United States Department of Agriculture, Natural Resources Conservation Service

United States Department of the Interior, Bureau of Land Management

In cooperation with the Arizona Agricultural Experiment Station

Soil Survey of Shivwits Area, Arizona,

Part of Mohave County



How to Use This Soil Survey

General Soil Map

The general soil map, which is a color map, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

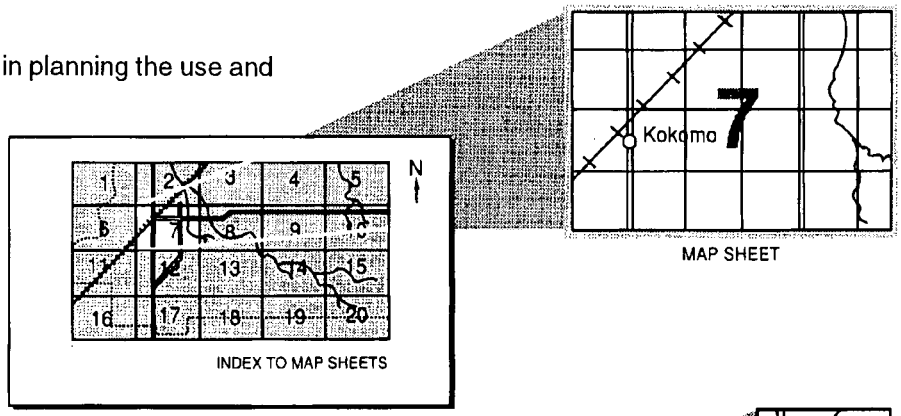
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1993. Soil names and descriptions were approved in 1994. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Arizona Agricultural Experiment Station. The survey is part of the technical assistance furnished to the Littlefield-Hurricane Valley Natural Resource Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover: Parashant Canyon, featured here looking south toward the Grand Canyon, is one of the more picturesque canyons in the survey area. The canyon walls are Meriwhitica-Rock outcrop-Strych complex, 35 to 75 percent slopes. At the bottom is Riverwash-Torrifluvents complex, 1 to 3 percent slopes.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

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Foreword

This soil survey contains information that can be used in land-planning programs in northwest Mohave County. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for efficient food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey soils are poorly suited to use as septic tank absorption fields.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Michael Somerville
State Conservationist for Arizona
Natural Resources Conservation Service

Soil Survey of Shivwits Area, Arizona, Part of Mohave County

By Alfred A. DeWall

Fieldwork by Alfred A. DeWall, Douglas E. Walk, Wendell Jorgensen, Rick VanRemortel, Ed Fenn, Mark Clark, and Gregg W. Schellentrager

United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, Bureau of Land Management, in cooperation with the Arizona Agricultural Experiment Station

General Nature of the Survey Area

This section provides brief information about the survey area. It describes settlement and development and climate.

Settlement and Development

Janice B. DeWall prepared this section.

The Shivwits clan of the Southern Paiute Indians occupied the Shivwits Plateau by 1,300 A.D. They were wanderers with no permanent habitation (Lavender 1984).

From 1776 to 1870, mountain men and explorers occasionally crossed the Shivwits, and the Old Spanish Trail cut through the corner of Arizona, following the Virgin River. Mormon explorers established trails across the Arizona Strip (Lavender 1984).

Henry W. Miller began Millersburg, the first permanent white agricultural settlement in Arizona, in 1864. The town's name was later changed to Beaver Dam (McClintock 1985). Neighboring Littlefield was settled about 1875 (Cox and Russell 1973).

In 1865 the Arizona Legislature cut off the northern part of Mojave County to make Pah-Ute County. In 1866, Congress gave most of it to Nevada, so Pah-Ute became Arizona's "lost county" and the area again became part of Mojave County (Wyllys 1950).

The first sawmill on the Arizona Strip was erected about 1870, at the foot of Mt. Trumbull, to cut lumber for the new temple being built in St. George

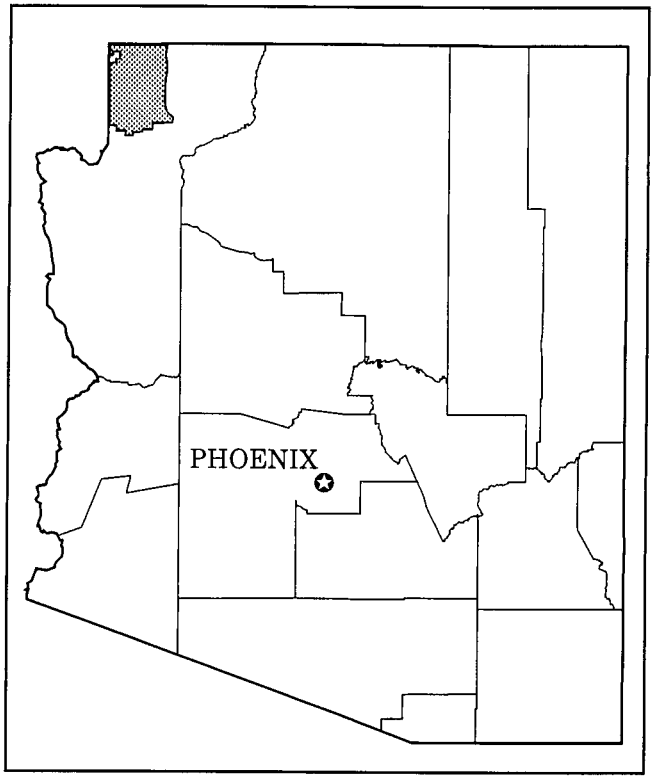


Figure 1.—Location of Shivwits Area in Mohave County in Arizona.

(McClintock 1985). Lumber was hauled over the "Temple Trail" down a break in the Hurricane Cliffs. After completion of the temple, the "Honeymoon Trail" was established, leading from settlements in Arizona

to the temple, where couples went for marriage ceremonies (Lavender 1984).

Copper mining operations ran at the Grand Gulch, Apex, Savanic, and Copper Mountain mines from 1884 to 1918. The mines were reworked from 1955 to 1961 (Cox 1982).

Ranchers began settling on the Shivwits in the late 1800's. William Atkin settled Atkinville, right on the Arizona line, in 1877 (Cox 1982). Other sheepmen followed. One of the first was Preston Nutter, who moved into the area in 1893 (Lavender 1984). Most of the small ranchers sold steers to Nutter every year, who then drove them to the railhead at Modena, Utah (Cox 1982). In 1936-37, during the "Winter of the Blue Snow," people were stranded and great numbers of animals died. The sheep industry never recovered, most going broke or converting to cattle (Cox 1982).

Livestock owners were always looking for water. They dug ponds and dammed springs and creeks, but the dams soon washed out. In 1947, they began building big reservoirs. Later, the BLM helped ranchers construct water "catchments" (Cox 1982).

The Shivwits became famous for outlaw hideouts and bootleg whiskey. Little Arizona was a notorious drinking establishment just over the Arizona state line, a little south of present-day St. George, Utah. It operated for seven or eight years (Cox 1982).

The Enlarged Homestead Act offered free land, but most homesteaders quickly learned that the arid land could not support them and abandoned their homes and their dreams. Abraham Bundy and his family took homesteads in 1916 and established Bundyville, officially named "Mt. Trumbull." At its peak in the early 1930's, it boasted between 100 and 200 residents (Cox and Russell 1973).

The Taylor Grazing Act of 1934 restricted grazing land to those who owned the water rights. This was the final straw for most homesteaders. Some bigger ranchers bought up homesteaders' land and all the water rights they could get, creating large ranches which could support a family or two (Cox 1982). The Bureau of Land Management (BLM) criss-crossed the area with fences and regulated how many cattle could be run, conserving the range (Cox 1982). Wild mustangs became a problem, so the BLM hired people to shoot them. Within a very few years, all the mustangs were gone (Cox 1982).

Most ranchers currently in the area still do not live on the Strip and must hold other jobs (Cox 1982). Commercial crops are raised in the Beaver Dam-Littlefield area (Tavernetti 1971). A 21.5 mile stretch of Interstate 15 parallels the Virgin River through the Shivwits. Completed in 1973, the 3-mile section through the Virgin River Gorge cost $100 an inch, the most expensive piece of pavement in Arizona at that time. The highway provides campsites and access to recreation areas (Heatwole 1982).

In 1984, the Arizona Wilderness Bill created four wilderness areas in the Shivwits, totaling 154,900 acres. Currently, about 90 percent of the Shivwits is public land and 10 percent is private.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina, Bureau of Land Management RAWS, and Alfred A. DeWall, SSPL, NRCS.

Table 1 gives data on temperature and precipitation for a portion of the survey area as recorded at St. George, Utah, and Beaver Dam, Arizona. Table 2 shows average annual precipitation for 25 stations throughout the survey area. Table 3 shows probable dates of the first freeze in fall and last freeze in spring. Table 4 provides data on length of the growing season.

There are six distinct temperature-moisture climates in the Shivwits Soil Survey Area. These climates are related to elevation changes within the survey. The lowest point is in the southwest corner at 1,440 feet, and the highest is at 8,000 feet on Mount Bangs in the Virgin Mountains.

Detailed climate data is only available for two sites just outside the survey area: Saint George, Utah, and Beaver Dam, Arizona. These two climate stations represent the climate of the lowest elevation range, or about one-fourth of the area.

Using just the data from the National Climate Center leaves most of the survey area without climatic data. The Bureau of Land Management (BLM) has monitored 25 precipitation stations throughout the survey area. Most of the stations have been monitored since 1977. The BLM established three Remote Automated Weather Stations (RAWS) in the survey area in 1985 and one more in 1987. The RAWS sites are young sites and lack sufficient data to show climatic cycles and good yearly averages, but they do show the drought the area has been in during the 1980's and early 1990's. They also give some insight on air temperature, frost-free season, and wind velocities. Figure 2 shows the location of each precipitation station (site number, location, and average annual precipitation in inches) and location of the RAWS sites and names.

The BLM precipitation stations are observed and recorded monthly. The monthly data is entered into the computer as quarterly data. The fall quarter includes October and November; the winter quarter includes December, January, and February; the spring quarter includes March, April, and May; and the

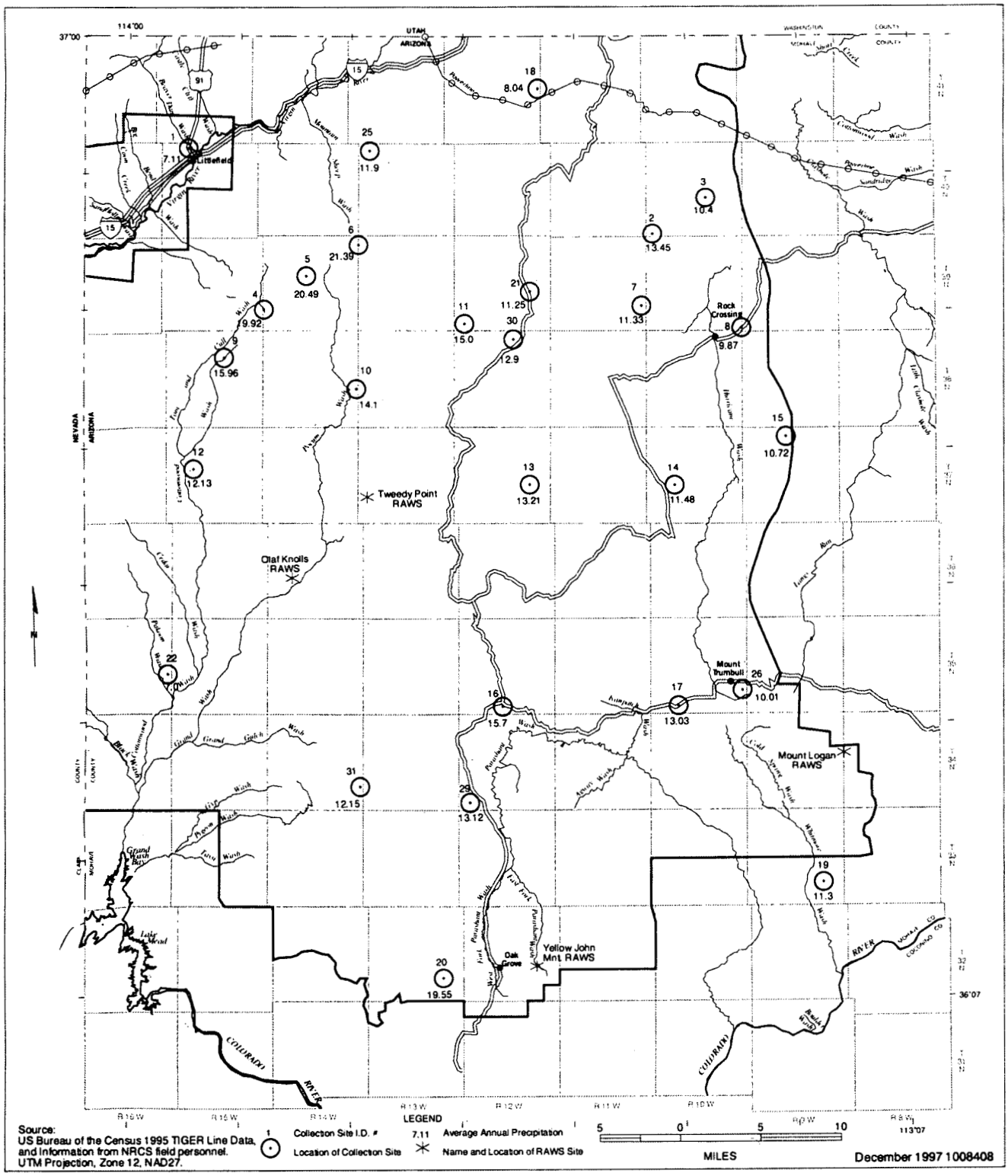


Figure 2.—Location of rain gauges and Remote Automated Weather Stations (RAWS) in the Shivwits Area.

summer quarter includes June, July, August, and September.

The RAWS site at Olaf Knolls is in the same temperature-moisture-climate as Beaver Dam, Arizona, and St. George, Utah. The temperature-precipitation tables for these three sites show an average annual precipitation of 7 to 8.12 inches and an average annual air temperature of 61.6 to 68 degrees F. Comparing the daily minimum and maximum temperatures for the three sites shows an average of 210 to 282 frost-free days. These sites represent the hottest, driest climate in the survey area. This area is representative of the D30-3 Major Land Sub-Resource Area known as Grand Canyon Desert Shrub. Soils in this area are mapped as Typic Aridic Thermic. The 3,266 acres mapped as Hyperthermic, a slightly hotter and drier area at the lowest elevation in the southwest corner of the survey, constitute an included area in this temperature-moisture climate.

Precipitation sites numbered 3, 8, 15, and 26 represent the next driest-hottest area in the survey. Average annual precipitation of these sites ranges from 9.87 to 10.72 inches. Average annual air temperature is estimated to be around 54 to 57 degrees F, and the average annual number of frost-free days is estimated to be around 165 to 180 days. These sites represent the D35-4 Major Land Sub-Resource Area known as Colorado Plateau Cold Desert Grassland. Soils in this area are mapped as Typic Aridic Mesic.

The Tweedy Point RAWS site and precipitation sites numbered 2, 7, 10, 12, 13, 14, 17, 19, 21, 25, 29, and 31 represent the next step up in moisture and elevation and a step down in temperature. Average annual precipitation at these sites ranges from 11.25 to 14.1 inches. The 9-inch average annual precipitation recorded at the Tweedy Point site shows the drought of the 1980's and early 1990's. The average annual air temperature recorded at the Tweedy site is 57 degrees F, and the estimated number of frost-free days is 140 to 160. These sites represent the D35-3 Major Land Sub-Resource Area known as Colorado Plateau Cold Desert Shrub. Soils in this area are mapped as Ustic Aridic Mesic.

Precipitation sites 11 and 16 represent the next step up in moisture and elevation, and a step down in temperature. Average annual precipitation for these sites ranges from 15 to 15.7 inches. Average annual air temperature is estimated to be around 48 to 52 degrees F, and the average annual number of frost-free days is estimated to be around 135 to 150 days. These sites represent the D39-2 Major Land Sub-Resource Area known as Mogollon Plateau Woodland-Grassland. Soils in this area are mapped as Aridic Ustic Mesic.

Precipitation sites 4 and 9 represent an area of the Virgin Mountains that has chaparral vegetation. Average annual precipitation for these sites ranges from 15.96 to 19.92 inches. Average annual air temperature is estimated to be around 45 to 56 degrees F, and the average annual number of frost-free days is estimated to be around 120 to 165 days. These sites represent the D39-4 Major Land Sub-Resource Area known as Arizona Interior Chaparral-Grassland. Soils in this area are mapped as Aridic Ustic Mesic.

RAWS sites Yellow John Mountain and Mount Logan, and precipitation sites numbered 5, 6 and 20 represent the upper range of the survey area and have the highest precipitation, highest elevations, and lowest temperatures. Average annual precipitation for these sites ranges from 19.55 to 21.39 inches. The figures of 12.4 and 10.8 inches average annual precipitation recorded at the RAWS sites are very low, showing the drought of the 1980's and early 1990's. Average annual temperature is 48 degrees F for both RAWS sites, and the frost-free season is estimated from temperature data to be around 100 to 135 days. These sites represent the D39-1 Major Land Sub-Resource Area known as Mogollon Plateau Coniferous Forest. Soils in this area are mapped as Typic Ustic Mesic.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind

of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). . Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some Minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage and other characteristics that affect management.

Hot, Arid Soils

Number of map units in group: 1
Percent of survey area: 0.3 percent
Elevation: 1,500 to 2,500 feet
Average annual precipitation: 4 to 8 inches
Average annual air temperature: 70 to 78 degrees F
Average frost-free period: 240 to 320 days

1. Pompeii Family-Huevi-Carrizo

Nearly level to strongly sloping, very shallow to very deep, well to excessively drained, very gravelly loamy and very gravelly sandy soils on flood plains and fan terraces

Setting

Topography: flood plains, dry washes and fan terraces
Location: southern end of Pakoon
Flooding: none to occasional, very brief
Slope range: 1 to 15 percent
Vegetation: creosotebush, white bursage, catclaw acacia, sand dropseed, big galleta and bush muhly
Elevation: 1,500 to 2,000 feet
Mean annual precipitation: 4 to 8 inches
Mean annual air temperature: 70 to 78 degrees F
Frost-free period: 240 to 320 days

Composition

Percent of survey area: 0.3 percent
Pompeii family soils: 32 percent
Huevi soils: 21 percent
Carrizo soils: 21 percent
Minor soils: 26 percent

Soil Characteristics

Pompeii family

Depth: shallow and very shallow
Drainage class: well drained
Parent material: mixed alluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content and shallow or very shallow to cemented pan

Huevi

Depth: very deep
Drainage class: well drained
Parent material: mixed alluvium and colluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content and low or very low available water

Carrizo

Depth: very deep
Drainage class: excessively drained
Parent material: mixed alluvium
Textural class: very gravelly sandy
Distinctive properties: occasional flooding, very rapid permeability and very low available water.

Minor soils

- Stratified sand-gravel-cobble, moderately deep to very deep Riverwash miscellaneous land type in drainages
- Loamy and very gravelly loamy, deep Calciorthids and Torriorthents soils on fan terraces and along breaks

- Badland miscellaneous land type on escarpments

Use and Management

Major uses: livestock grazing and wildlife habitat

Rangeland

Major management factors:
- Flooding
- Very low available water capacity
- Well to excessively drained

Wildlife habitat

General management considerations:
- Supports a narrow band of riparian vegetation
- Important migration corridor for neotropical birds

Warm, Arid Soils

Number of map units in group: 3
Percent of survey area: 30.0 percent
Elevation: 1,600 to 4,500 feet
Average annual precipitation: 7 to 12 inches
Average annual air temperature: 57 to 70 degrees F
Average frost-free period: 180 to 240 days

2. Yurm Family-Hindu-Rock Outcrop

Moderately steep to very steep, very shallow and shallow, well drained, very gravelly and extremely gravelly loamy soils on fan terraces, mesas and mountains

Setting

Topography: fan terraces, mesas and mountains
Location: Littlefield, Beaver Dam and Paiute Wilderness Areas, Hurricane and Grand Wash Cliffs, and the Pakoon
Flooding: none to occasional, very brief
Slope range: 15 to 70 percent
Vegetation: Joshua-trees, Mormontea, creosotebush, black brush, fourwing saltbush, black grama, big galleta, and desert needlegrass
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 7 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Percent of survey area: 22.7 percent
Yurm family and similar soils: 34 percent
Hindu and similar soils: 23 percent
Rock outcrop: 15 percent
Minor soils: 28 percent

Soil Characteristics

Yurm family

Depth: shallow
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content and shallow to a lime-cemented pan.

Hindu

Depth: shallow and very shallow
Drainage class: well drained
Parent material: colluvium
Textural class: extremely gravelly loamy
Distinctive properties: very low available water and low slope stability

Rock outcrop

- Forms vertical and near vertical canyon walls, cliffs and mountain slopes. Consists dominantly of limestone but includes sandstone, gypsite, mudstone, and basalt.

