sand, 0 to 4 percent slopes	45	None	----	VIc-K	73
PhA	Prey loamy sand, 0 to 2 percent slopes	45	None	----	VIc-K	73
PmD	Prey stony sandy loam, 4 to 16 percent slopes	46	None	----	VIc-K	73
PnC	Prey stony loam, heavy subsoil variant, 2 to 16 percent slopes	46	None	----	VIc-K	73
Pu	Puddle silt loam, gypsic variant	47	None	----	VIIw-6	74
QuE	Quincy fine sand, 2 to 30 percent slopes	47	None	----	VIIs-L	74
ReB	Reno gravelly sandy loam, 2 to 8 percent slopes	48	None	----	VIc-K	73
RgC2	Reno gravelly sandy loam, moderately deep, 2 to 8 percent slopes, eroded	49	None	----	VIc-K	73
RnD	Reno stony sandy loam, 4 to 16 percent slopes	49	None	----	VIc-K	73
Ro	Rock land	49	None	----	VIIIs-8	75
Ru	Rough broken land	49	None	----	VIIe-1	73
Sa	Sandy alluvial land	49	VIIw-L	74	None	----
Sc	Settlemeyer clay loam	49	IIIw-2	65	None	----
Se	Settlemeyer clay loam, somewhat poorly drained	50	IIw-2	62	None	----
Sg	Settlemeyer clay loam, slightly saline-alkali	50	IIIw-2	65	None	----
Sk	Settlemeyer clay loam, strongly saline-alkali	50	VIw-6	73	None	----
SlD	Springmeyer gravelly fine sandy loam, 4 to 16 percent slopes	51	None	----	VIc-K	73
SmB	Springmeyer loam, 2 to 4 percent slopes	51	IIe-1	61	None	----
SnF	Springmeyer stony fine sandy loam, 16 to 45 percent slopes	51	None	----	VIIe-1	73
SoD	Springmeyer stony fine sandy loam, moderately deep, 4 to 16 percent slopes	52	None	----	VIc-K	73
SpF	Springmeyer very stony fine sandy loam, 30 to 45 percent slopes	52	None	----	VIIs-7	74
StD	Stodick very stony fine sandy loam, 4 to 16 percent slopes	52	None	----	VIIs-8	74

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit: Irrigated Symbol	Irrigated Page	Nonirrigated Symbol	Nonirrigated Page
TaF	Toiyabe very rocky loamy coarse sand, 30 to 60 percent slopes	53	None	----	VIIs-1	74
TlB	Toll sand, 0 to 4 percent slopes	53	IVs-4L	71	None	----
TlD	Toll sand, 4 to 16 percent slopes	54	None	----	VIIs-L	75
TmA	Toll sand, clay substratum, water table, 0 to 2 percent slopes	54	IVw-L	71	None	----
ToB	Toll sandy loam, 0 to 4 percent slopes	54	IVs-4L	71	None	----
Tr	Turria clay loam	55	IIc-K	64	None	----
Tt	Turria clay loam, water table	55	IIw-2	62	None	----
Tu	Turria loam	54	IIc-K	64	None	----
Tw	Turria loam, water table	55	IIw-2	62	None	----
Va	Voltaire clay, slightly saline-alkali	56	IVw-36P	70	None	----
Vc	Voltaire silty clay	56	IVw-36P	70	None	----
Ve	Voltaire silty clay, water table, slightly saline-alkali	56	Vw-3	72	None	----
Vr	Voltaire silty clay, water table, strongly saline-alkali	57	VIw-6	73	None	----
Vs	Voltaire silty clay loam, strongly saline-alkali	57	VIw-6	73	None	----
Vt	Voltaire clay loam, seeped variant	57	VIw-6	73	None	----
Wa	Washoe cobbly sandy loam	58	None	----	VIc-K	73
Wg	Washoe gravelly sandy loam	58	IIIs-4	69	None	----

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