Minor soils

- Stratified sand-gravel-cobble, moderately deep to very deep Riverwash miscellaneous land type in drainages
- Very gravelly sandy, very deep Arizo and Tonopah soils on alluvial fans and fan terraces
- Sandy, very deep Arada family soils on fan terraces
- Loamy, very deep Grapevine soils on fan terraces

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- High lime content
- Shallow and very shallow depth
- Low and very low available water capacity
- Slope

Wildlife Habitat

General management considerations:
- Supports a plant community of perennial grasses, forbs and shrubs
- Provides important foraging habitat for raptors
- Proposed critical habitat for desert tortoise
- Important chuckwalla habitat

3. Gypill-Ruesh-Badland

Gently sloping to steep, very shallow to deep, well drained, loamy and loamy, gypsiferous soils and badland on hills, escarpments, and mesas

Setting

Topography: hills, escarpments and mesas
Location: northern one-third of survey area and in the southern portion of the Pakoon
Flooding: none
Slope range: 6 to 50 percent
Vegetation: creosotebush, white bursage, gyp dropseed, and big galleta
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 7 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Percent of survey area: 4 percent
Gypill soils: 35 percent
Ruesh and similar soils: 22 percent
Badland and similar miscellaneous land types: 12 percent
Minor soils: 31 percent

Soil Characteristics

Gypill

Depth: shallow and very shallow
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: loamy
Distinctive properties: high gypsum content and high erodibility

Ruesh and similar soils

Depth: moderately deep and deep
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: loamy
Distinctive properties: high gypsum content

Badland and similar miscellaneous land types

- Consists of highly erodible mudstone, siltstone, and Rock outcrop

Minor soils

- Loamy, calcareous, moderately deep to very deep Nikey family soils on mesas
- Loamy, gypsiferous, very deep Hobcan soils on alluvial fans and fan terraces
- Sandy-skeletal and loamy-skeletal, gypsiferous, deep Akinville and Mokaac soils on fan terraces

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- High gypsum content
- Highly erodible
- Slope
- Subsidence
- Piping caused by gypsum content

Wildlife Habitat

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs
- Provides important foraging habitat for raptors
- Proposed critical habitat for desert tortoise
- Important chuckwalla habitat

4. Arizo-Meadview-Shelley

Nearly level to steep, very deep, well to excessively drained, loamy and very gravelly sandy soils on flood plains, alluvial fans, fan terraces, and mesas

Setting

Topography: flood plains, alluvial fans, fan terraces, and mesas
Location: Littlefield-Beaver Dam area and the Pakoon Valley
Flooding: none to occasional
Slope range: 1 to 40 percent
Vegetation: creosotebush, blackbrush, Mormontea, big galleta, black grama, and bush muhly
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 7 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Percent of survey area: 3.6 percent
Arizo soils: 38 percent
Meadview soils: 17 percent
Shelley soils: 12 percent
Minor soils: 33 percent

Soil Characteristics

Arizo

Depth: very deep

Drainage class: excessively drained
Parent material: mixed alluvium
Textural class: very gravelly sandy
Distinctive properties: low available water

Meadview

Depth: very deep
Drainage class: well drained
Parent material: mixed alluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content

Shelley

Depth: very deep
Drainage class: somewhat excessively drained
Parent material: mixed alluvium and colluvium
Textural class: very gravelly sandy
Distinctive properties: very low available water capacity

Minor soils

- Very cobbly loamy, very deep Blind family soils on fan terraces
- Sandy, very deep Arada family soils on fan terraces
- Loamy, very deep Nikey family soils on mesas

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- High lime content
- Droughtiness
- Stones

Wildlife Habitat

General management considerations:
- Supports a plant community of perennial grasses, forbs and shrubs
- Important foraging habitat for raptors
- Proposed critical habitat for desert tortoise
- Important chuckwalla habitat

Cool, Arid Soils

Number of map units in group: 2
Percent of survey area: 8.3 percent
Elevation: 4,000 to 5,000 feet
Average annual precipitation: 7 to 11 inches
Average annual air temperature: 54 to 57 degrees F
Average frost-free period: 165 to 180 days

5. Berzatic Family-Rock Outcrop-Goblin

Gently sloping to very steep, shallow and very shallow, well drained, loamy and extremely cobbly loamy soils and Rock outcrop on escarpments, hills, and structural benches

Setting

Topography: escarpments, hills and structural benches
Location: Hurricane Cliffs
Flooding: none
Slope range: 5 to 70 percent
Vegetation: fourwing saltbush, shrubby buckwheat, gyp dropseed, blue grama, Indian ricegrass, and galleta
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 11 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 1.5 percent
Berzatic family soils: 50 percent
Rock outcrop: 30 percent
Goblin soils: 10 percent
Minor soils: 10 percent

Soil Characteristics

Berzatic family

Depth: shallow and very shallow
Drainage class: well drained
Parent material: colluvium
Textural class: extremely cobbly loamy
Distinctive properties: very low available water capacity

Rock outcrop

- Forms vertical land near vertical rock walls
- Consists dominantly of limestone but includes sandstone, gypsite, and mudstone

Goblin

Depth: shallow and very shallow
Drainage class: well drained
Parent material: colluvium and alluvium
Textural class: loamy
Distinctive properties: high gypsum content

Minor soils

- Loamy, moderately deep to deep, gypsiferous Gypsiorthids soils on fan terraces and hills

• Loamy, shallow to moderately deep, calcareous Calciorthids soils on escarpments

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
• Slope
• Rock fragment content (cobbles and stones)
• Gypsum content,
• Depth to bedrock
• Droughtiness

Wildlife Habitat

General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs
• Steep slopes and low rainfall make this area prone to water erosion
• Provides nesting and foraging habitat for peregrine falcons

6. Goblin-Moenkopie-Robroost

Nearly level to steep, very shallow to very deep, well drained, loamy, calcareous and gypsiferous soils on hills, mesas, escarpments, fan terraces, plateaus, and structural benches

Setting

Topography: hills, mesas, escarpments, fan terraces, plateaus and structural benches
Location: Lower Hurricane Valley
Flooding: none to rare
Slope range: 1 to 50 percent
Vegetation: fourwing saltbush, Mormontea, galleta, blue grama, black grama, gyp dropseed and Indian ricegrass
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 11 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 6.8 percent
Goblin and similar soils: 26 percent
Moenkopie and similar soils: 21 percent
Robroost and similar soils: 20 percent
Minor soils: 33 percent

Soil Characteristics

Goblin

Depth: shallow and very shallow
Drainage class: well drained
Parent material: colluvium and alluvium
Textural class: loamy
Distinctive properties: high gypsum content and very low available water capacity

Moenkopie

Depth: shallow
Drainage class: well drained
Parent material: alluvium and eolian
Textural class: loamy
Distinctive properties: high lime content and very low available water capacity

Robroost

Depth: very deep
Drainage class: well drained
Parent material: mixed alluvium
Textural class: loamy
Distinctive properties: high gypsum content

Minor soils

• Miscellaneous land type Rock outcrop on mesas and escarpments
• Very gravelly loamy, calcareous, very deep Dera soils on fan terraces
• Loamy, very deep Tours and Ives soils on flood plains and alluvial fans

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
• Depth to bedrock
• High gypsum content
• High lime content
• Droughtiness

Wildlife Habitat

General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs
• Steep slopes and low rainfall make this area prone to water erosion
• Provides nesting and foraging habitat for peregrine falcons

Cool, Semiarid Soils

Number of map units in group: 2
Percent of survey area: 40.5 percent
Elevation: 4,800 to 6,000 feet
Average annual precipitation: 10 to 14 inches
Average annual air temperature: 52 to 55 degrees F
Average frost-free period: 150 to 165 days

7. Rock Outcrop-Meriwhitica-Strych

Strongly sloping to very steep, very shallow to deep, well drained, very gravelly loamy soils and Rock outcrop on escarpments, mesas, and plateaus (fig. 3)

Setting

Topography: escarpments, mesas, and plateaus
Location: Andrus, Parashant, Hidden, Hobble and Jump Canyons, Grand Wash Cliffs and escarpments of Seegmuller and Mokaac Mountains
Flooding: none
Slope range: 10 to 70 percent
Vegetation: big sagebrush, blackbrush, galleta, blue grama and juniper
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Percent of survey area: 9.5 percent
Rock outcrop: 28 percent
Meriwhitca soils: 23 percent

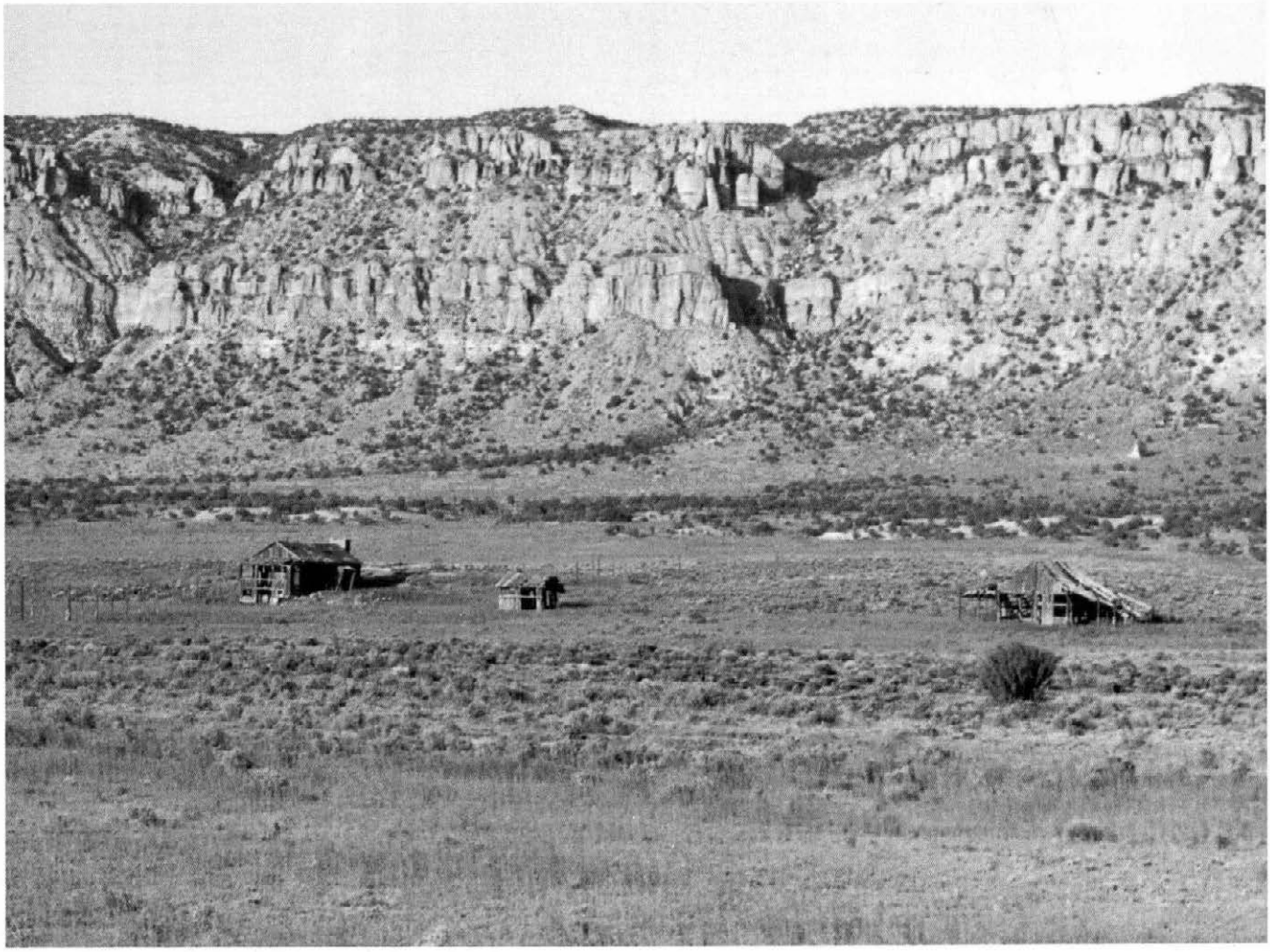


Figure 3.—The Hurricane Cliffs, which show interbedded limestone, gypsite, and gypsiferous mudstone, form the western boundary of the survey area. The cliffs are mapped as Meriwhitica-Rock outcrop-Strych, 35 to 70 percent slopes; the footslopes are Strych very gravelly loam, 2 to 10 percent slopes; the area near the old barn and house is Moenkopie-Goblin complex, 5 to 50 percent slopes; and the grassy area in the foreground is Barx fine sandy loam, 1 to 5 percent slopes.

Strych and similar soils: 19 percent
Minor soils: 30 percent

Soil Characteristics

Rock outcrop

• Forms vertical and near vertical rock walls. Consists dominantly of limestone but includes sandstone, mudstone, gypsite, and basalt.

Meriwhitca

Depth: very shallow
Drainage class: well drained
Parent material: colluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content and very low available water capacity

Strych

Depth: very deep
Drainage class: well drained
Parent material: colluvium and alluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content

Minor soils

• Loamy, gypsiferous, shallow Tanbark family soils on mesas
• Loamy, moderately deep and deep Torriorthents soils on hills, mesas, and escarpments
• Sandy and very gravelly sandy, shallow and moderately deep soils in dry washes and canyon bottoms

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
• Slope
• Depth to rock
• Droughtiness

Wildlife Habitat

General management considerations:
• Supports a sparse plant community of perennial grasses, forbs, and shrubs
• Steep slopes and low rainfall make this area prone to water erosion
• Area provides habitat for desert tortoise, and some has been proposed as critical habitat
• Provides important forage and lambing area for desert bighorn sheep

8. Mellenthin-Strych-Rock Outcrop

Gently sloping to very steep, shallow to very deep, well drained, very gravelly loamy soils and Rock outcrop on plateaus and mesas

Setting

Topography: plateaus and mesas
Location: Seegmuller, Mokaac and Mud Mountains, Twist Hills, Bundyville, Main Street Valley, Sullivan Draw, and Wolfhole Lake
Flooding: none to occasional
Slope range: 1 to 50 percent
Vegetation: big sagebrush, galleta, blue grama, needleandthread, and juniper
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Percent of survey area: 31 percent
Mellenthin and similar soils: 44 percent
Strych and similar soils: 17 percent
Rock outcrop: 10 percent
Minor soils: 29 percent

Soil Characteristics

Mellenthin and similar soils

Depth: shallow and very shallow
Drainage class: well drained
Parent material: colluvium, alluvium and eolian
Textural class: very gravelly loamy
Distinctive properties: high lime content and very low available water capacity

Strych

Depth: very deep
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content

Rock outcrop

• Occurs as undulating exposed areas of rock to vertical walls of rock. Consists dominantly of limestone but includes sandstone, mudstone, gypsite and basalt.

Minor soils

• Loamy, gypsiferous, shallow Tanbark soils on plateaus and mesas

- Extremely gravelly loamy, very deep Chic soils on cinder cones
- Loamy, very deep Spenlo, Sedillo, and Barx soils on fan terraces
- Loamy, very deep Radnik soils on flood plains
- Clayey, very deep Padilla soils on fan terraces
- Sandy, very deep Mespun soils on fan terraces

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- Depth to bedrock
- Slope
- High lime content
- Droughtiness of the upland soils
- Occasional flooding
- Good water impoundment area of valley floor soils

Wildlife Habitat

General management considerations:
- Supports a plant community of perennial grasses, forbs, trees and shrubs

Cool, Dry, Subhumid Soils

Number of map units in group: 3
Percent of survey area: 19.5 percent
Elevation: 5,800 to 8,000 feet
Average annual precipitation: 14 to 20 inches
Average annual air temperature: 48 to 52 degrees F
Average frost-free period: 135 to 150 days

9. Showlow-Boquillas Family-Springerville

Nearly level to steep, moderately deep to very deep, well drained, clayey and gravelly clayey soils on hills and mesas

Setting

Topography: escarpments, basalt mesas, buttes and mountains
Location: Black Rock, Poverty, Wolfhole, Yellow John, and Grassy Mountains
Flooding: none
Slope range: 1 to 50 percent
Vegetation: pinyon pine, juniper, big sagebrush, sideoats grama, pinyon ricegrass, and muttongrass
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Percent of survey area: 7.3 percent
Showlow and similar soils: 32 percent
Boquillas family and similar soils: 20 percent
Springerville and similar soils: 15 percent
Minor soils: 33 percent

Soil Characteristics

Showlow

Depth: very deep
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: clayey
Distinctive properties: high shrink-swell potential, medium available water capacity, and stones and cobbles on the surface

Boquillas family

Depth: moderately deep
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: gravelly clayey
Distinctive properties: highly erodible, high shrink-swell potential, low available water capacity, and cobbles on the surface

Springerville

Depth: deep
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: clayey
Distinctive properties: high shrink-swell potential, low available water capacity, and cobbles on the surface

Minor soils

- Loamy, moderately deep to very deep Guy family soils on mesas
- Miscellaneous land type Rock outcrop on escarpments, hills, and mesas
- Clayey, very deep Albers soils on stream terraces

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- High shrink-swell potential
- Cobbles and sometimes stones and boulders on the surface

- Moderate depths to bedrock

Wildlife Habitat

General management considerations:
- Supports a pinyon-juniper woodland with an understory of shrubs, perennial grasses, and forbs.
- Provides important habitat for mule deer.

10. Yumtheska-Natank-Disterheff

Nearly level to hilly, shallow to very deep, clayey to very gravelly loamy soils on plateaus, mesas, hills, and mountains

Setting

Topography: plateaus, mesas, hills and mountains
Location: Shivwits Plateau
Flooding: none
Slope range: 2 to 50 percent
Vegetation: pinyon pine, juniper, big sagebrush, sideoats grama, and bottlebrush squirreltail
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Percent of survey area: 8.6 percent
Yumtheska soils: 39 percent
Natank soils: 18 percent
Disterheff soils: 13 percent
Minor soils: 30 percent

Soil Characteristics

Yumtheska

Depth: shallow
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: very gravelly loamy
Distinctive properties: high lime content, shallow depth to bedrock, and very low available water capacity

Natank

Depth: moderately deep
Drainage class: well drained
Parent material: alluvium
Textural class: clayey
Distinctive properties: high shrink-swell potential, very low available water capacity, and moderate depth to bedrock

Disterheff

Depth: very deep
Drainage class: well drained
Parent material: alluvium
Textural class: gravelly clayey
Distinctive properties: high shrink-swell potential and medium available water capacity

Minor soils

- Very gravelly loamy, very deep, calcareous Katzine soils on hills and mountains
- Miscellaneous land type Rock outcrop on plateaus and hills
- Loamy, moderately deep to deep soils in drainages
- Loamy and clayey, very deep Lykorly and Albers soils on terraces

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- Depth to bedrock
- Slope
- High shrink-swell potential
- Droughtiness

Wildlife Habitat

General management considerations:
- Supports a pinyon-juniper woodland that has an understory of shrubs, perennial grasses, and forbs.

11. Virgin Peak-Rock Outcrop-Tsezhin Family

Strongly sloping to very steep, very shallow to deep, well drained, very gravelly and very cobbly loamy soils and Rock outcrop on mountains, plateaus, mesas, and hills

Setting

Topography: mountains, plateaus, mesas, and hills
Location: Virgin Mountains
Flooding: none
Slope range: 2 to 70 percent
Vegetation: yerba-de-pasmo, turbinella oak, silktassel, cliffrose, buckbrush ceanothus, manzanita and skunkbush sumac, along with a few scattered pinyon pine and juniper trees. A few scattered ponderosa pine and Douglas fir trees grow above 6,500 feet.
Elevation: 5,000 to 8,000 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 45 to 56 degrees F
Frost-free period: 120 to 165 days

Composition

Percent of survey area: 3.6 percent
Virgin Peak and similar soils: 27 percent
Rock outcrop: 23 percent
Tsezhin family and similar soils: 18 percent
Minor soils: 32 percent

Soil Characteristics

Virgin Peak and similar soils

Depth: shallow and very shallow
Drainage class: well drained
Parent material: colluvium
Textural class: very gravelly loamy
Distinctive properties: bedrock at less than 20 inches, very severe erosion hazard, and very low available water capacity

Rock outcrop

• Forms steep to near vertical mountain slopes. Consists dominantly of granite and gneiss but also includes limestone and sandstone.

Tsezhin family and similar soils

Depth: moderately deep to deep
Drainage class: well drained
Parent material: colluvium
Textural class: very cobbly loamy
Distinctive properties: bedrock at less than 60 inches, severe erosion hazard, and low to medium available water capacity

Minor soils

• Very cobbly loamy, very deep, calcareous Tsezhin soils on fan terraces
• Very gravelly loamy, very deep, calcareous Katzine soils on hills and mountains

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
• Slope
• Very severe erosion hazard
• Very low available water capacity
• Shallow and very shallow depths to bedrock

Wildlife Habitat

General management considerations:
• These soils support a chaparral plant community with perennial grasses and forbs and provide crucial summer habitat for mule deer.

Cool, Subhumid Soils

Number of map units in group: 1
Percent of survey area: 1.4 percent
Elevation: 5,800 to 8,000 feet
Average annual precipitation: 18 to 22 inches
Average annual air temperature: 45 to 50 degrees F
Average frost-free period: 120 to 135 days

12. Yellowhorse-Luzena Family-Sponiker

Nearly level to strongly sloping, shallow to very deep, well drained, clayey soils on mesas and fan terraces

Setting

Topography: Mesas and fan terraces
Location: Mount Dellenbaugh, Mount Logan, Slide Mountain, and Mount Emma
Flooding: none
Slope range: 0 to 10 percent
Vegetation: ponderosa pine, Gambel oak, Canada bluegrass, pine dropseed, and Arizona fescue
Elevation: 5,800 to 8,000 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 135 days

Composition

Percent of survey area: 1.4 percent
Yellowhorse and similar soils: 42 percent
Luzena soils: 24 percent
Sponiker soils: 11 percent
Minor soils: 23 percent

Soil Characteristics

Yellowhorse and similar soils

Depth: moderately deep
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: clayey
Distinctive properties: high shrink-swell potential, low to high available water capacity, and bedrock at a depth of 20 to 40 inches

Luzena family

Depth: shallow
Drainage class: well drained
Parent material: alluvium and colluvium
Textural class: clayey
Distinctive properties: bedrock at less than 20 inches and very low available water capacity

Sponiker

Depth: very deep
Drainage class: well drained
Parent material: alluvium
Textural class: clayey
Distinctive properties: high shrink-swell potential and medium available water capacity

Minor soils

- Miscellaneous land type Rock outcrop on mesas, plateaus, and escarpments
- Very gravelly and extremely gravelly loamy, very deep, cindery Wutoma and Lozinta soils on cinder cones

Use and Management

Major uses: Livestock grazing and wildlife habitat

Rangeland

Major management factors:
- Slope
- High shrink-swell potential

Wildlife Habitat

General management considerations:
- Support a diverse plant community of conifers, shrubs, perennial grasses, and forbs
- Provide islands of habitat for a diverse avifauna
- Provide important habitat for cavity-nesting birds

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Twist loam is a phase of the Twist series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Pocum-Childers-Ubank complex, 1 to 10 percent slopes, is an example.

An *association* is made up of two or more

geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Childers-Rizno association, 4 to 15 percent slopes, is an example.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables in this survey give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

1—Akinville-Mokaac association, 2 to 20 percent slopes

Setting

Landform: fan terraces
Landscape position: Akinville—upper end: summits and shoulders; Mokaac—lower end: summits and shoulders
Flooding: Akinville—none; Mokaac—none to rare
Slope range: 2 to 20 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Akinville and similar soils: 40 percent
Mokaac and similar soils: 35 percent
Contrasting inclusions: 25 percent

Typical Profile

Akinville

0 to 2 inches—brown very gravelly fine sandy loam
2 to 18 inches—light brown, calcareous very gravelly loam
18 to 32 inches—light brown, calcareous very gravelly sandy loam
32 to 48 inches—light brown, gypsiferous very gravelly sandy loam
48 to 60 inches—reddish yellow, gypsiferous extremely gravelly loamy sand

Mokaac

0 to 3 inches—light brown very cobbly loamy fine sand
3 to 10 inches—light brown, calcareous gravelly loamy fine sand
10 to 26 inches—light brown, gypsiferous extremely gravelly sand
26 to 32 inches—light brown, gypsiferous loamy fine sand
32 to 41 inches—light brown, gypsiferous very gravelly loamy coarse sand
41 to 60 inches—red and reddish yellow, calcareous loam and clay loam

Soil Properties and Qualities

Akinville

Parent material: alluvium and colluvium from sedimentary formations, high in gypsum and calcium carbonate
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: slow to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Mokaac

Parent material: alluvium and colluvium from sedimentary formations, high in gypsum and calcium carbonate
Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: very slow to slow
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy Hobcan soils that have moderate amounts of gypsum on lower toe slopes
- Shallow, loamy Gypill soils that have high amounts of gypsum on upper slopes

• Deep, loamy Ruesh soils that have high amounts of gypsum on lower toe slopes
Similar inclusions:
• Areas of Mokaac soils that have a very cobbly fine sandy loam, fine sand, or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Akinville and Mokaac soils:
• Potential plant community—perennial grasses (such as sand dropseed and big galleta); shrubs (such as creosotebush and Anderson wolfberry).
Important forage species: big galleta, sand dropseed, and annuals.
Major management factors: Slope, gypsum content, droughtiness, and hazard of erosion.
General management considerations on the Akinville and Mokaac soils:
• Complex slopes encourage overgrazing of the lower slopes.
• Steep-sided gullies on upper slopes limit access by livestock.
• Drainageways can provide shelter, forage, and water.
• Production of vegetation useable as livestock forage is very limited.
• This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.
Suitable management practices on the Akinville and Mokaac soils:
• Planned grazing systems help control erosion and increase plant vigor and variety.
• Constructing trails in steeply sloping areas increases access to livestock.
• Fencing and water developments are an important part of a planned grazing system.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Provides important foraging habitat for raptors.
• Proposed critical habitat for desert tortoise.
• Important chuckwalla habitat.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.
• Control off-road vehicle use.

Interpretive Groups

Land capability classification: Akinville and Mokaac—7S
Range site: Akinville and Mokaac—Limy Upland, Deep 9-12" p.z.

2—Albers silty clay, 0 to 1 percent slopes

Setting

Landform: stream terraces in mountain valleys
Landscape position: summits
Flooding: none
Slope range: 0 to 1 percent
Elevation: 6,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Albers and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—brown silty clay
2 to 47 inches—very dark grayish brown clay and silty clay
47 to 60 inches—strong brown, slightly calcareous clay

Soil Properties and Qualities

Parent material: alluvium from sedimentary and volcanic formations
Depth class: very deep
Drainage class: well drained
Permeability: very slow
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Moderately deep, clayey Thunderbird soils on side slopes
• Deep, loamy soils in drainageways

• Deep, clayey, Showlow soils on side slopes
Similar inclusions:
• Areas of soils that have a cobbly surface
• Areas of soils that have a clay loam surface

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as western wheatgrass, bottlebrush squirreltail, and blue grama); shrubs (such as Wyoming big sagebrush and fourwing saltbush).
Important forage species: western wheatgrass, bottlebrush squirreltail, and blue grama.
Major management factors: High shrink-swell potential and very slow permeability.
General management considerations:
• Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure.
Suitable management practices:
• Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, western bluebird, common flicker, common raven, dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, rock squirrel, pinyon mouse, deer mouse, cougar, northern whiptail lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.
General management considerations:
• Supports a plant community of pinyon-juniper woodland that has an understory of perennial grasses, forbs, and shrubs.
• Provides important habitat for mule deer.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Develop water for wildlife.

Interpretive Groups

Land capability classification: 6S
Range site: Clay Upland 13-17" p.z.

3—Arada family loamy fine sand, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: stabilized dunes over alluvium
Flooding: none
Elevation: 1,600 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 60 to 70 degrees F
Frost-free period: 220 to 260 days

Composition

Arada family and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 3 inches—light brown loamy fine sand
3 to 26 inches—light brown to reddish yellow loamy sand
26 to 49 inches—light brown, calcareous loamy sand
49 to 60 inches—reddish yellow, calcareous gravelly loamy coarse sand

Soil Properties and Qualities

Parent material: mixed alluvium and eolian deposits
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—low, uncoated steel—high

Inclusions

Contrasting inclusions:
• Shallow, loamy Bard family and Cave soils on summits
• Deep and very deep, very gravelly loamy Tonopah soils on side slopes
Similar inclusions:
• Areas of a moderately deep variant of Arada family that has a cemented pan at 30 or 40 inches
• Areas of soils that have a fine sand and fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as creosotebush and white bursage).
Important forage species: Indian ricegrass and big galleta.
Major management factors: Droughtiness and hazard of erosion.

General management considerations:
- This soil is easily traversed by livestock.
- This soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.
- Dune movement can be kept to a minimum through proper grazing use.

Suitable management practices:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Coarse Sandy Loam, Limy 6-9" p.z.

4—Arizo gravelly sandy loam, 1 to 5 percent slopes, nonflooded

Setting

Landform: alluvial fans
Landscape position: all
Flooding: none to rare
Slope range: 1 to 5 percent
Elevation: 1,800 to 2,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Arizo and similar soils: 75 percent
Contrasting inclusions: 25 percent

Typical Profile

0 to 3 inches—light yellowish brown gravelly sandy loam
3 to 60 inches—very pale brown, stratified sand and gravel (average texture very gravelly loamy sand)

Soil Properties and Qualities

Parent material: mixed alluvium dominated by granite and gneiss
Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Very deep, very gravelly loamy soils that are calcareous and are irregular in occurrence
- Very deep, very gravelly sandy soils that are calcareous and are irregular in occurrence

Similar inclusions:
- Soils that have occasional, very brief flooding
- Soils that have a cobbly or very cobbly loamy sand surface texture

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as creosotebush and white bursage).

Important forage species: Indian ricegrass and big galleta.
Major management factors: Presence of cobbles and a few stones on the surface, droughtiness, and hazard of erosion.

General management considerations:
- These soils are easily traversed by livestock.
- These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.
- Production of vegetation for use as livestock forage is limited.

Suitable management practices:
- Planned grazing systems are essential to maintain plant vigor and forage production.

• Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Provides important foraging habitat for raptors.
• Proposed critical habitat for desert tortoise.
• Important chuckwalla habitat.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.
• Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7S
Range site: Limy Upland, Deep 6-9" p.z.

5—Arizo very gravelly sandy loam, 1 to 5 percent slopes, flooded

Setting

Landform: flood plains and alluvial fans
Flooding: occasional, very brief
Elevation: 1,800 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Arizo GRV-SL and similar soils: 45 percent
Arizo CBV-SL and similar soils: 30 percent
Contrasting inclusions: 25 percent

Typical Profile

0 to 10 inches—light brown very gravelly sandy loam
10 to 60 inches—light brown, stratified very gravelly and extremely gravelly loamy sand

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep to very deep, sandy and very gravelly sandy, fluventic soils in drainages
• Deep, very gravelly loamy, calcareous soils on summits
Similar inclusions:
• Soils that are not flooded
• Soils that have stones and cobbles on the surface

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as big galleta); shrubs (such as creosotebush and white burrobrush).
Important forage species: big galleta.
Major management factors: Hazard of flooding, droughtiness, and rapid permeability.
General management considerations:
• Good accessibility, a variety of streamside plant species, and availability of water encourage a constant grazing pressure.
• Droughtiness, flooding, and a severe water erosion hazard limit management alternatives.
Suitable management practices:
• This soil is managed in conjunction with adjacent soils.
• Planned grazing systems are essential to maintain plant vigor and variety.
• Diverting water onto sites more suitable for construction of livestock watering facilities is recommended.

Wildlife Habitat

Wildlife on these soils include black hawk, willow flycatcher, Gambel's quail, ferruginous hawk, mourning dove, golden eagle, beaver, water shrew, muskrat, ringtail, bobcat, kit fox, badger, desert tortoise, Gila monster, chuckwalla, sidewinder, Mojave rattlesnake, spadefoot toad, tiger salamander, and leopard frog.
General management considerations:
• Supports a narrow band of riparian vegetation,

providing seasonal habitat for mule deer and an important migration corridor for neotropical migratory birds.
Suitable management practices:
• Proper grazing use of vegetation to provide streambank stability and forage for wildlife.

Interpretive Groups

Land capability classification: 7W
Range site: Sandy Wash 6-9" p.z.

6—Badland

Setting

Landform: escarpments
Landscape position: back slopes
Flooding: none to rare
Slope range: 10 to 70 percent
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 165 days

Composition

Badland and similar areas: 85 percent
Contrasting inclusions: 15 percent

Reference Profile

Exposed areas of mudstone, siltstone, shale, and gypsite caused by active geological erosion.

Soil Properties and Qualities

Parent material: unconsolidated sedimentary deposits.
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: moderate to high
Shrink-swell potential: high
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
• Shallow to deep, loamy, gypsiferous soils on foot slopes
• Shallow to deep, loamy, fluventic soils in drainages
Similar inclusions:
• Rock outcrop, sandstone

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as Indian ricegrass and galleta); shrubs (such as rabbitbrush and big sagebrush); trees (such as Utah juniper and pinyon pine).
Important forage species: Indian ricegrass and galleta.
Major management factors: Depth to mudstone, droughtiness, and erosion hazard.
General management considerations:
• Vegetation is sparse, forage production is very low, and livestock usually avoid areas of this unit except to traverse it to access water or forage on adjacent areas.
Suitable management practices:
• Manage areas of this unit in conjunction with adjacent units.
• Essentially consider this unit as nonproductive except as it affects livestock movement and surface runoff for possible collection for livestock watering facilities.

Wildlife Habitat

Wildlife on these soils include golden eagle, road runner, dark-eyed junco, turkey vulture, western kingbird, pinyon jay, rock wren, kangaroo rat, woodrat, rock squirrel, gray fox, mule deer, pronghorn antelope, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.
General management considerations:
• Supports a sparse plant community of scattered trees that have an understory of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Develop water for wildlife.

Interpretive Groups

Land capability classification: 8
Range site: none

7—Bard family-Tonopah-Arada family association, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: Bard family—summits; Tonopah—back slopes, foot slopes, and summits; Arada family—stabilized dunes
Flooding: none
Slope range: Bard family—1 to 8 percent; Tonopah and Arada family—1 to 10 percent
Elevation: 1,600 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 60 to 70 degrees F

Frost-free period: 220 to 260 days

Composition

Bard family and similar soils: 50 percent
Tonopah and similar soils: 25 percent
Arada family and similar soils: 15 percent
Contrasting inclusions: 10 percent

Typical Profile

Bard:
0 to 2 inches—pink gravelly loamy sand
2 to 5 inches—pink loamy sand
5 to 17 inches—reddish yellow, calcareous gravelly sandy loam
17 to 60 inches—indurated, lime-cemented hardpan
Tonopah:
0 to 3 inches—light brown gravelly loamy fine sand
3 to 8 inches—reddish yellow, calcareous gravelly loamy fine sand
8 to 60 inches—pink and reddish yellow, calcareous very gravelly loamy sand and loamy fine sand
Arada:
0 to 2 inches—light brown loamy sand
2 to 26 inches—light brown and reddish yellow loamy sand
26 to 49 inches—light brown, calcareous loamy sand
49 to 60 inches—reddish yellow, calcareous gravelly loamy coarse sand

Soil Properties and Qualities

Bard family

Parent material: mixed alluvium
Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Tonopah

Parent material: mixed alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Arada family

Parent material: mixed alluvium and eolian deposits
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow over a hardpan, loamy Cave soils on summits
- Moderately deep, sandy to loamy fluventic soils in drainages

Similar inclusions:
- Areas of Arada family soils that have a fine sand or fine sandy loam surface texture
- Areas of Bard family soils that have gravelly fine sandy loam and gravelly loamy fine sand surface textures

Use and Management

Rangeland

Dominant vegetation on the Bard family and Tonopah soils:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as Mormontea, creosotebush, and white bursage).

Dominant vegetation on the Arada family soils:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as Joshua-trees, creosotebush, and white bursage).

Important forage species: Indian ricegrass, big galleta, Mormontea, and annuals.
Major management factors: Depth to hardpan on the Bard family soil, droughtiness, and hazard of erosion on all three soils.
General management considerations on the Bard family, Tonopah, and Arada family soils:
- High lime content, low available water capacity, and the inhibiting influence of creosotebush contribute to the low production of forage on these soils.
- Drainageways can provide shelter, forage, and water,

which encourages overgrazing and increases erosion hazard.
- Grazing is mostly limited to winter and spring annuals.
- This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Suitable management practices on the Bard family, Tonopah, and Arada family soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: All—7E
Range site: Bard family—Limy Upland 6-9" p.z.; Tonopah—Limy Upland, Deep 6-9" p.z.; Arada family—Coarse Sandy Loam, Limy 6-9" p.z.

8—Barx fine sandy loam, 1 to 5 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Barx and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 1 inch—light reddish brown fine sandy loam
1 to 5 inches—reddish brown clay loam
5 to 21 inches—reddish brown, calcareous clay loam
21 to 33 inches—pinkish white, calcareous loam
33 to 50 inches—light reddish brown, calcareous clay loam
50 to 60 inches—light reddish brown, calcareous sandy loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: moderate
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, gravelly loamy soils on side slopes
- Deep, loamy soils in drainages
- Rock outcrop and exposed mudstone in highly eroded areas

Similar inclusions:
- Loamy soils that are shallower than 60 inches over mudstone

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as galleta, Indian ricegrass, and western wheatgrass); shrubs (such as big sagebrush and fourwing saltbush).

Important forage species: Galleta, Indian ricegrass, western wheatgrass, and fourwing saltbush (fig. 4).
Major management factors: Hazard of erosion.
General management considerations:
- Good accessibility, a large variety of plants, and the availability of water encourages constant grazing pressure.
- Livestock grazing should be managed to protect the soil from excessive erosion.
- Responds well to proper management.



Figure 4.—The deep, loamy soils of the Upper Hurricane Valley produce some of the most abundant and high-quality grazeable forage in the survey area. The grassy area in the foreground is Barx fine sandy loam, 1 to 5 percent slopes.

Suitable management practices:
- Planned grazing systems help control erosion and increase plant variety and production.
- Fencing and deferred grazing are important in a planned grazing system.
- Brush management can be used to improve deteriorated areas of range on this unit.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: 6E
Range site: Loamy Upland 10-14" p.z.

9—Barx-Strych complex, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: Barx—summits and swales; Strych—back slopes and summits
Flooding: none
Slope range: Barx—1 to 5 percent; Strych—1 to 10 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Barx soils—10 to 14 inches; Strych soils—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Barx and similar soils: 40 percent
Strych and similar soils: 35 percent
Contrasting inclusions: 25 percent

Typical Profile

Barx

0 to 1 inch—light brown gravelly loam
1 to 3 inches—brown loam
3 to 12 inches—brown clay loam
12 to 24 inches—brown, calcareous clay loam
24 to 42 inches—pink, calcareous loam
42 to 60 inches—pink, calcareous gravelly sandy loam

Strych

0 to 2 inches—light brown very gravelly loam
2 to 7 inches—light brown very gravelly loam
7 to 45 inches—pink, highly calcareous very gravelly loam
45 to 60 inches—pink, calcareous very gravelly loamy sand

Soil Properties and Qualities

Barx

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Corrosivity: concrete—low; uncoated steel—high

Strych

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy Tours or Ives soils along drainages
- Deep, very gravelly sandy soils in drainages
- Moderately deep to shallow, loamy soils over bedrock on slope breaks

Similar inclusions:
- Soils that are similar to Barx, but have less than 35 percent rock fragments
- Soils that are similar to Strych, but have a small amounts of gypsum in lower part of subsoil
- Areas of Strych soils where the precipitation ranges to 14 inches

Use and Management

Rangeland

Dominant vegetation on the Barx soil:
- Potential plant community—perennial grasses (such as galleta, western wheatgrass, blue grama, and Indian ricegrass); shrubs (such as fourwing saltbush and Mormontea).

Dominant vegetation on the Strych soil:
- Potential plant community—perennial grasses (such as galleta, blue grama, and bottlebrush squirreltail); shrubs (such as big sagebrush).

Important forage species: Galleta, blue grama, Indian ricegrass, and western wheatgrass.
Major management factors: Hazard of erosion on both soils and high lime content of the Strych soil.
General management considerations on the Barx and Strych soils:
- These soils are easily traversed by livestock.
- Livestock tend to overgraze this unit because of the availability of water and ease of access.
- Overgrazing depletes vegetative cover and increases the hazard of erosion.

Suitable management practices on the Barx and Strych soils:
- Prevent overgrazing by fencing and controlling water availability.
- Provide rest periods during the growing season to maintain plant vigor and production.
- Control erosion and promote forage production with proper utilization.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: Barx and Strych—6S
Range site: Barx and Strych—Loamy Upland 10-14" p.z.

10—Berzatic family-Rock outcrop-Goblin complex, 35 to 70 percent slopes

Setting

Landform: Berzatic family and Goblin—escarpments; Rock outcrop—cliffs and canyon walls
Landscape position: Berzatic family and Goblin—colluvial slopes; Rock outcrop—cliffs and canyon walls
Flooding: none
Slope range: Berzatic family—35 to 70 percent; Goblin—35 to 50 percent; Rock outcrop—vertical to near vertical
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: Berzatic family and Rock outcrop—7 to 10 inches; Goblin soils—7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Berzatic family and similar soils: 50 percent
Rock outcrop and similar soils: 30 percent
Goblin and similar soils: 10 percent
Contrasting inclusions: 10 percent

Reference Profile

Berzatic family

0 to 2 inches—brown extremely cobbly loam
2 to 6 inches—brown, calcareous extremely cobbly loam
6 inches—limestone bedrock

Rock outcrop

Steeply sloping to vertical exposures of limestone, sandstone, and shale (gypsiferous shale and gypsite).

Goblin

0 to 1 inch—pink, gypsiferous gravelly fine sandy loam
1 to 10 inches—very pale brown, gypsiferous fine sandy loam
10 inches—interbedded, rippable gypsite and gypsiferous shales

Soil Properties and Qualities

Berzatic family

Parent material: colluvium from sedimentary formations
Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Goblin

Parent material: colluvium and alluvium from gypsiferous shales (mudstone, siltstone, and gypsite), limestone and sandstone
Depth class: very shallow to shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy, gypsiferous soils on foot slopes
- Shallow to moderately deep, loamy, calcareous soils on foot slopes
- Shallow to moderately deep, loamy, fluventic soils in drainages

Similar inclusions:
- Areas of Goblin soils where the precipitation ranges to 11 inches
- Areas of Berzatic family soils that have a very cobbly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Berzatic family soil:
- Potential plant community—perennial grasses (such

as galleta, needleandthread, and Indian ricegrass); shrubs (such as Mormontea and buckwheat).
Dominant vegetation on the Goblin soil:
• Potential plant community—perennial grasses (such as gyp dropseed, Indian ricegrass, and desert needlegrass); shrubs (such as buckwheat, Mormontea, and fourwing saltbush).
Important forage species: blue grama, galleta, desert needlegrass, and Indian ricegrass.
Major management factors: Steep slopes, droughtiness, hazard of erosion in both soils; depth to bedrock in Berzatic family soils; depth to weathered bedrock and gypsum content in Goblin soils.
General management considerations on the Berzatic family soils:
• Typically steep slopes severely restrict use by livestock.
• Heavy grazing occurs on the lower slopes.
• Overgrazing lower slopes increases erosion.
Suitable management practices on the Berzatic family soils:
• Constructing trails in steeply sloping areas increases access to livestock.
General management considerations on the Goblin soils:
• These soils are very fragile, and any activities such as stock trailing and vehicular traffic can result in serious losses from erosion.
• Because of unfavorable growing conditions on these soils, overgrazing will leave the ground bare and susceptible to erosion.
• The complex topography prevents proper grazing distribution.
Suitable management practices on the Goblin soils:
• Light stocking rates can be used on the lower slopes.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, mourning dove, prairie falcon, red-tail hawk, peregrine falcon, golden eagle, rock squirrel, woodrat, kangaroo rat, antelope ground squirrel, kit fox, bighorn sheep, mule deer, cougar, badger, Grand Canyon rattlesnake, gopher snake, and short-horned lizard.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Steep slopes and low rainfall make this area prone to water erosion.
• Provides nesting and foraging habitat for peregrine falcons.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.

Interpretive Groups

Land capability classification: Berzatic family and Goblin—7E; Rock outcrop—8
Range site: Berzatic family—Breaks 7-11" p.z.; Goblin—Breaks, Gypsiferous 7-11" p.z.; Rock outcrop—none

11—Bisoodi-Anasazi family complex, 1 to 8 percent slopes

Setting

Landform: plateaus
Landscape position: both may occur anywhere, but dominantly Bisoodi soils are on summits, and Anasazi family are on back slopes and depressions
Flooding: none
Slope range: 1 to 8 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Bisoodi and similar soils: 35 percent
Anasazi family and similar soils: 35 percent
Contrasting inclusions: 30 percent

Typical Profile

Bisoodi

0 to 1 inch—light brown channery loam
1 to 6 inches—light brown, calcareous loam
6 to 17 inches—pink, highly calcareous loam
17 inches—limestone bedrock that has a 1- to 2-centimeter thick accumulation of weakly cemented, secondary carbonates coating the upper surface of the bedrock

Anasazi family

0 to 1 inch—light brown fine sandy loam
1 to 12 inches—light brown and brown fine sandy loam and loam
12 to 34 inches—light brown, calcareous, moderately to strongly alkaline loam
34 inches—limestone bedrock that has a 1- to 2-centimeter thick secondary calcium carbonate accumulation weakly cemented to top of bedrock

Soil Properties and Qualities

Bisoodi

Parent material: mixed alluvium
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Anasazi family

Parent material: eolian and mixed alluvium
Depth class: moderately deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy Ives and Tours soils along drainages
- Limestone, Rock outcrop
- Deep, very gravelly loamy, calcareous Dera soils on back slopes
- Shallow, gravelly loamy Moenkopie soils on summits

Similar inclusions:
- Loamy, calcareous soils that have a lime-cemented pan at shallow depths above the bedrock
- Loamy, calcareous soils that are deeper than 40 inches
- Areas of Anasazi family soils that have a sandy loam or gravelly fine sandy loam surface texture
- Areas of Bisoodi soils that have a loam, fine sandy loam or channery fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Bisoodi soil:
- Potential plant community—perennial grasses (such as blue grama, needleandthread, Indian ricegrass, and bottlebrush squirreltail); shrubs (such as fourwing saltbush, winterfat, and Mormontea).

Dominant vegetation on the Anasazi family soil:
- Potential plant community—perennial grasses (such as Indian ricegrass, needleandthread, and blue grama); shrubs (such as fourwing saltbush and Mormontea).

Important forage species: needleandthread, Indian ricegrass, bottlebrush squirreltail, black grama, blue grama, and fourwing saltbush.
Major management factors: Available water holding capacity, high lime content, and hazard of erosion on the both soils.
General management considerations on the Bisoodi and Anasazi family soils:
- High lime content and limited available water capacity contribute to low production of forage.
- Livestock prefer this unit to most others in the survey area because of accessibility and availability of water. This results in overgrazing and subsequent deterioration of vegetation.
- This unit responds less readily to management than other soils in the area.

Suitable management practices on the Bisoodi and Anasazi family soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: Bisoodi—7S; Anasazi family—7E
Range site: Bisoodi—Loamy Upland 10-14" p.z.; Anasazi family—Sandy Loam Upland, Calcareous 10-14" p.z.

12—Blind family-Shelley complex, 5 to 15 percent slopes, moist

Setting

Landform: fan terraces

Landscape position: Blind family—summits and upper back slopes; Shelley—back slopes and foot slopes
Flooding: none
Slope range: 5 to 15 percent
Elevation: 3,000 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Blind family and similar soils: 40 percent
Shelley and similar soils: 40 percent
Contrasting inclusions: 20 percent

Typical Profile

Blind family

0 to 3 inches—pink very cobbly sandy loam
3 to 16 inches—pink very cobbly loam
16 to 28 inches—reddish yellow, calcareous very gravelly sandy clay loam
28 to 50 inches—light brown, calcareous very cobbly sandy loam
50 to 60 inches—very pale brown, calcareous very cobbly loamy sand

Shelley

0 to 2 inches—light yellowish brown very gravelly loamy sand
2 to 13 inches—light yellowish brown, calcareous very gravelly loamy sand
13 to 33 inches—light yellowish brown, calcareous very gravelly sand
33 to 60 inches—light yellowish brown, calcareous, stratified sand and gravel

Soil Properties and Qualities

Blind family

Parent material: mixed alluvium and colluvium from granite and gneiss
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Shelley

Parent material: mixed alluvium and colluvium from granite and gneiss
Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Very deep, very gravelly sandy Arizo soils along drainages
- Very deep, very gravelly loamy Meadview soils on back slopes
- Shallow, loamy Cave soils on summits

Use and Management

Rangeland

Dominant vegetation on the Blind family soil:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as blackbrush, creosotebush, and white bursage).

Dominant vegetation on the Shelley soil:
- Potential plant community—perennial grasses (such as big galleta); shrubs (such as blackbrush and creosotebush).

Important forage species: Indian ricegrass, big galleta, and annuals.
Major management factors: Droughtiness and hazard of erosion on both soils.
General management considerations on the Blind family and Shelley soils:
- These soils are easily traversed by livestock in most places.
- Steep-sided gullies limiting access by livestock occur on upper slopes near mountain foot slopes.
- These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.
- Drainageways can provide shelter, forage, and water, which encourages overgrazing and increases erosion hazard.
- Low productivity and slow recovery require special management.

Suitable management practices on the Blind family and Shelley soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.
- Construction of trails in steeply sloping areas increases access to livestock.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Blind family and Shelley—7S
Range site: Blind family and Shelley—Sandy Loam, Gravelly 9-12" p.z.

13—Blind family-Shelley complex, 5 to 15 percent slopes, stony

Setting

Landform: fan terraces
Landscape position: Blind family—summits and upper back slopes; Shelley—fan terrace back slopes and foot slopes
Flooding: none
Slope range: 5 to 15 percent
Elevation: 1,900 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Blind family and similar soils: 40 percent
Shelley and similar soils: 40 percent
Contrasting inclusions: 20 percent

Typical Profile

Blind family

0 to 3 inches—pink very stony sandy loam
3 to 16 inches—pink very cobbly loam
16 to 28 inches—reddish yellow, calcareous very cobbly sandy clay loam
28 to 50 inches—light brown, calcareous very cobbly sandy loam
50 to 60 inches—very pale brown, calcareous very cobbly loamy sand

Shelley

0 to 2 inches—light brown very gravelly sandy loam
2 to 8 inches—light brown, calcareous gravelly sandy loam
8 to 30 inches—light yellowish brown, calcareous extremely cobbly loamy coarse sand
30 to 60 inches—light yellowish brown, calcareous, stratified coarse sand and very gravelly coarse sand

Soil Properties and Qualities

Blind family

Parent material: mixed alluvium and colluvium from granite and gneiss
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Shelley

Parent material: mixed alluvium and colluvium from granite and gneiss
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow

Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Very deep, very gravelly sandy Arizo soils along drainages
- Very deep, very gravelly loamy Meadview soils on back slopes
- Shallow, loamy Cave soils on summits

Use and Management

Rangeland

Dominant vegetation on the Blind family soil:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as creosotebush and white bursage).

Dominant vegetation on the Shelley soil:
- Potential plant community—perennial grasses (such as big galleta); shrubs (such as creosotebush and white bursage).

Important forage species: Indian ricegrass, big galleta, and annuals.
Major management factors: Droughtiness, hazard of erosion, and presence of boulders, stones, and cobbles on both soils.
General management considerations on the Blind family and Shelley soils:
- These soils are easily traversed by livestock in most places.
- Steep-sided gullies limiting access by livestock occur on upper slopes near mountain foot slopes.
- These soils are limited for livestock watering ponds and other water impoundments because of the seepage potential.
- Drainageways can provide shelter, forage, and water, encouraging overgrazing and increasing the erosion hazard.

Suitable management practices on the Blind family and Shelley soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.
- Construction of trails in steeply sloping areas increases access to livestock.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Blind family and Shelley—7S
Range site: Blind family and Shelley—Cobbly Limy Upland, Deep 6-9" p.z.

14—Boquillas family-Showlow complex, 25 to 50 percent slopes

Setting

Landform: mesas
Landscape position: back slopes and foot slopes
Flooding: none
Slope range: 25 to 50 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 135 to 150 days

Composition

Boquillas family and similar soils: 50 percent
Showlow and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Boquillas family

Surface coverage—0 to 10 percent stones, 25 to 35 percent cobbles, and 25 to 35 percent gravel
0 to 3 inches—dark brown extremely cobbly clay loam
3 to 13 inches—dark brown and reddish brown gravelly clay
13 to 23 inches—light reddish brown gravelly clay loam
23 inches—stratified sedimentary formation (limestone, mudstone, sandstone)

Showlow

Surface coverage—0 to 10 percent stones, 25 to 35 percent cobbles, and 25 to 35 percent gravel
0 to 1 inch—dark reddish gray extremely cobbly clay loam
1 to 23 inches—dark reddish gray clay
23 to 38 inches—yellowish red stony clay
38 to 60 inches—yellowish red very cobbly clay

Soil Properties and Qualities

Boquillas family

Parent material: colluvium and alluvium from sedimentary and igneous formations
Depth class: moderately deep
Drainage class: well drained
Permeability: slow
Available water capacity: very low to low
Potential rooting depth: 20 to 40 inches
Runoff: rapid to very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Showlow

Parent material: colluvium and alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: rapid to very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop at upper edge of escarpment
- Rubbleland (talus slopes of basalt stones and cobble)
- Moderately deep to deep, very cobbly clayey Delenbaw soils on back slopes

Similar inclusions:
- Areas of Boquillas family soils that have a very cobbly silty clay or very cobbly loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Boquillas family and Showlow soils:
- Potential plant community—perennial grasses (such as needleandthread and galleta); shrubs (such as big sagebrush); trees (such as Utah juniper and Colorado pinyon).

Important forage species: needleandthread and galleta.
Major management factors: Steep slopes, class 3 stoniness and hazard of erosion on both soils.
General management considerations on the Boquillas family and Showlow soils:
- Steep slopes and vertical exposures of rock severely limit access to adjacent grazeable areas for livestock (fig. 5).
- Areas which are grazed can be easily overgrazed.

Suitable management practices on the Boquillas family and Showlow soils:
- Construction of trails increases access of livestock to adjacent grazeable areas.

Fuelwood Production

- These soils can produce about 45 cords of fuelwood per acre with a site index of 40.

General management considerations on the Boquillas family and Showlow soils:
- Reduce risk or erosion by proper installation and maintenance of access roads.
- Steep slopes and availability of the soils limit use of this unit for fuelwood harvesting.

Wildlife Habitat

Wildlife on these soils include golden eagle, road runner, dark-eyed junco, turkey vulture, western kingbird, pinyon jay, rock wren, kangaroo rat, woodrat, rock squirrel, gray fox, mule deer, pronghorn antelope, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of scattered trees with an understory of perennial grasses, forbs, and shrubs.
- Area provides escape cover for pronghorn antelope and mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.

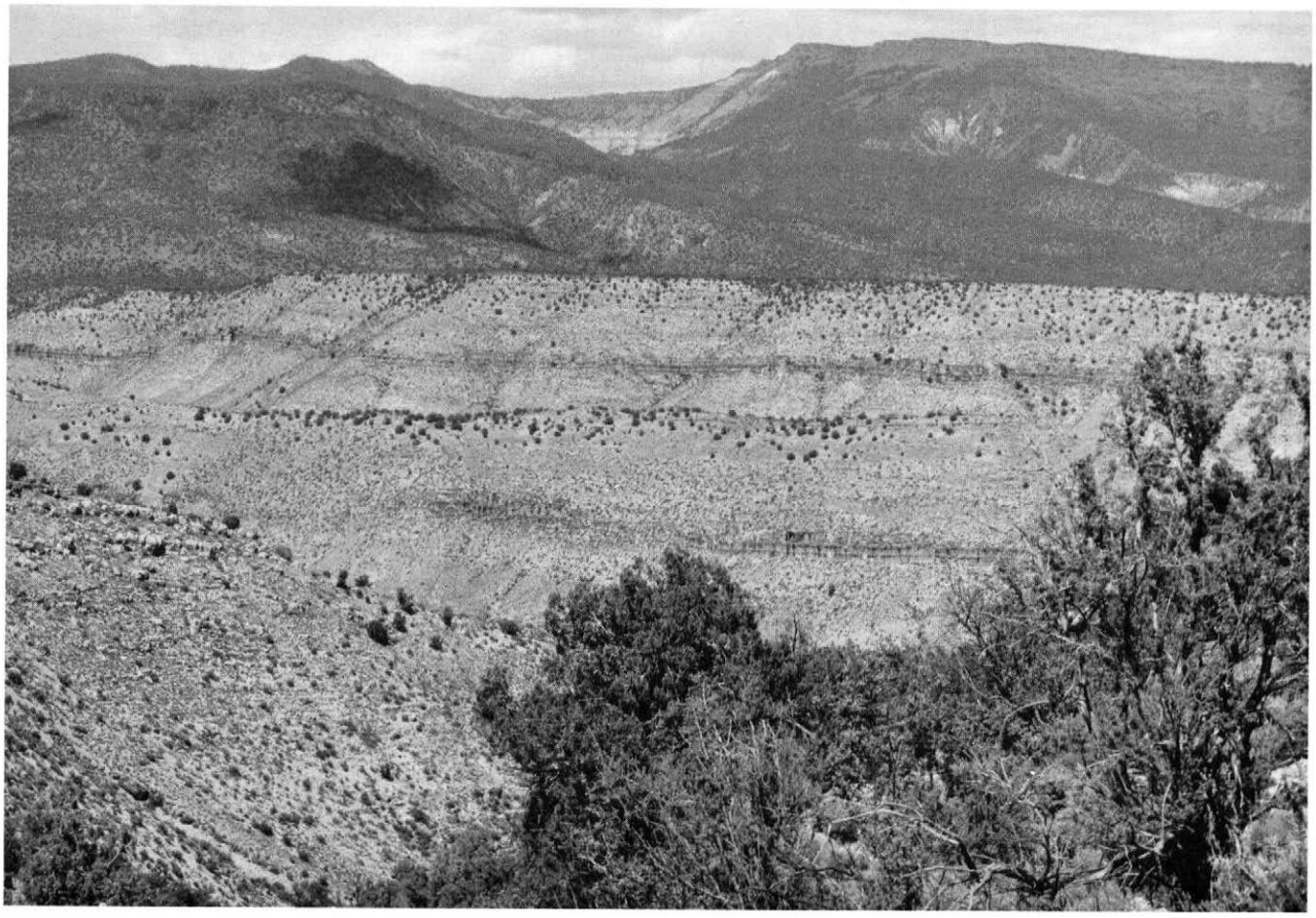


Figure 5.—Many side canyons reach up from the Grand Canyon into the Shivwits survey area. Shown here is Whitmore Canyon. The escarpment in the foreground is Mellenthin-Rock outcrop-Torriorthents complex, 10 to 70 percent slopes; and the juniper-covered hills in the background are mapped as Boquillas Family-Showlow complex, 25 to 50 percent slopes. This shot is looking north up the canyon towards Mount Logan. The eroded-looking hole in the middle of the mountains is called Hell's Hole.

- Develop water for wildlife.

Interpretive Groups

Land capability classification: Boquillas family and Showlow—7E
Range site: Boquillas family and Showlow—Basalt Slopes 13-17" p.z.

15—Carrizo complex, 1 to 5 percent slopes

Setting

Landform: flood plains
Landscape position: bars and channels
Flooding: occasional, very brief
Slope range: 1 to 5 percent
Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 70 to 78 degrees F
Frost-free period: 240 to 320 days

Composition

Carrizo GRV-LS and similar soils: 50 percent
Carrizo CBV-LS and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Carrizo GRV-LS

0 to 3 inches—reddish yellow very gravelly loamy sand
3 to 60 inches—pinkish gray very gravelly coarse sand and very gravelly loamy sand

Carrizo CBV-LS

0 to 4 inches—light brown very cobbly loamy sand
4 to 60 inches—light brown, stratified very cobbly loamy sand and sand

Soil Properties and Qualities

Carrizo GRV-LS and CBV-LS

Parent material: mixed alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy and very gravelly loamy, calcareous soils along drainages
- Deep, loamy and very gravelly loamy, noncalcareous soils on flood plains

Similar inclusions:
- Areas where surface textures are loamy coarse sand or coarse sandy loam with varying amounts of gravel and cobble-sized rock fragments

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as bush muhly and big galleta); shrubs (such as creosotebush, white burrobush, and catclaw acacia).

Important forage species: big galleta, bush muhly, and annuals.
Major management factors: Droughtiness, flooding, seepage, and hazard of erosion.
General management considerations on the Carrizo soils:
- Good accessibility, a variety of streamside plant species, and availability of water encourage a constant grazing pressure.
- Droughtiness, flooding, and a severe water erosion hazard limit management alternatives.

Suitable management practices on the Carrizo soils:
- This soil is managed in conjunction with adjacent soils.
- Planned grazing systems are essential to maintain plant vigor and variety.
- Diverting of water onto sites more suitable for construction of livestock watering facilities is recommended.

Wildlife Habitat

Wildlife on these soils include black hawk, willow flycatcher, Gambel's quail, ferruginous hawk, mourning dove, golden eagle, beaver, water shrew, muskrat, ringtail, bobcat, kit fox, badger, desert tortoise, Gila monster, chuckwalla, sidewinder, Mojave rattlesnake, spadefoot toad, tiger salamander, and leopard frog.
General management considerations:
- Supports a narrow band of riparian vegetation providing seasonal habitat for mule deer and an important migration corridor for neotropical migratory birds.

Suitable management practices:
- Proper grazing use of vegetation to provide streambank stability and forage for wildlife.

Interpretive Groups

Land capability classification: Carrizo GRV-LS and CBV-LS—7W
Range site: Carrizo GRV-LS and CBV-LS—Sandy Wash 3-6" p.z.

16—Cave-Harrisburg-Grapevine complex, 1 to 15 percent slopes

Setting

Landform: fan terraces
Landscape position: Cave and Harrisburg—summits; Grapevine—back slopes and pockets on summits
Flooding: none
Slope range: Cave—1 to 10 percent; Harrisburg—1 to 15 percent; Grapevine—1 to 15 percent
Elevation: 1,600 to 4,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Cave and similar soils: 30 percent
Harrisburg and similar soils: 30 percent
Grapevine and similar soils: 15 percent
Contrasting inclusions: 25 percent

Typical Profile

Cave

0 to 2 inches—light brown gravelly fine sandy loam
2 to 11 inches—strong brown, calcareous gravelly fine sandy loam

11 to 60 inches—indurated, lime-cemented hardpan

Harrisburg

0 to 2 inches—light reddish brown gravelly fine sandy loam
2 to 18 inches—reddish yellow, calcareous fine sandy loam
18 to 26 inches—reddish yellow, calcareous gravelly fine sandy loam
26 to 60 inches—indurated, lime-cemented hardpan

Grapevine

0 to 4 inches—light reddish brown gravelly fine sandy loam
4 to 25 inches—reddish yellow, calcareous fine sandy loam
25 to 60 inches—pink, calcareous fine sandy loam

Soil Properties and Qualities

Cave

Parent material: mixed alluvium
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Harrisburg

Parent material: mixed alluvium
Depth class: moderately deep to a hard pan
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low to low
Potential rooting depth: 20 to 40 inches
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Grapevine

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and moderately deep, eolian sand dunes
- Deep and moderately deep, loamy to sandy, fluventic soils in and along drainages
- Moderately deep to deep, very gravelly loamy Meadview soils on back slopes
- Eroded areas that have an indurated pan exposed on the surface
- Eroded areas that have sharp drop-offs into gullies
- Areas of Cave soils that have gravelly loam or gravelly sandy loam surface textures
- Areas of Harrisburg soils that have a fine sandy loam surface texture

Similar inclusions:
- Areas that have more than 35 percent rock fragments on the surface and in the soil profile

Use and Management

Rangeland

Dominant vegetation on the Cave and Harrisburg soils:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as creosotebush and white bursage).

Dominant vegetation on the Grapevine soils:
- Potential plant community—perennial grasses (such as sand dropseed and big galleta); shrubs (such as fourwing saltbush, creosotebush, and white bursage).

Important forage species: Indian ricegrass, big galleta, fourwing saltbush, and annuals.
Major management factors: Depth to hard pan and droughtiness of the Cave and Harrisburg soils, and hazard of erosion on all three soils.
General management considerations on the Cave, Harrisburg, and Grapevine soils:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to low production of forage on these soils.

Suitable management practices on the Cave, Harrisburg, and Grapevine soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils Include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox,

antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Cave and Harrisburg—7S; Grapevine—7E
Range site: Cave and Harrisburg—Limy Upland 6-9" p.z.; Grapevine—Limy Upland, Deep 6-9" p.z.

17—Chic-Teesto-Rock outcrop complex, 1 to 30 percent slopes

Setting

Landform: volcanic hills, cinder cones, and terraces
Landscape position: Chic—back slopes and foot slopes; Teesto—summits and back slopes; Rock outcrop—anywhere, but dominantly summits
Flooding: none
Slope range: Chic—1 to 30 percent; Teesto—1 to 15 percent; Rock outcrop—1 percent to vertical
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Chic and similar soils: 40 percent
Teesto and similar soils: 20 percent
Rock outcrop and similar soils: 15 percent
Contrasting inclusions: 25 percent

Typical Profile

Chic

0 to 2 inches—light brown extremely gravelly loam
2 to 9 inches—light brown very gravelly loam
9 to 27 inches—pink and pinkish white, violently effervescent, strongly alkaline extremely gravelly loam and sandy loam; weakly lime-cemented in the lower part
27 to 60 inches—loose cinders with tongues of secondary carbonates to 40 inches

Teesto

0 to 2 inches—light brown very cobbly loam
2 to 10 inches—light brown very cobbly loam
10 inches—basalt bedrock

Rock outcrop

Hard to extremely hard basalt bedrock exposed on the surface and areas which may have a 1- to 4-inch thick layer of gravel, cobbles, and loamy materials over the bedrock.

Soil Properties and Qualities

Chic

Parent material: colluvium and eolian
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: slow to moderate
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Teesto

Parent material: eolian and colluvium
Depth class: shallow and very shallow
Drainage class: well
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep to deep, clayey soils that have less than 35 percent rock fragments on back slopes and foot slopes
- Moderately deep to deep, loamy soils that have less than 35 percent rock fragments on back slopes and foot slopes

Similar inclusions:

- Cindery-loamy soils that are deep or very deep to loose cinders
- Shallow and very shallow, loamy soils that do not contain a calcic horizon
- Areas of Chic soils that have very gravelly or very cobbly loam or sandy loam surface textures
- Areas of Teesto soils that have a very gravelly loam or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Chic soil:
- Potential plant community—perennial grasses (such as galleta, black grama, bottlebrush squirreltail, and Indian ricegrass); shrubs (such as stickeyleaf low rabbitbrush and Mormontea).

Dominant vegetation on the Teesto soil:
- Potential plant community—perennial grasses (such as galleta, blue grama, and bottlebrush squirreltail); shrubs (such as stickeyleaf low rabbitbrush and Mormontea).

Important forage species: Galleta, blue grama, Indian ricegrass, and bottlebrush squirreltail.

Major management factors: Slope, very low available water, and erosion hazard on both soils.

General management considerations on the Chic and Teesto soils:
- Complex slopes and vertical exposures of rock limit access to livestock in some areas and encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.
- Low vegetative production limits management alternatives.

Suitable management practices on the Chic and Teesto soils:
- Planned grazing systems help increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: Chic and Teesto—7S; Rock outcrop—8

Range site: Chic—Cinder Upland 10-14" p.z.; Teesto—Basalt Upland 10-14" p.z.; Rock outcrop—none

18—Childers-Rizno association, 4 to 15 percent slopes

Setting

Landform: plateaus
Landscape position: summits and back slopes
Flooding: none
Slope range: 4 to 15 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Childers and similar soils: 50 percent
Rizno and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Childers

0 to 3 inches—brown gravelly loam
3 to 16 inches—brown and light brown, calcareous very gravelly loam
16 to 22 inches—indurated, lime-cemented hardpan
22 inches—limestone bedrock

Rizno

0 to 1 inch—reddish brown very channery sandy loam
1 to 6 inches—reddish brown channery sandy loam and loam
6 inches—calcareous sandstone or limestone bedrock

Soil Properties and Qualities

Childers

Parent material: mixed alluvium
Depth class: shallow to hardpan
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: rapid
Hazard of water erosion: slight

Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Rizno

Parent material: mixed alluvium and colluvium from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Deep to shallow, very gravelly loamy, calcareous soils on back slopes
- Deep to shallow, loamy soils in swales

Similar inclusions:
- Areas of Rizno soils that have a flaggy sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Childers soils:
- Potential plant community—perennial grasses (such as Indian ricegrass, blue grama, and black grama); shrubs (such as blackbrush, Stansbury cliffrose, and green Mormontea).

Dominant vegetation on the Rizno soils:
- Potential plant community—perennial grasses (such as desert needlegrass and galleta); shrubs (such as blackbrush, Mexican cliffrose, and Mormontea).

Important forage species: Indian ricegrass, desert needlegrass, blue grama, galleta, and annuals.
Major management factors: Shallow depths and droughtiness on both soils.
General management considerations on the Childers and Rizno soils:
- Vertical exposures of rock and steep-sided drainageways limit access to livestock.
- Densely populated blackbrush inhibits grazeable forage.

Suitable management practices on the Childers and Rizno soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Constructing trails in steeply sloping areas increases access to livestock.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: Childers and Rizno—6S
Range site: Childers—Shallow Upland, Calcareous 10-14" p.z.; Rizno—Shallow Sandy Loam, Calcareous 10-14" p.z.

19—Dera very gravelly fine sandy loam, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Dera and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—light brown very gravelly fine sandy loam
2 to 9 inches—light brown gravelly loam
9 to 42 inches—light brown and pinkish white, calcareous very gravelly loam
42 to 60 inches—light brown and pink, calcareous, gypsiferous very gravelly sandy loam

Soil Properties and Qualities

Parent material: mixed alluvium derived from sedimentary sources high in lime

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep and deep loamy soils along drainageways.
- Areas of exposed bedrock

Similar inclusions:
- Areas where slopes exceed 10 percent
- Areas that contain less than 35 percent rock fragments
- Areas where the precipitation ranges to 11 inches
- Areas where surface textures are very gravelly sandy loam or very gravelly loam

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as galleta, black grama, and sand dropseed); shrubs (such as Mormontea and winterfat).

Important forage species: Galleta, black grama, sand dropseed, and winterfat.
Major management factors: Erosion hazard.
General management considerations:
- These soils are easily traversed by livestock.
- Overgrazing depletes the plant cover and increases the rate of erosion.
- Ground cover should be maintained or improved to reduce risk of erosion.

Suitable management practices:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.
- Development of permanent water supply for livestock.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- When water is present, this is the most important waterfowl and wading bird area in the survey area.
- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: 7S
Range site: Sandy Loam Upland 7-11" p.z.

20—Dermala family-Guy family-Rock outcrop complex, 10 to 40 percent slopes

Setting

Landform: mesas
Landscape position: back slopes and foot slopes
Flooding: none
Slope range: Dermala family and Guy family—10 to 40 percent; Rock outcrop—20 percent to vertical
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Dermala family and similar soils: 35 percent.
Guy family and similar soils: 20 percent.
Rock outcrop 20 percent
Contrasting inclusions: 25 percent

Reference Profile

Dermala family

Various; is usually moderately deep to very deep; very cobbly, gravelly, or stony in the surface and sometimes throughout the profile. Textures range from loam to clay loam. These soils are usually calcareous below 24 inches and may have some visible gypsum above a paralithic contact in moderately deep profiles over gypsiferous mudstone or gypsite.

One of the more common profiles of the Dermala family is:
0 to 2 inches—reddish brown very cobbly loam
2 to 8 inches—reddish brown very cobbly clay loam
8 to 24 inches—reddish brown cobbly clay loam

24 to 38 inches—light reddish brown, calcareous cobbly clay loam
38 to 60 inches—pink, calcareous cobbly loam

Guy family

Various; is usually moderately deep to very deep; very cobbly, gravelly, or stony in the surface and sometimes throughout the profile. Textures range from a fine sandy loam to a clay loam. Calcium carbonate ranges from 10 to 35 percent. Gypsum content ranges from 0 to 5 percent in some subsurface horizons. Lithic or paralithic contact is basalt, gypsite, or gypsiferous mudstone.

One of the more common profiles of the Guy family is:

0 to 4 inches—reddish brown very cobbly loam
4 to 8 inches—reddish brown cobbly loam
8 to 28 inches—reddish brown, calcareous gravelly loam
28 to 40 inches—soft, reddish brown mudstone interbedded with lime-coated weathered sandstone and gypsite

Rock outcrop

Rock outcrop consists of exposed basalt, gypsite, gypsiferous mudstone or talus slopes of basalt rubble. Basalt is usually vertical exposures at the upper end of the escarpment capping the mesa above the escarpment. Gypsite and gypsiferous mudstone are exposed on the steep to very steep side slopes. Talus slopes consist of basalt cobble, stones, and boulders and have very little to no soil materials to sustain plant growth.

Soil Properties and Qualities

Dermala family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to very deep
Drainage class: well
Permeability: moderate to moderately slow
Available water capacity: moderate
Potential rooting depth: 20 to 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: moderate
Corrosivity: concrete—moderate; uncoated steel—high

Guy family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to very deep
Drainage class: well
Permeability: moderate to moderately slow
Available water capacity: very low to low
Potential rooting depth: 20 to 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, gravelly to nongravelly loamy, gypsic soils on back slopes
- Shallow to moderately deep, gravelly to very gravelly loamy soils on back slopes

Similar inclusions:
- Areas of Dermala family soils that have a very cobbly clay loam surface texture
- Areas of Guy family soils that have a very cobbly fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Dermala family and Guy family soils:
- Potential plant community—perennial grasses (such as sideoats grama, needleandthread, and black grama); shrubs (such as fourwing saltbush and Wyoming big sagebrush); trees (such as Utah juniper and Colorado pinyon).

Important forage species: needleandthread, sideoats grama, galleta, and fourwing saltbush.
Major management factors: Depth to bedrock, steep slopes, droughtiness, and hazard of erosion in all the soils of this unit.
General management considerations on all the soils of this unit:
- Typically steep slopes restrict use by livestock.
- Proper distribution is often impossible to obtain.
- Heavy grazing occurs on the lower slopes of the unit.
- Overgrazing in these limited areas promotes erosion.

Suitable management practices on all the soils of this unit:
- Trails leading up the break make the range at the top more accessible to the livestock.
- Planned grazing systems are essential to control erosion, maintain or improve range condition, and increase forage production.

Wildlife Habitat

Wildlife on these soils include golden eagle, road runner, dark-eyed junco, turkey vulture, western

kingbird, pinyon jay, rock wren, kangaroo rat, woodrat, rock squirrel, gray fox, mule deer, pronghorn antelope, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:

- Supports a plant community of scattered trees with an understory of perennial grasses, forbs, and shrubs.
- Area provides escape cover for pronghorn antelope and mule deer.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Develop water for wildlife.

Interpretive Groups

Land capability classification: Dermala family and Guy family—7E; Rock outcrop—8

Range site: Dermala family and Guy family—Basalt Slopes 13-17" p.z.; Rock outcrop—none

21—Disterheff-Natank-Yumtheska complex, 2 to 15 percent slopes

Setting

Landform: plateaus

Landscape position: Disterheff and Natank—summit depressions; Yumtheska—summits and back slopes

Flooding: none

Slope range: Disterheff—2 to 10 percent; Natank—2 to 8 percent; Yumtheska—3 to 15 percent

Elevation: 5,800 to 6,500 feet

Mean annual precipitation: 14 to 18 inches

Mean annual air temperature: 48 to 54 degrees F

Frost-free period: 135 to 150 days

Composition

Disterheff and similar soils: 30 percent

Natank and similar soils: 30 percent

Yumtheska and similar soils: 20 percent

Contrasting inclusions: 20 percent

Typical Profile

Disterheff

0 to 2 inches—brown very gravelly loam
2 to 5 inches—dark brown clay loam
5 to 14 inches—brown gravelly clay
14 to 32 inches—reddish brown clay
32 to 41 inches—yellowish red, calcareous gravelly clay
41 to 60 inches—yellowish red, calcareous gravelly clay loam

Natank

0 to 1 inch—brown very gravelly loam
1 to 3 inches—dark brown clay loam
3 to 16 inches—reddish brown and yellowish red clay
16 to 25 inches—reddish brown and pink, calcareous cobbly clay loam
25 to 37 inches—pink, calcareous cobbly loam
37 inches—limestone bedrock

Yumtheska

0 to 2 inches—brown very gravelly loam
2 to 14 inches—dark brown and light gray, calcareous very gravelly loam
14 inches—limestone bedrock

Soil Properties and Qualities

Disterheff

Parent material: alluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: very slow
Available water capacity: medium to high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Natank

Parent material: alluvium from sedimentary formations
Depth class: moderately deep
Drainage class: well drained
Permeability: slow
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Yumtheska

Parent material: alluvium and colluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid

Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Moderately deep to deep, loamy, gypsic soils on backslopes
- Moderately deep to deep, loamy, fluventic soils along drainages

Similar inclusions:
- Areas of Disterheff soils that have a gravelly loam, gravelly clay loam, or clay loam surface texture
- Areas of Yumtheska soils that have a very gravelly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Disterheff and Natank soils:
- Potential plant community—perennial grasses (such as blue grama, western wheatgrass, and galleta); shrubs (such as big sagebrush); trees (such as Utah juniper and Colorado pinyon).

Dominant vegetation on the Yumtheska soil:
- Potential plant community: perennial grasses (such as prairie junegrass, blue grama, and bottlebrush squirreltail); shrubs (such as big sagebrush and cliffrose); trees (such as Utah juniper and Colorado pinyon).

Important forage species: blue grama, galleta, prairie junegrass, and western wheatgrass.
Major management factors: High shrink-swell potential of the Disterheff and Natank soils, depth to bedrock and droughtiness of the Yumtheska soil, and rapid runoff of all three soils.
General management considerations on the Disterheff, Natank and Yumtheska soils:
- These soils are easily traversed by livestock.
- Areas where brush is managed by prescribed burning or mechanical methods may be subject to a greater hazard of erosion.
- If shrubs are managed to create open areas, this unit produces a good stand of desirable grasses and forbs.

Suitable management practices on the Disterheff, Natank and Yumtheska soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Areas heavily infested with undesirable plants can be improved by prescribed burning or mechanical treatment.
- Treated areas can be reseeded to shorten recovery time and decrease erosion hazard.

Fuelwood Production

- The Disterheff and Natank soils can produce about 5 cords per acre.
- The Yumtheska soils can produce about 3 to 5 cords per acre.

Suitable management considerations on the Disterheff, Natank, and Yumtheska soils:
- Reduce risk of erosion by proper installation and maintenance of access roads.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, mountain bluebird, green-tailed towhee, dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, cottontail, pinyon mouse, deer mouse, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of pinyon-juniper woodland that has an understory of perennial grasses, forbs, and shrubs.
- Area provides escape cover for pronghorn antelope and mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Develop water for wildlife.
- Brush management—prescribed fire and chaining.
- Brush management must retain thermal and escape cover for wildlife and create habitat diversity.

Interpretive Groups

Land capability classification: Disterheff, Natank and Yumtheska—6S
Range site: Disterheff and Natank—Clay Loam Upland, Gravelly (PIED, JUOS) 13-17" p.z.; Yumtheska—Limestone Slopes 13-17" p.z.

22—Dutchman-McCullan complex, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Slope range: 1 to 10 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches

Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Dutchman and similar soils: 40 percent
McCullan and similar soils: 40 percent
Contrasting inclusions: 20 percent

Typical Profile

Dutchman

0 to 2 inches—light brown fine sandy loam
2 to 20 inches—reddish yellow, pink, and pinkish white, calcareous sandy loam and fine sandy loam
20 to 33 inches—white, gypsiferous sandy loam, 50 to 80 percent gypsum
33 to 60 inches—pink, gypsiferous sandy loam, 30 to 40 percent gypsum

McCullan

0 to 1 inch—light brown gravelly loam
1 to 6 inches—light brown loam
6 to 25 inches—white, gypsiferous sandy loam, 50 to 80 percent gypsum
25 to 41 inches—pink, gypsiferous sandy loam, 30 to 50 percent gypsum
41 to 60 inches—reddish yellow, gypsiferous sandy loam, 20 to 40 percent gypsum

Soil Properties and Qualities

Dutchman

Parent material: alluvium from sedimentary formations high in gypsum
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

McCullan

Parent material: mixed alluvium from sedimentary formations high in gypsum
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, loamy soils on back slopes
- Deep and very deep, loamy and very gravelly loamy, calcareous soils on back slopes

Similar inclusions:
- Areas of Dutchman soils that have a very fine sandy loam or sandy loam surface texture
- Areas of McCullan soils that have a gravelly fine sandy loam or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Dutchman and McCullan soils:
- Potential plant community—grasses (such as galleta, black grama, gyp dropseed, and sand dropseed) and few shrubs (such as Nevada Mormontea and fourwing saltbush).

Important forage species: sand dropseed, galleta, black grama, and fourwing saltbush.
Major management factors: Gypsum content, depth to gypsum, droughtiness, and hazard of erosion on both soils.
General management considerations on the Dutchman and McCullan soils:
- High gypsum content, depth to gypsum, and low available water capacity may contribute to low production of forage on this soil (fig. 6).
- Proper grazing distribution is often difficult to obtain.
- This site is difficult to restore once vegetation has been removed.

Suitable management practices on the Dutchman and McCullan soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies is an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:



Figure 6.—This area of Dutchman-McCullan complex, 1 to 10 percent slopes, is typical of gypsum soils of the Shivwits area. Note the gypsum cryptocrystaline structures at the soil surface in the foreground of this photo.

- Supports a plant community of perennial grasses, forbs, and shrubs.
- When water is present, this is the most important waterfowl and wading bird area in the survey area.
- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: Dutchman—7E; McCullan—7S

Range site: Dutchman and McCullan—Gypsum Upland 7-11" p.z.

23—Goblin gravelly fine sandy loam, 15 to 50 percent slopes

Setting

Landform: hills and escarpments
Landscape position: summits and back slopes
Flooding: none
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F

Frost-free period: 165 to 180 days

Composition

Goblin and similar soils: 80 percent.
Contrasting inclusions: 20 percent.

Typical Profile

0 to 1 inch—pink, gypsiferous gravelly fine sandy loam
1 to 10 inches—very pale brown, gypsiferous fine sandy loam
10 to 20 inches—interbedded, rippable gypsite and gypsiferous shale

Soil Properties and Qualities

Parent material: colluvium and alluvium from gypsiferous shales (mudstone, siltstone, and gypsite), limestone and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow, loamy Moenkopie soils on summits
- Riverwash in washes
- Moderately deep to deep, loamy, gypsiferous soils on foot slopes
- Rock outcrop—limestone, sandstone, and shales (mudstone, siltstone, and gypsite)

Similar inclusions:
- Soils moderately deep over gypsite
- Areas receiving 11 inches of mean annual precipitation

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as gyp dropseed and galleta); shrubs (such as buckwheat, Mormontea, and fourwing saltbush).

Important forage species: galleta and fourwing saltbush.
Major management factors: Gypsum content, depth to bedrock, steep slopes, droughtiness, hazard of erosion.
General management considerations:
- These soils are very fragile, and any activities such as stock trailing and vehicular traffic can result in serious losses from erosion.
- Because of unfavorable growing conditions on these soils, overgrazing will leave the ground bare and susceptible to erosion.
- The complex topography prevents proper grazing distribution.

Suitable management practices:
- Light stocking rates can be used on the lower slopes.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- When water is present, this is the most important waterfowl and wading bird area in the survey area.
- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: 7E
Range site: Gypsum Hills 7-11" p.z.

24—Goblin-Gyppocket complex, 2 to 10 percent slopes

Setting

Landform: Goblin—hills; Gyppocket—fan terraces along fault lines
Landscape position: Goblin—back slopes; Gyppocket—summits, back slopes, and foot slopes
Flooding: none
Slope range: Goblin—5 to 10 percent;Gyppocket—2 to 10 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: Goblin—7 to 10 inches; Gyppocket—7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F

Frost-free period: 165 to 180 days

Composition

Goblin and similar soils: 50 percent
Gyppocket and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Goblin

0 to 1 inch—light brown gravelly fine sandy loam
1 to 14 inches—white gypsum (sand grain to fine gravel-sized crystals)
14 inches—very hard gypsite

Gyppocket

0 to 2 inches—pink very cobbly sandy loam
2 to 12 inches—light brown, calcareous very cobbly loam
12 to 22 inches—reddish yellow, gypsiferous very cobbly sandy loam
22 to 60 inches—white and yellow extremely cobbly gypsum (fine to medium gypsum crystals between rock fragments)

Soil Properties and Qualities

Goblin

Parent material: colluvium and alluvium
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium
Hazard of water erosion: severe
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Gyppocket

Parent material: colluvium and alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Available water capacity: low to very low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, gypsic, loamy Robroost soils near drainageways
- Rock outcrop, exposures of gypsite or shale
- Moderately deep to deep, sandy to loamy soils that have common flooding in drainages

Similar inclusions:
- Areas of moderately deep soils
- Areas where the gypsum is not very hard but rippable under the Goblin soils
- Areas of Goblin soils where the precipitation ranges to 11 inches

Use and Management

Rangeland

Dominant vegetation on the Goblin soil:
- Potential plant community—perennial grasses (such as gyp dropseed and galleta); shrubs (such as fourwing saltbush, rubber rabbitbrush, and Mormontea).

Dominant vegetation on the Gyppocket soil:
- Potential plant community—perennial grasses (such as gyp dropseed, galleta, and black grama); shrubs (such as fourwing saltbush and Nevada Mormontea).

Important forage species: Galleta, black grama, and fourwing saltbush.
Major management factors: Droughtiness and erosion hazard.
General management considerations on the Goblin and Gyppocket soils:
- Because of high content of gypsum, these soils limit forage variety and production.
- Overgrazing depletes the ground cover and increases the rate of erosion.
- Seepage and piping limit use of these soils for water catchment and storage development.

Suitable management practices on the Goblin and Gyppocket soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:

• Supports a plant community of perennial grasses, forbs, and shrubs.
• When water is present, this is the most important waterfowl and wading bird area in the survey area.
• Provides important foraging and lambing habitat for pronghorn antelope.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Erosion control.

Interpretive Groups

Land capability classification: Goblin—7E; Gyppocket—7S
Range site: Goblin—Gypsum Hills 7-11" p.z.; Gyppocket—Gypsum Upland 7-11" p.z.

25—Goesling loam, 1 to 5 percent slopes

Setting

Landform: fan terraces
Landscape position: summits
Flooding: none
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Goesling and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—light brown loam
2 to 9 inches—light brown loam
9 to 33 inches—light brown clay loam
33 to 60 inches—light brown, calcareous clay loam

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep, loamy, soils along drainages
• Moderately deep loamy soils on back slopes
Similar inclusions:
• Areas that have a gravelly surface
• Areas that have a gravelly substratum
• Areas that have bedrock at a depth of 40 to 60 inches
• Areas that have a fine sandy loam or clay loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as blue grama, western wheatgrass, needleandthread, and muttongrass); shrubs (such as Wyoming big sagebrush and fourwing saltbush); trees (such as Utah juniper and singleleaf pinyon).
Important forage species: Muttongrass, western wheatgrass, blue grama, and fourwing saltbush.
Major management factors: Hazard of erosion and brush management.
General management considerations:
• This unit is one of the more productive units in the survey area.
• This unit receives runoff from the adjacent slopes.
• Unless grazing is controlled, livestock generally overgraze this unit because of availability of water and forage.
Suitable management practices:
• Planned grazing systems are essential to maintain plant vigor and forage production.
• Fencing and deferred grazing are important in planned grazing systems.
• Brush management, contour furrowing, and range seeding can be used to restore productivity on this unit.

Fuelwood Production

• These soils can produce about 6 cords per acre.
Suitable management considerations:
• Reduce risk of erosion by proper installation and maintenance of access roads.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, western bluebird, common flicker, common raven,

dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, rock squirrel, pinyon mouse, deer mouse, cougar, northern whiptail lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:

- Supports a plant community of pinyon-juniper woodland that has an understory of perennial grasses, forbs, and shrubs.
- Provides important habitat for mule deer.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Develop water for wildlife.

Interpretive Groups

Land capability classification: 6S
Range site: Loamy Upland, Gravelly (PIED, JUOS) 13-17" p.z.

26—Grapevine-Hobcan complex, 1 to 5 percent slopes

Setting

Landform: Grapevine—fan terraces; Hobcan—fan terraces and alluvial fans
Landscape position: Grapevine and Hobcan—summits and back slopes
Flooding: Grapevine—none; Hobcan—none to rare
Slope range: 1 to 5 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Grapevine and similar soils: 45 percent
Hobcan and similar soils: 35 percent
Contrasting inclusions: 20 percent

Typical Profile

Grapevine

0 to 4 inches—light reddish brown gravelly fine sandy loam
4 to 13 inches—light reddish brown, calcareous fine sandy loam
13 to 60 inches—reddish yellow, calcareous fine sandy loam

Hobcan

0 to 1 inch—reddish yellow very fine sandy loam
1 to 8 inches—reddish yellow, calcareous very fine sandy loam
8 to 15 inches—reddish yellow, gypsiferous fine sandy loam
15 to 51 inches—reddish yellow, gypsiferous loam
51 to 60 inches—reddish yellow, gypsiferous very fine sandy loam

Soil Properties and Qualities

Grapevine

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to medium
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Hobcan

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:

- Deep and very deep, loamy, fluventic soils along drainages
- Shallow to moderately deep, loamy, gypsiferous Ruesh and Gypill soils on summits and backslopes

Similar inclusions:

- Areas that have very gravelly or cobbly surfaces
- Areas of Grapevine soils that have 1 to 10 percent gypsum below a depth of 40 inches

Use and Management

Rangeland

Dominant vegetation on the Grapevine soil:

- Potential plant community—perennial grasses (such

as Indian ricegrass, sand dropseed, and big galleta); shrubs (such as creosotebush, white bursage, and fourwing saltbush).
Dominant vegetation on the Hobcan soil:
• Potential plant community—perennial grasses (such as sand dropseed and big galleta); shrubs (such as winterfat, white bursage, creosotebush, and fourwing saltbush).
Important forage species: sand dropseed, big galleta, winterfat, and fourwing saltbush.
Major management factors: Moderate to high content of gypsum in the Hobcan soils and hazard of erosion on both soils.
General management considerations on the Grapevine and Hobcan soils:
• Lack of available water for livestock.
• These soils are easily traversed by livestock.
• Overgrazing decreases plant variety and increases erosion.
• Production of vegetation for use as livestock forage is limited.
Suitable management practices on the Grapevine and Hobcan soils:
• Improve the distribution of grazing by developing and maintaining permanent water and fences.
• Control erosion and promote forage production with proper utilization.
• Planned grazing systems help increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Provides important foraging habitat for raptors.
• Proposed critical habitat for desert tortoise.
• Important chuckwalla habitat.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.
• Control off-road vehicle use.

Interpretive Groups

Land capability classification: Grapevine and Hobcan—7E
Range site: Grapevine—Limy Upland, Deep 6-9" p.z.; Hobcan—Loamy Wash, Gypsic 6-9" p.z.

27—Grapevine-Shelley complex, 1 to 5 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Slope range: 1 to 5 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Grapevine and similar soils: 45 percent
Shelley and similar soils: 35 percent
Contrasting inclusions: 20 percent

Typical Profile

Grapevine

0 to 4 inches—light reddish brown gravelly fine sandy loam
4 to 60 inches—reddish yellow, calcareous fine sandy loam

Shelley

0 to 2 inches—light brown very gravelly sandy loam
2 to 11 inches—light brown, calcareous very gravelly sandy loam
11 to 17 inches—pink, calcareous very gravelly loamy sand
17 to 60 inches—pink very gravelly loamy sand

Soil Properties and Qualities

Grapevine

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to medium
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Shelley

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, loamy, gypsic Ruesh and Hobcan soils on summits and back slopes
- Deep and very deep, loamy, fluventic soils along drainages
- Deep and very deep, very gravelly sandy Arizo soils along drainages

Similar inclusion:
- Areas of Grapevine soils that have 1 to 10 percent gypsum below a depth of 40 inches

Use and Management

Rangeland

Dominant vegetation on the Grapevine and Shelley soils:
- Potential plant community—perennial grasses (such as sand dropseed and big galleta); shrubs (such as creosotebush, white bursage, and fourwing saltbush).

Important forage species: Indian ricegrass, big galleta, and fourwing saltbush.
Major management factors: Hazard of erosion on the Grapevine soils, and droughtiness and seepage in the Shelley soils.
General management considerations on the Grapevine and Shelley soils:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage on this soil.
- These soils are easily traversed by livestock.
- Earthen water impoundments are limited because of the potential for seepage.

Suitable management practices on the Grapevine and Shelley soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.
- Alternatives to earthen water impoundments could include concrete and steel, butyl rubber or asphalt-lined storage tanks and drinkers, and livestock water pipelines

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Grapevine—7E; Shelley—7S
Range site: Grapevine and Shelley—Limy Upland, Deep 6-9" p.z.

28—Gypill-Badland association, 10 to 70 percent slopes

Setting

Landform: geologically eroding areas of hills and escarpments
Landscape position: Gypill—foot slopes and summits; Badland—summits and back slopes
Flooding: none
Slope range: Gypill—10 to 50 percent; Badland—10 to 70 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Gypill and similar soils: 40 percent
Badland and similar soils: 40 percent

Contrasting inclusions: 20 percent

Typical Profile

Gypill

0 to 2 inches—pink, gypsiferous fine sandy loam
2 to 6 inches—pale yellow gypsum, with some loamy materials
6 to 10 inches—white gypsum
10 to 60 inches—hard gypsite layered horizontally with mudstone, sandstone, and siltstone

Badland

Exposed areas of mudstone, siltstone, shale, and gypsite.

Soil Properties and Qualities

Gypill

Parent material: alluvium, colluvium, eolian, and residuum from sedimentary formations
Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 15 inches
Runoff: medium to very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Badland

Parent material: unconsolidated sedimentary deposits
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: moderate to high
Shrink-swell potential: high
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, sandy Arada family soils on summits
- Moderately deep to deep, loamy, gypsic soils on foot slopes
- Moderately deep to deep, loamy, fluventic soils along drainages

Use and Management

Rangeland

Dominant vegetation on the Gypill soil:
- Potential plant community—perennial grasses (such as gyp dropseed); shrubs (such as shadscale and Nevada Mormontea).

Dominant vegetation on the Badland miscellaneous land type:
- Potential plant community—very few annual grasses and forbs.

Important forage species: fourwing saltbush, when available, and annuals.
Major management factors: Depth to mudstone and droughtiness of the Gypill soil, and erosion hazard of both Gypill and Badland.
General management considerations on the Gypill soil and Badland:
- Vegetation is sparse, forage production is very low, and livestock usually avoid areas of this unit except to traverse it to access water or forage on adjacent areas.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices on the Gypill soil and Badland:
- Manage areas of this unit in conjunction with adjacent units.
- Essentially consider this unit as nonproductive except as it affects livestock movement and surface runoff for possible collection for livestock watering facilities.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Gypill—7E; Badland—8
Range site: Gypill—Gypsum Hills, Alkaline 6-9" p.z.; Badland—none

29—Gypill fine sandy loam, 15 to 40 percent slopes

Setting

Landform: hills and escarpments
Landscape position: summits and back slopes
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Gypill and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—pink, gypsiferous fine sandy loam
2 to 6 inches—pale yellow gypsum, with some loamy materials
6 to 10 inches—white, pink, and light yellowish gray, weathered gypsite
10 to 60 inches—hard gypsite

Soil Properties and Qualities

Parent material: alluvium, colluvium, eolian, and residuum from gypsiferous shales (mudstone, siltstone, and gypsite), limestone, and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 15 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep, loamy, gypsic soils on foot slopes
- Moderately deep, loamy, calcareous-gypsic soils on foot slopes
- Moderately deep, loamy, fluventic soils along drainages

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as gyp dropseed); shrubs (such as white burrobrush and shadscale).

Important forage species: Fourwing saltbush, when available, and annuals.
Major management factors: Gypsum content, droughtiness, depth to mudstone or gypsite, and hazard of erosion.
General management considerations:
- Because of the unfavorable growing conditions on these soils, overgrazing will leave the ground bare and highly susceptible to erosion.
- Livestock usually avoid areas of this soil unless their movement is controlled by fencing.

Suitable management practices:
- Light stocking rates can be used on lower slopes.
- Planned grazing systems are essential to maintain plant vigor and protection from erosion.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Gypsum Hills, Alkaline 6-9" p.z.

30—Gypill-Hobog complex, 6 to 35 percent slopes

Setting

Landform: Gypill—hills and escarpments; Hobog—ridges and mesa remnants
Landscape position: Gypill—back slopes; Hobog—summits and back slopes
Flooding: none
Slope range: Gypill—6 to 35 percent; Hobog—8 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches

Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Gypill and similar soils: 55 percent
Hobog and similar soils: 25 percent
Contrasting inclusions: 20 percent

Typical Profile

Gypill

0 to 2 inches—light brown, gypsiferous fine sandy loam
2 to 12 inches—light brown, gypsiferous loam
12 to 60 inches—alternate layers of soft and hard gypsite

Hobog

0 to 2 inches—light brown very gravelly sandy loam
2 to 12 inches—brown, calcareous very gravelly sandy loam
12 inches—extremely hard limestone bedrock

Soil Properties and Qualities

Gypill

Parent material: alluvium, colluvium, eolian, and residuum from sedimentary and igneous formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 15 inches
Runoff: medium to very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Hobog

Parent material: alluvium and eolian deposits from sedimentary and igneous formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: rapid
Hazard of water erosion: moderate to very severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Badland
- Deep, loamy Grapevine soils along drainages
- Limestone rock outcrop
- Deep and moderately deep, loamy, fluventic soils along drainages

Similar inclusions:
- Areas where Gypill soils are deeper than 15 inches
- Areas where Hobog soils are deeper than 20 inches

Use and Management

Rangeland

Dominant vegetation on the Gypill soil:
- Potential plant community—perennial grasses (such as gyp dropseed); shrubs (such as white burrobrush and Nevada Mormontea).

Dominant vegetation on the Hobog soil:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as creosotebush and Nevada Mormontea).

Important forage species: big galleta, Indian ricegrass, and annuals.
Major management factors: Gypsum content of the Gypill soil and depth to bedrock, steepness of slope, droughtiness, and erosion hazard on both soils.
General management considerations on the Gypill and Hobog soils:
- Good grazing distribution is difficult to obtain.
- Complex slopes encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices on the Gypill and Hobog soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.
- Development of livestock watering facilities is essential to achieve proper grazing use.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tail hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger,

red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.
General management considerations:
• Supports a sparse plant community of perennial grasses, forbs, and shrubs.
• Steep slopes and low rainfall make this area prone to water erosion.
• Provides important forage and lambing area for desert bighorn sheep.
• Proposed critical habitat for desert tortoise.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.

Interpretive Groups

Land capability classification: Gypill and Hobog—7E
Range site: Gypill—Gypsum Hills 6-9" p.z.; Hobog—Limy Upland 6-9" p.z.

31—Gypill very cobbly sandy loam, 15 to 40 percent slopes

Setting

Landform: hills and escarpments
Landscape position: summits and back slopes
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Gypill and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—pink very cobbly sandy loam
2 to 10 inches—light brown, gypsiferous sandy loam
10 to 18 inches—weathered, soft, gypsiferous shale
18 to 60 inches—hard gypsite interbedded with soft, gypsiferous shale

Soil Properties and Qualities

Parent material: alluvium, colluvium, eolian, and residuum from gypsiferous shales (mudstone, siltstone, and gypsite)
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 15 inches
Runoff: rapid to very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
• Moderately deep, loamy, calcareous soils on back slopes
• Moderately deep loamy, fluventic soils along drainages
Similar inclusions:
• Areas of Gypill soils more than 15 inches thick

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as gyp dropseed and big galleta); shrubs (such as white bursage, Nevada Mormontea, and white ratany).
Important forage species: big galleta and annuals.
Major management factors: Gypsum content, droughtiness, depth to paralithic contact, and hazard of erosion.
General management considerations:
• Because of the unfavorable growing conditions on these soils, overgrazing will leave the ground bare and highly susceptible to erosion.
• Livestock usually avoid areas of this soil unless their movement is controlled by fencing.
• Grazing is mostly limited to winter and spring annuals.
Suitable management practices:
• Light stocking rates can be used on lower slopes.
• Planned grazing systems are essential to maintain plant vigor and protect the soil from erosion.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Provides important foraging habitat for raptors.
• Proposed critical habitat for desert tortoise.
• Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Cobbly Gypsum Hills 6-9" p.z.

32—Gypsiorthids-Gypsiorthids, shallow complex, 1 to 50 percent slopes

Setting

Landform: fan terraces and hills
Landscape position: back slopes
Flooding: none
Slope range: 1 to 50 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Gypsiorthids and similar soils: 60 percent
Gypsiorthids, shallow and similar soils: 35 percent
Contrasting inclusions: 5 percent

Reference Profile

Note: Profiles described are reference profiles for the soils of this great group Soil Taxonomic name. Textures and depths may vary from those described.

Gypsiorthids

0 to 2 inches—brown, gypsiferous silt loam
2 to 13 inches—very pale brown, gypsiferous coarse sandy loam
13 to 31 inches—light brownish gray, gypsiferous loamy coarse sand
31 to 60 inches—light brownish gray, gypsiferous coarse sandy loam

Gypsiorthids, shallow

0 to 1 inch—strong brown, gypsiferous silt loam
1 to 7 inches—light brown, gypsiferous coarse sandy loam
7 inches—weathered, gypsiferous shale

Soil Properties and Qualities

Gypsiorthids

Parent material: alluvium and colluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Gypsiorthids, shallow

Parent material: alluvium and colluvium
Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 50 percent
- Shallow, loamy soils over limestone bedrock
- Rock outcrop

Similar inclusions:
- Moderately deep, gypsiferous soils over bedrock or weathered bedrock

Use and Management

Rangeland

Dominant vegetation on the Gypsiorthids soil:
- Potential plant community—perennial grasses (such as galleta, Indian ricegrass and bottlebrush squirreltail); shrubs (such as shadscale and fourwing saltbush).

Dominant vegetation on the Gypsiorthids, shallow soil:
- Potential plant community—perennial grasses (such as gyp dropseed, galleta, and Indian ricegrass); shrubs (such as rubber rabbitbrush, Bigelow sagebrush, and fourwing saltbush).

Important forage species: Galleta, bottlebrush squirreltail, Indian ricegrass, and fourwing saltbush.
Major management factors: Slope, gypsum content, depth to rock, low and very low available water capacity, and hazard of erosion.
General management considerations on the Gypsiorthids and Gypsiorthids, shallow soils:
- Production of vegetation suitable as forage is limited by high gypsum content.

• Slope limits access by livestock and results in overgrazing of the less sloping areas.
• Desirable grasses are slow to recover even under the best management.
Suitable management practices on the Gypsiorthids and Gypsiorthids, shallow soils:
• Proper grazing use
• Planned grazing systems
• Fencing
• Deferred grazing

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, mourning dove, prairie falcon, red-tail hawk, peregrine falcon, golden eagle, rock squirrel, woodrat, kangaroo rat, antelope ground squirrel, kit fox, bighorn sheep, mule deer, cougar, badger, Grand Canyon rattlesnake, gopher snake, and short-horned lizard.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Steep slopes and low rainfall make this area prone to water erosion.
• Provides nesting and foraging habitat for peregrine falcons.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.

Interpretive Groups

Land capability classification: Gypsiorthids and Gypsiorthids, shallow—7E
Range site: Gypsiorthids—Gypsum Upland 7-11" p.z.; Gypsiorthids, shallow—Gypsum Hills 7-11" p.z.

33—Havasupai very gravelly loam, 1 to 5 percent slopes

Setting

Landform: fan terraces
Landscape position: summit
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Havasupai and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—light brown very gravelly loam
2 to 14 inches—light brown, calcareous very gravelly loam
14 to 18 inches—very strongly lime-cemented hardpan that has laminated cap
18 to 48 inches—white, strongly lime-cemented very gravelly coarse sandy loam
48 to 60 inches—reddish yellow, calcareous very gravelly loamy coarse sand

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Moderately deep to deep, loamy, calcareous soils that have less than 35 percent coarse fragments on summits
• Deep to very deep, very gravelly loamy, calcareous Strych soils on back slopes
• Deep to very deep, loamy Barx soils on summits
Similar inclusions:
• Soils that have 20 to 35 percent coarse fragments
• Soils that have a very gravelly fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as blue grama, needleandthread, bottlebrush squirreltail, and Indian ricegrass); shrubs (such as fourwing saltbush and big sagebrush).
Important forage species: Indian ricegrass, blue grama, bottlebrush squirreltail, and needleandthread.
Major management factors: Low available water and shallow soil depth.
General management considerations:
• High lime content and low water supply capacity contribute to low production of forage on this unit.

Suitable management practices:
• Planned grazing systems are essential to maintain plant vigor and forage production.
• Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed fire.

Interpretive Groups

Land capability classification: 7S
Range site: Limy Upland 10-14" p.z.

34—Hindu-Rock outcrop-Gypill complex, 35 to 70 percent slopes

Setting

Landform: Hindu and Gypill—escarpments and mountains; Rock outcrop—cliffs and canyon walls
Landscape position: Hindu—steps, benches and back slopes; Gypill—back slopes; Rock outcrop—cliffs and canyon walls
Flooding: none
Slope range: Hindu—35 to 70 percent; Gypill—35 to 50 percent; Rock outcrop—50 percent to vertical
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Hindu and similar soils: 45 percent
Rock outcrop and similar soils: 30 percent
Gypill and similar soils: 10 percent
Contrasting inclusions: 15 percent

Typical Profile

Hindu

0 to 1 inch—light yellowish brown extremely gravelly loam
1 to 7 inches—light yellowish brown extremely gravelly loam
7 inches—limestone bedrock

Rock outcrop

Hard to extremely hard sedimentary and igneous rock formations. Rock types include limestone, sandstone, gypsite, shale, and conglomerates.

Gypill

0 to 2 inches—pink, gypsiferous fine sandy loam
2 to 6 inches—pale yellow, gypsiferous loam
6 to 60 inches—interbedded shales and gypsum layers varying in thickness and hardness

Soil Properties and Qualities

Hindu

Parent material: colluvium from sedimentary formations
Depth class: very shallow to shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Gypill

Parent material: colluvium and residuum from sedimentary formations
Depth class: very shallow to shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 15 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
• Shallow to moderately deep, very gravelly or cobbly loamy, gypsic soils on foot slopes and back slopes.
• Shallow to moderately deep, very gravelly or cobbly loamy, calcareous soils on foot slopes and back slopes.
• Shallow to moderately deep, very gravelly or cobbly loamy to sandy, fluventic soils along drainages.
Similar inclusions:

- Loamy soils that are on slopes of less than 35 percent.
- Gypsic soils that are moderately deep.

Use and Management

Rangeland

Dominant vegetation on the Hindu soil:
- Potential plant community—perennial grasses (such as big galleta, bush muhly, and three awn); shrubs (such as Mormontea, creosotebush, and white ratany).

Dominant vegetation on the Gypill soil:
- Potential plant community—perennial grasses (such as gyp dropseed); shrubs (such as creosotebush, fourwing saltbush, white burrobush, and Nevada Mormontea).

Some areas along Grand Wash Cliffs have blackbrush as a dominant shrub on both soils.

Important forage species: Big galleta, bush muhly, and fourwing saltbush

Major management factors: Steep slopes, droughtiness, and hazard of erosion in both soils; depth to bedrock in Hindu soil; and depth to paralithic and gypsum content in Gypill soil.

General management considerations on the Hindu soil:
- No significant moisture is received as runoff from adjacent slopes.
- Typically steep slopes severely restrict use by livestock.
- Proper distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes.
- Overgrazing lower slopes increases erosion.

Suitable management practices on the Hindu soil:
- Constructing trails in steeply sloping areas increases access to livestock.

General management considerations on the Gypill soil:
- These soils are very fragile, and any activities such as stock trailing and vehicular traffic can result in serious losses from erosion.
- Because of unfavorable growing conditions on these soils, overgrazing will leave the ground bare and susceptible to erosion.
- The complex topography prevents proper grazing distribution.

Suitable management practices on the Gypill soil:
- Light stocking rates can be used on the lower slopes.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tailed hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.

General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.

Interpretive Groups

Land capability classification: Hindu and Gypill—7E; Rock outcrop—8

Range site: Hindu—Limestone Hills 6-9" p.z.; Gypill—Gypsum Hills 6-9" p.z.; Rock outcrop—none

35—Hobcan fine sandy loam, 1 to 5 percent slopes

Setting

Landform: alluvial fans and fan terraces
Landscape position: summits and back slopes
Flooding: none to rare
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Hobcan and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—yellowish red fine sandy loam
2 to 14 inches—yellowish red, calcareous very fine sandy loam
14 to 19 inches—yellowish red, gypsiferous fine sandy loam
19 to 60 inches—yellowish red, gypsiferous very fine sandy loam

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate

Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy, gypsic Ruesh soils on back slopes
- Deep, loamy, calcareous Grapevine soils on summits
- Deep, loamy and sandy, fluventic soils along drainages

Similar inclusions:
- Areas that have gravelly fine sandy loam or loam surface layers
- Moderately deep, loamy soils that have moderate amounts of gypsum

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as big galleta and sand dropseed); shrubs (such as creosotebush, fourwing saltbush, and white bursage).

Important forage species: big galleta, sand dropseed, and fourwing saltbush.
Major management factors: Flooding and hazard of erosion.
General management considerations:
- This unit receives runoff from adjacent slopes.
- Livestock generally overgraze this unit because of the availability of water and ease of access.
- Overgrazing depletes vegetative cover and increases the hazard of erosion.

Suitable management practices:
- Prevent overgrazing by fencing and controlling water availability.
- Provide rest periods during the growing season to maintain plant vigor and production.
- Control erosion and promote forage production with proper utilization.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Loamy Wash, Gypsic 6-9" p.z.

36—Hobog-Grapevine complex, 2 to 35 percent slopes

Setting

Landform: Hobog—ridges and mesa remnants; Grapevine—fan terraces
Landscape position: Hobog—summits and back slopes; Grapevine—summits and back slopes
Flooding: none
Slope range: Hobog—2 to 35 percent; Grapevine—0 to 10 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Hobog and similar soils: 50 percent
Grapevine and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Hobog

0 to 2 inches—light brown very gravelly sandy loam
2 to 12 inches—pink, calcareous very gravelly sandy loam
12 inches—limestone bedrock

Grapevine

0 to 2 inches—light reddish brown gravelly fine sandy loam
2 to 35 inches—reddish yellow, calcareous fine sandy loam

35 to 60 inches—pink, calcareous fine sandy loam

Soil Properties and Qualities

Hobog

Parent material: alluvium from sedimentary and igneous formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Grapevine

Parent material: mixed alluvium from sedimentary and igneous rocks
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to medium
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow, loamy soils on summits of ridges and mesas
- Rock outcrop
- Shallow to moderately deep, loamy, gypsic soils on back slopes
- Moderately deep, very gravelly loamy, calcareous soils on footslopes below ridges and mesas

Similar inclusions:
- Areas of moderately deep, loamy soils similar to Grapevine
- Areas of Grapevine soils that have moderate amounts of gypsum below a depth of 40 inches

Use and Management

Rangeland

Dominant vegetation on the Hobog soil:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as creosotebush, winterfat, and Nevada Mormontea).

Dominant vegetation on the Grapevine soil:
- Potential plant community—perennial grasses (such as sand dropseed and big galleta); shrubs (such as creosotebush, Anderson wolfberry, and fourwing saltbush).

Important forage species: bush muhly, big galleta, sand dropseed, Indian ricegrass, winterfat, fourwing saltbush, and annuals.
Major management factors: Depth to bedrock, droughtiness, and moderate to very severe hazard of erosion on both soils.
General management considerations on the Hobog and Grapevine soils:
- Good grazing distribution is difficult to obtain.
- Complex slopes encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover and increases the rate of erosion.
- Good grazing distribution is difficult to obtain because of the lack of water.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices on the Hobog and Grapevine soils:
- Improve the grazing distribution by developing and maintaining permanent water supplies and fences.
- Control erosion and promote forage production with proper utilization.
- Provide rest periods during the growing season to maintain plant vigor and production.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tail hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.

General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.

Interpretive Groups

Land capability classification: Hobog and Grapevine—7E
Range site: Hobog—Limy Upland 6-9" p.z.; Grapevine—Limy Upland, Deep 6-9" p.z.

37—Hobog-Grapevine complex, 2 to 35 percent slopes, moist

Setting

Landform: Hobog—ridges and mesa remnants; Grapevine—fan terraces
Landscape position: Hobog—summits and back slopes; Grapevine—summits and back slopes
Flooding: none
Slope range: Hobog—2 to 35 percent; Grapevine—2 to 10 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Hobog and similar soils: 50 percent.
Grapevine and similar soils: 30 percent.
Contrasting inclusions: 20 percent

Typical Profile

Hobog

0 to 2 inches—light brown very gravelly fine sandy loam
2 to 12 inches—pink, calcareous very gravelly sandy loam
12 inches—limestone bedrock

Grapevine

0 to 2 inches—light brown gravelly fine sandy loam
2 to 35 inches—strong brown, calcareous fine sandy loam
35 to 60 inches—pink, calcareous fine sandy loam

Soil Properties and Qualities

Hobog

Parent material: alluvium from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Grapevine

Parent material: mixed alluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to medium
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Shallow, loamy soils on summits of ridges and mesa remnants
- Moderately deep, loamy, fluventic soils in drainages
- Shallow to moderately deep, loamy, gypsic soils on back slopes
- Moderately deep, very gravelly loamy soils on back slopes

Similar inclusions:
- Moderately deep, loamy, soils similar to Grapevine soils
- Areas of Grapevine soils that have moderate amounts of gypsum below a depth of 40 inches

Use and Management

Rangeland

Dominant vegetation on the Hobog soil:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as blackbrush, creosotebush, and Nevada Mormontea).

Dominant vegetation on the Grapevine soil:
- Potential plant community—perennial grasses (such as big galleta and sand dropseed); shrubs (such as blackbrush, Nevada Mormontea, and creosotebush).

Important forage species: Indian ricegrass and big galleta.

Major management factors: Droughtiness and hazard of erosion on both soils; and depth to bedrock on the Hobog soil.
General management considerations on the Hobog and Grapevine soils:
• Complex slopes encourage overgrazing of less sloping areas.
• Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.
Suitable management practices on the Hobog and Grapevine soils:
• Planned grazing systems help control erosion and increase plant vigor and variety.
• Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tail hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.
General management considerations:
• Supports a sparse plant community of perennial grasses, forbs, and shrubs.
• Steep slopes and low rainfall make this area prone to water erosion.
• Provides important forage and lambing area for desert bighorn sheep.
• Proposed critical habitat for desert tortoise.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.

Interpretive Groups

Land capability classification: Hobog and Grapevine—7E
Range site: Hobog—Shallow Upland 9-12" p.z.; Grapevine—Sandy Loam, Gravelly 9-12" p.z.

38—Hobog-Tidwell family complex, 8 to 35 percent slopes

Setting

Landform: plateaus, mesas and ridges
Landscape position: summits and back slopes
Flooding: none
Slope range: 8 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Hobog and similar soils: 50 percent
Tidwell family and similar soils: 25 percent
Contrasting inclusions: 25 percent

Typical Profile

Hobog

5 to 10 percent surface coverage with cobble-sized limestone fragments (flagstone)
0 to 4 inches—light brown very gravelly sandy loam
4 to 19 inches—pink, calcareous very gravelly sandy loam
19 inches—extremely hard limestone bedrock

Tidwell family

5 to 10 percent surface coverage of cobble-sized limestone fragments (flagstone)
0 to 2 inches—light brown very gravelly fine sandy loam
2 to 6 inches—reddish yellow, calcareous gravelly loam
6 inches—extremely hard limestone bedrock

Soil Properties and Qualities

Hobog

Parent material: alluvium and eolian materials from sedimentary and igneous formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Tidwell family

Parent material: alluvium from sedimentary and igneous formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to very rapid

Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep, loamy, calcareous soils on foot slopes
- Moderately deep, loamy, fluventic soils in drainages
- Rock outcrop

Similar inclusions:
- Areas that have a very flaggy, fine sandy loam, or sandy loam surface texture on both soils

Use and Management

Rangeland

Dominant vegetation on the Hobog and Tidwell family soils:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as creosotebush, winterfat, and Mormontea).

Important forage species: Indian ricegrass, big galleta, and winterfat.
Major management factors: Depth to bedrock, droughtiness, hazard of erosion, and steepness on both soils.
General management considerations on the Hobog and Tidwell family soils:
- No significant moisture is received as runoff from adjacent slopes.
- Good grazing distribution is difficult to obtain because of the lack of water and complex slopes.
- Low productivity and slow recovery require special management.

Suitable management practices on the Hobog and Tidwell family soils:
- Improve grazing distribution by developing and maintaining permanent water supplies and fences.
- Control erosion and promote forage production with proper utilization.
- Provide rest periods during the growing season to maintain plant vigor and production.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tail hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.
General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.

Interpretive Groups

Land capability classification: Hobog and Tidwell family—7E
Range site: Hobog and Tidwell family—Limy Upland 6-9" p.z.

39—Hobog very gravelly sandy loam, 5 to 30 percent slopes

Setting

Landform: plateaus and mesas
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Hobog and similar soils: 80 percent.
Contrasting inclusions: 20 percent.

Typical Profile

5 to 10 percent surface coverage with cobble-sized limestone fragments
0 to 4 inches—light brown very gravelly sandy loam
4 to 19 inches—pink, calcareous very gravelly sandy loam
19 inches—extremely hard limestone bedrock

Soil Properties and Qualities

Parent material: local alluvium and eolian materials from limestone and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches

Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep, loamy, calcareous soils in swales
- Moderately deep, loamy to sandy, fluventic soils in drainages
- Rock outcrop

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as blackbrush, creosotebush, and Nevada Mormontea).

Important forage species: desert needlegrass, Indian ricegrass, and big galleta.
Major management factors: Depth to bedrock, droughtiness, hazard of erosion, and steepness of slope.
General management considerations:
- No significant moisture is received as runoff from adjacent slopes.
- These soils are easily traversed by livestock.
- Overgrazing depletes vegetative cover and increases the rate of erosion.
- Good grazing distribution is difficult to obtain because of the lack of water.

Suitable management practices:
- Improve the grazing distribution by developing and maintaining permanent water supplies and fences.
- Control erosion and promote forage production with proper utilization.
- Provide rest periods during the growing season to maintain plant vigor and production.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tail hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.
General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.

Interpretive Groups

Land capability classification: 7S
Range site: Shallow Upland 9-12" p.z.

40—Ivanpatch fine sandy loam, 1 to 5 percent slopes

Setting

Landform: fan terraces
Landscape position: valley side slopes
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Frost-free period: 150 to 165 days

Composition

Ivanpatch and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—light reddish brown fine sandy loam
2 to 11 inches—reddish yellow, gypsiferous loam
11 to 60 inches—reddish yellow, gypsiferous loam

Soil Properties and Qualities

Parent material: alluvium from sedimentary formations high in gypsum and calcium carbonate
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:

• Deep, loamy, gypsic, fluventic soils along drainages
• Deep, gravelly loamy, gypsic soils on foot slopes
Similar inclusions:
• Areas that have 15 to 35 percent gravel on the surface
• Areas that have a loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as sand dropseed, galleta, and gyp dropseed); shrubs (such as winterfat and fourwing saltbush).
Important forage species: galleta, sand dropseed, winterfat, and fourwing saltbush.
Major management factors: Droughtiness, gypsum content, and hazard of erosion.
General management considerations:
• Overgrazing depletes vegetation and increases the hazard of erosion.
• Range recovery is very slow.
• Stocking rates and length of grazing periods should be carefully controlled.
Suitable management practices:
• Light stocking rates should be used to control erosion and promote forage production.
• Improve grazing distribution by providing and maintaining permanent water supplies.
• Provide rest periods during the growing season to maintain plant vigor and production.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed fire.

Interpretive Groups

Land capability classification: 6E
Range site: Gypsum Fan 10-14" p.z.

41—Ives loam, 1 to 3 percent slopes

Setting

Landform: flood plains
Flooding: frequent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 59 degrees F
Frost-free period: 165 to 180 days

Composition

Ives and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—brown loam
2 to 60 inches—brown and light brown, stratified fine sandy loam and loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
• Areas of riverwash
• Rock outcrop, erratic areas of bedrock
• Shallow, loamy soils over bedrock near rock outcrops
Similar inclusions:
• Areas that are moderately deep
• Areas that have a fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as galleta, Indian ricegrass, bottlebrush squirreltail, and blue grama) and shrubs (such as fourwing saltbush and winterfat).

Important forage species: Indian ricegrass, galleta, sand dropseed, blue grama, winterfat, and fourwing saltbush.
Major management factors: Hazard of erosion and flooding.
General management considerations:
• This soil receives moisture from the adjacent slopes.
• Overgrazing occurs unless grazing is controlled.
• Ground cover should be maintained or improved to reduce erosion hazard.
Suitable management practices:
• Planned grazing systems will increase plant vigor and forage production.
• Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• When water is present, this is the most important waterfowl and wading bird area in the survey area.
• Provides important foraging and lambing habitat for pronghorn antelope.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Erosion control.

Interpretive Groups

Land capability classification: 7W
Range site: Loamy Bottom 7-11" p.z.

42—Katzine-Rock outcrop-Yumtheska complex, 35 to 70 percent slopes

Setting

Landform: mountains
Landscape position: Katzine—foot slopes and back slopes; Yumtheska—summits and back slopes; Rock outcrop—vertical cliff walls and canyons
Flooding: none
Slope range: Katzine—35 to 50 percent; Rock outcrop—50 percent to vertical; Yumtheska—35 to 50 percent
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 56 degrees F
Frost-free period: 120 to 165 days

Composition

Katzine and similar soils: 30 percent
Rock outcrop and similar soils: 25 percent
Yumtheska and similar soils: 20 percent
Contrasting inclusions: 25 percent

Typical Profile

Katzine

0 to 1 inch—light brown very cobbly loam
1 to 10 inches—light brown very gravelly loam
10 to 60 inches—pink, calcareous very gravelly loam

Rock outcrop

Hard to extremely hard sedimentary formations (limestone, sandstone, shale, and conglomerate).

Yumtheska

0 to 1 inch—dark brown very gravelly loam
1 to 10 inches—dark brown, calcareous very gravelly loam
10 inches—limestone bedrock

Soil Properties and Qualities

Katzine

Parent material: colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to medium
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Yumtheska

Parent material: colluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained

Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep to deep, very gravelly loamy soils on back slopes and foot slopes

Similar inclusions:
- Loamy soils that have less than 35 percent rock fragments
- Loamy soils on slopes of less than 35 percent

Use and Management

Rangeland

Dominant vegetation on the Katzine soil:
- Potential plant community—perennial grasses (such as prairie junegrass, muttongrass, and blue grama); shrubs (such as yellowleaf silktassel, mountain big sagebrush, and Utah serviceberry); trees (such as singleleaf pinyon and Gambel oak).

Dominant vegetation on the Yumtheska soil:
- Potential plant community—perennial grasses (such as prairie junegrass, muttongrass, and blue grama); shrubs (such as big sagebrush, Utah serviceberry, silktassel, and cliffrose); trees (such as singleleaf pinyon and Gambel oak).

Important forage species: cliffrose, mutton grass, blue grama, and prairie junegrass.
Major management factors: Steepness, droughtiness, depth to bedrock, and hazard of erosion.
General management considerations on the Katzine and Yumtheska soils:
- Typically, steep slopes restrict use by livestock.
- Proper grazing distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes.
- Overgrazing on lower slopes increases erosion.

Suitable management practices on the Katzine and Yumtheska soils:
- Building trails in steeply sloping areas increases access to livestock.
- Development of livestock watering facilities increases use of area.

Wildlife Habitat

Wildlife on these soils include scrub jay, bushtit, long-eared owl, ash-throated flycatcher, rufous-sided towhee, American kestrel, mule deer, coyote, woodrat, brush mouse, great basin pocket mouse, cottontail, gray fox, cougar, striped whiptail, short-horned lizard, gopher snake, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of chaparral that has an understory of perennial grasses, forbs, and shrubs.
- Provides crucial summer habitat for mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: Katzine and Yumtheska—7E; Rock outcrop—8
Range site: Katzine and Yumtheska—Limestone Slopes (PIED, JUOS) 13-17" p.z.; Rock outcrop—none

43—Meadview-Cave complex, 2 to 30 percent slopes, stony

Setting

Landform: fan terraces
Landscape position: Meadview—back slopes, foot slopes and summits; Cave—summits
Flooding: none
Slope range: Meadview—2 to 30 percent; Cave—2 to 10 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Meadview and similar soils: 45 percent
Cave and similar soils: 30 percent
Contrasting inclusions: 25 percent

Typical Profile

Meadview

0 to 5 inches—light brown very stony sandy loam
5 to 19 inches—pink, calcareous very cobbly sandy loam
19 to 60 inches—pink, weakly lime-cemented very cobbly sandy loam

Cave

0 to 2 inches—light brown stony sandy loam

2 to 9 inches—light brown, calcareous cobbly fine sandy loam
9 to 60 inches—pinkish white, indurated, lime-cemented hardpan

Soil Properties and Qualities

Meadview

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Cave

Parent material: mixed alluvium
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy soils that have more than 35 percent rock fragments over an indurated pan on summits and back slopes
- Moderately deep to deep, sandy soils that are stony throughout on foot slopes

Similar inclusions:
- Soils that have slopes greater than 30 percent
- Areas that have a bouldery surface
- Areas of Meadview soils that have a very cobbly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Meadview soils:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as Creosotebush, white bursage, and Nevada Mormontea).

Dominant vegetation on the Meadview and Cave soils:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as creosotebush, white ratany, and white bursage).

Important forage species: Indian ricegrass, big galleta, Nevada Mormontea, and annuals.
Major management factors: Surface stones and boulders, steepness of side slopes, and droughtiness of both soils.
General management considerations on the Meadview and Cave soils:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage.
- Steep side slopes of the terraces limit access by livestock.

Suitable management practices on the Meadview and Cave soils:
- Development of a permanent water supply.
- Construction of trails up the steep side slopes increases access of livestock to inaccessible areas.
- Planned grazing systems are essential for erosion control and maintaining plant vigor and forage production.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Meadview—7E; Cave—7S
Range site: Meadview—Limy Upland, Deep 6-9" p.z.; Cave—Limy Upland 6-9" p.z.

44—Meadview very gravelly sandy loam, 2 to 18 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Slope range: 2 to 18 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Meadview and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

50 percent surface coverage with gravel and few cobbles
0 to 2 inches—light brown very gravelly sandy loam
2 to 6 inches—light brown very gravelly fine sandy loam
6 to 50 inches—pink, weakly lime-cemented very gravelly sandy loam
50 to 60 inches—reddish yellow, slightly calcareous very gravelly loamy sand

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: slow to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy, calcareous Cave and Harrisburg soils on summits
- Shallow to deep, loamy, gypsic Gypill and Ruesh soils on summits and back slopes
- Deep and moderately deep, loamy and sandy, fluventic soils along drainages

Similar inclusions:
- Moderately deep to deep soils that have weathered bedrock (mudstone) at 30 to 60 inches (Pakoon area only).
- Areas that have a very gravelly fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as Indian ricegrass and big galleta); shrubs (such as creosotebush, white ratany, and white bursage).

Important forage species: Indian ricegrass and big galleta.
Major management factors: Droughtiness and hazard of erosion.
General management considerations:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage on these soils.

Suitable management practices:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7S
Range site: Limy Upland, Deep 6-9" p.z.

45—Mellenthin-Rock outcrop-Torriorthents complex, 10 to 70 percent slopes

Setting

Landform: plateaus, mesas and hills
Landscape position: Mellenthin—summits and back slopes; Rock outcrop—randomly throughout; Torriorthents—colluvial foot slopes
Flooding: none
Slope range: Mellenthin—10 to 30 percent; Rock outcrop—10 percent to vertical; Torriorthents—10 to 70 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Mellenthin—10 to 14 inches; Rock outcrop and Torriorthents—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin very gravelly loam and similar soils: 40 percent.
Rock outcrop: 20 percent.
Torriorthents and similar soils: 20 percent.
Contrasting inclusions: 20 percent

Typical Profile

Mellenthin

0 to 2 inches—dark brown very gravelly loam
2 to 10 inches—dark brown, calcareous very gravelly loam
10 inches—limestone bedrock

Rock outcrop

Hard and extremely hard limestone bedrock exposed to the surface and areas which may have a 1- to 4-inch thick layer of gravel, cobbles, and loamy materials above the bedrock.

Torriorthents

Various; is usually very cobbly to very gravelly throughout. Textures range from loamy sands to loam.
One of the more common profiles of Torriorthents is:
0 to 2 inches—light brown very gravelly loam
2 to 40 inches—light brown, calcareous very gravelly loam
40 inches—limestone bedrock

Soil Properties and Qualities

Mellenthin

Parent material: alluvium, colluvium, and eolian materials from limestone and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Torriorthents

Parent material: colluvium and alluvium from limestone and sandstone
Depth class: shallow to very deep
Drainage class: well drained to somewhat excessively
Permeability: moderate to moderately rapid
Available water capacity: very low to low
Potential rooting depth: 10 to 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep to deep, loamy, fluventic soils along drainages
- Moderately deep to deep, loamy, gypsic soils on back slopes

Similar inclusions:
- Shallow, loamy, calcareous soils that have less than 35 percent rock fragments
- Areas of Mellenthin soils where the precipitation ranges to 14 inches
- Areas of Mellenthin soils that have a very channery or very flaggy loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Mellenthin soil:
- Potential plant community—perennial grasses (such

as bottlebrush squirreltail, galleta, Indian ricegrass, and blue grama); shrubs (such as big sagebrush and Mormontea); trees (such as Utah juniper).
Dominant vegetation on the Torriorthents soil:
- Potential plant community—perennial grasses (such as prairie junegrass, galleta, bottlebrush squirreltail, and blue grama); shrubs (such as fourwing saltbush and Wyoming big sagebrush).

Important forage species: blue grama, galleta, bottlebrush squirreltail, prairie junegrass, and fourwing saltbush.
Major management factors: Steep slopes, droughtiness, moderate hazard of erosion, and depth to bedrock.
General management considerations on the Mellenthin and Torriorthents soils:
- Typically steep slopes severely restrict use by livestock.
- Proper grazing distribution is difficult to obtain.
- Heavy grazing occurs on lower slopes.
- Overgrazing lower slopes increases erosion.

Suitable management practices on the Mellenthin and Torriorthents soils:
- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed fire.

Interpretive Groups

Land capability classification: Mellenthin—6S; Rock outcrop—8; Torriorthents—7E
Range site: Mellenthin—Shallow Loamy 10-14" p.z.; Rock outcrop—none; Torriorthents—Breaks, Calcareous 10-14" p.z.

46—Mellenthin-Strych complex, 4 to 25 percent slopes, cool

Setting

Landform: plateaus and mesas
Landscape position: Mellenthin—summits and back slopes; Strych—summits, back slopes and foot slopes
Flooding: none
Slope range: Mellenthin—4 to 25 percent; Strych—4 to 10 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin and similar soils: 70 percent
Strych and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Mellenthin

0 to 2 inches—dark brown very gravelly loam
2 to 17 inches—dark brown and brown, calcareous very gravelly loam
17 inches—limestone bedrock

Strych

0 to 2 inches—light brown very gravelly loam
2 to 24 inches—light brown and pink, calcareous very gravelly loam
24 to 48 inches—pink, calcareous extremely gravelly loam
48 to 60 inches—light brown, calcareous very gravelly clay loam

Soil Properties and Qualities

Mellenthin

Parent material: alluvium, colluvium, and eolian deposits from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate

Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Strych

Parent material: alluvium and colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Moderately deep to deep, loamy, fluventic Radnik soils along drainages
- Moderately deep to deep, loamy Barx soils in swales

Similar inclusions:
- Areas where the precipitation ranges to 14 inches
- Areas of Mellenthin soils that have a very channery or very flaggy loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Mellenthin soil:
- Potential plant community—perennial grasses (such as galleta, Indian ricegrass, bottlebrush squirreltail, and blue grama); shrubs (such as Nevada Mormontea and big sagebrush); trees (such as Utah juniper).

Dominant vegetation on the Strych soil:
- Potential plant community—perennial grasses (such as bottle squirreltail, galleta, and blue grama); shrubs (such as big sagebrush).

Important forage species: Indian ricegrass, galleta, bottlebrush squirreltail, and blue grama.
Major management factors: Depth to bedrock, slope, and droughtiness on the Mellenthin soil; hazard of erosion on both soils.
General management considerations on the Mellenthin and Strych soils:
- Vertical rock exposures from fault blocks, steps, and canyons limit access to livestock in many areas.
- Complex slopes encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.

Suitable management practices on the Mellenthin and Strych soils:
- Constructing trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Mellenthin and Strych—6S
Range site: Mellenthin—Shallow Loamy 10-14" p.z.; Strych—Loamy Upland 10-14" p.z.

47—Mellenthin-Strych complex, 4 to 25 percent slopes, warm

Setting

Landform: plateaus and mesas (fig. 7)
Landscape position: Mellenthin—summits and back slopes; Strych—back slopes and foot slopes
Flooding: none
Slope range: Mellenthin—4 to 25 percent; Strych—4 to 10 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin and similar soils: 70 percent
Strych and similar soils: 15 percent



Figure 7.—The Mellenthin-Strych complex, 4 to 25 percent slopes, covers much of the Shivwits Plateau. The mountains in the background are mapped Boquillas family-Showlow complex, 25 to 50 percent slopes.

Contrasting inclusions: 15 percent

Typical Profile

Mellenthin

0 to 2 inches—dark brown very gravelly loam
2 to 17 inches—brown, calcareous very gravelly loam
17 inches—limestone bedrock

Strych

0 to 2 inches—light brown very gravelly loam
2 to 24 inches—light brown and pink, calcareous very gravelly loam
24 to 48 inches—reddish yellow and pink, calcareous extremely gravelly loam
48 to 60 inches—light brown, calcareous very gravelly clay loam

Soil Properties and Qualities

Mellenthin

Parent material: alluvium, colluvium, and eolian deposits from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Strych

Parent material: alluvium and colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight

Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Moderately deep and deep, loamy, fluventic soils along drainages
- Moderately deep and deep, loamy Barx soils in swales

Similar inclusions:
- Areas where the precipitation ranges to 14 inches
- Areas of Mellenthin soils that have a very channery or very flaggy, loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Mellenthin soil:
- Potential plant community—perennial grasses (such as desert needlegrass); shrubs (such as blackbrush and Nevada Mormontea).

Dominant vegetation on the Strych soil:
- Potential plant community—perennial grasses (such as desert needlegrass); shrubs (such as blackbrush and Nevada Mormontea).

Important forage species: Desert needlegrass and Nevada Mormontea.
Major management factors: Depth to bedrock and slope on the Mellenthin soils, and droughtiness on both soils.
General management considerations on the Mellenthin and Strych soils:
- Vertical rock exposures from faults and canyons limit access to livestock in many areas.
- Complex slopes encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.

Suitable management practices on the Mellenthin and Strych soils:
- Constructing trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Mellenthin and Strych—6S
Range site: Mellenthin—Shallow Upland, Calcareous 10-14" p.z.; Strych—Loamy Upland, Calcareous 10-14" p.z.

48—Mellenthin-Tanbark complex, 5 to 50 percent slopes, cool

Setting

Landform: plateaus, mesas, and hills
Landscape position: Mellenthin—summits and back slopes; Tanbark—back slopes
Flooding: none
Slope range: Mellenthin—5 to 35 percent; Tanbark—15 to 50 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Mellenthin—10 to 14 inches; Tanbark—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin and similar soils: 40 percent
Tanbark and similar soils: 35 percent
Contrasting inclusions: 25 percent

Typical Profile

Mellenthin

0 to 2 inches—dark brown very gravelly loam
2 to 6 inches—dark brown, calcareous very gravelly loam
6 to 17 inches—brown, calcareous very gravelly loam
17 inches—limestone bedrock

Tanbark

0 to 1 inches—white, gypsiferous loam
1 to 17 inches—white and pinkish white, fine and medium gypsum crystals; sandy loam texture
17 to 20+ inches—white and pinkish white gypsite

Soil Properties and Qualities

Mellenthin

Parent material: alluvial and colluvial deposits from limestone and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Tanbark

Parent material: alluvium, colluvium and eolian material from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Bedrock; exposures of limestone, sandstone, and gypsite
- Deep and moderately deep, loamy soils that have 15 to 60 percent rock fragments on foot slopes
- Deep to shallow, loamy fluventic soils in drainages
- Shallow, loamy Bond soils over sandstone on summits

Similar inclusions:
- Areas where slopes exceed 50 percent
- Areas that have many surface cobbles
- Areas of Mellenthin soils where the precipitation ranges to 14 inches
- Areas of Mellenthin soils that have a very channery or very flaggy, loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Mellenthin soil:
- Potential plant community—perennial grasses (such as Indian ricegrass, bottlebrush squirreltail, blue grama and galleta); shrubs (such as big sagebrush, Mexican cliffrose, and Nevada Mormontea); trees (such as Utah juniper).

Dominant vegetation on the Tanbark soil:
- Potential plant community—perennial grasses (such as Indian ricegrass and gyp dropseed); shrubs (such as Nevada Mormontea and rubber rabbitbrush).

Important forage species: Indian ricegrass, bottlebrush squirreltail, blue grama, galleta, and Nevada Mormon tea.
Major management factors: Depth to bedrock, droughtiness, and hazard of erosion on both soils and gypsum content of the Tanbark soils.
General management considerations on the Mellenthin and Tanbark soils:
- Steep slopes limit proper grazing distribution.
- Lack of permanent water makes proper grazing distribution difficult.
- If areas are overgrazed, erosion becomes more severe.

Suitable management practices on the Mellenthin and Tanbark soils:
- Develop permanent water to improve grazing distribution.
- Planned grazing systems will increase plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Mellenthin and Tanbark—7E
Range site: Mellenthin—Shallow Loamy 10-14" p.z.; Tanbark—Gypsum Hills 10-14" p.z.

49—Mellenthin-Tanbark complex, 5 to 50 percent slopes, dry

Setting

Landform: plateaus, mesas and hills
Landscape position: Mellenthin—summits and back slopes; Tanbark—back slopes
Flooding: none
Slope range: Mellenthin—5 to 35 percent; Tanbark—15 to 50 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Mellenthin—10 to 14 inches; Tanbark—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin and similar soils: 40 percent
Tanbark and similar soils: 35 percent
Contrasting inclusions: 25 percent

Typical Profile

Mellenthin

0 to 2 inches—dark brown very gravelly loam
2 to 6 inches—reddish brown, calcareous very gravelly loam
6 to 17 inches—reddish brown, calcareous very gravelly loam
17 inches—sandstone bedrock

Tanbark

0 to 1 inches—light reddish brown, gypsiferous loam
1 to 17 inches—light reddish brown and pinkish white, fine and medium gypsum crystals; sandy loam texture
17 to 20+ inches—light reddish brown and pinkish white gypsite

Soil Properties and Qualities

Mellenthin

Parent material: alluvial and colluvial deposits from limestone and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Tanbark

Parent material: alluvial, colluvial, and eolian material from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Bedrock; exposures of limestone, sandstone, and gypsite
- Deep and moderately deep, loamy soils that have 15 to 60 percent rock fragments on foot slopes
- Deep to shallow, loamy fluventic soils in drainages
- Shallow, loamy Bond soils over sandstone on summits

Similar inclusions:
- Areas where slopes exceed 50 percent
- Areas that have many surface cobbles
- Areas of Mellenthin soil where the precipitation ranges to 14 inches
- Areas of Mellenthin soils that have a very channery or very flaggy loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Mellenthin soil:
- Potential plant community—perennial grasses (such as Indian ricegrass, blue grama, and galleta); shrubs (such as big sagebrush, Mexican cliffrose, Nevada Mormontea, and fourwing saltbush); trees (such as Utah juniper).

Dominant vegetation on the Tanbark soil:
- Potential plant community—perennial grasses (such as Indian ricegrass and gyp dropseed); shrubs (such as Bigelow sagebrush, Nevada Mormontea, and rubber rabbitbrush).

Important forage species: Indian ricegrass, blue grama, galleta, and Nevada Mormontea.
Major management factors: Depth to bedrock, hazard of erosion, and droughtiness on both soils and gypsum content of the Tanbark soils.
General management considerations on the Mellenthin and Tanbark soils:

- Steep slopes limit proper grazing distribution.
- Lack of permanent water makes proper grazing distribution difficult.
- If areas are overgrazed, erosion becomes more severe.

Suitable management practices on the Mellenthin and Tanbark soils:

- Develop permanent water to improve grazing distribution.
- Planned grazing systems will increase plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.

General management considerations:

- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Mellenthin and Tanbark—7E
Range site: Mellenthin—Limy Upland 10-14" p.z.; Tanbark—Gypsum Hills 10-14" p.z.

50—Mellenthin-Tanbark complex, 5 to 50 percent slopes, warm

Setting

Landform: mesa remnants and hills
Landscape position: Mellenthin—summits and back slopes; Tanbark—back slopes and summits
Flooding: none
Slope range: Mellenthin—5 to 30 percent; Tanbark—25 to 50 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Mellenthin—10 to 14 inches; Tanbark—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin and similar soils: 45 percent
Tanbark and similar soils: 35 percent
Contrasting inclusions: 20 percent

Typical Profile

Mellenthin

0 to 3 inches—brown very gravelly fine sandy loam
3 to 8 inches—brown very gravelly loam
8 inches—extremely hard limestone bedrock

Tanbark

0 to 1 inches—pink, gypsiferous loam, 60 to 80 percent crystalline gypsum
1 to 10 inches—pinkish white gypsum, with some loamy materials; sandy loam texture
10 to 20+ inches—gypsite

Soil Properties and Qualities

Mellenthin

Parent material: alluvium and colluvium derived dominantly from limestone and sandstone
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Tanbark

Parent material: colluvium and alluvium from gypsiferous shales (mudstone, siltstone, and gypsite), limestone, and sandstone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe to very severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:

- Rock outcrop, exposures of limestone,

sandstone, and shales (mudstone, siltstone, and gypsite)
• Shallow and very shallow, loamy soils on summits
• Deep, loamy, calcareous soils on foot slopes
Similar inclusions:
• Areas of Mellenthin soil where the precipitation ranges to 14 inches
• Areas of Mellenthin soils that have a very channery or very flaggy loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Mellenthin soil:
• Potential plant community—perennial grasses (such as desert needlegrass); shrubs (such as blackbrush and Nevada Mormontea).
Dominant vegetation on the Tanbark soil:
• Potential plant community—perennial grasses (such as gyp dropseed); shrubs (such as blackbrush, Bigelow sagebrush, Nevada Mormontea, and cliffrose).
Important forage species: Desert needlegrass, cliffrose, Nevada Mormontea, and annuals.
Major management factors: Gypsum content and steep slopes on the Tanbark soils; hazard of erosion, droughtiness, and depth to bedrock in both soils.
General management considerations on the Mellenthin soils:
• Achieving proper grazing distribution is difficult because of the lack of permanent water supplies.
• Overgrazing depletes vegetative cover and increases the rate of erosion.
• Earthen water impoundments are limited by shallow depth.
Suitable management practices on the Mellenthin soils:
• Improve grazing distribution by developing and maintaining permanent water supplies and fences.
• Control erosion and promote forage production with proper utilization.
• Provide rest periods during the growing season to maintain plant vigor and growth.
General management considerations on the Tanbark soils:
• These soils are very fragile, and any activities such as stock trailing and vehicular traffic can result in serious losses from erosion.
• Because of unfavorable growing conditions on these soils, overgrazing will leave the ground bare and susceptible to erosion.
• The complex topography prevents proper grazing distribution.
• Earthen water impoundments are limited by seepage and piping problems.
Suitable management practices on the Tanbark soils:
• Light stocking rates can be used on the lower slopes.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Mellenthin—6E; Tanbark—7E
Range site: Mellenthin—Shallow Upland, Calcareous 10-14" p.z.;
Tanbark—Gypsum Hills, Calcareous 10-14" p.z.

51—Meriwhitica-Rock outcrop-Strych complex, 35 to 70 percent slopes

Setting

Landform: escarpments; cliffs and canyon walls
Landscape position: Meriwhitica—steps and benches; Strych—foot slopes; Rock outcrop—vertical and near vertical rock walls of canyons and cliffs
Flooding: none
Slope range: Meriwhitica and Strych—35 to 70 percent; Rock outcrop—vertical and near vertical
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Meriwhitica and Rock outcrop—10 to 14 inches; Strych—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Meriwhitica and similar soils: 40 percent
Rock outcrop and similar soils: 30 percent



Figure 8.—In the Shivwits area, the upper edges of most of the canyons leading down into the Grand Canyon are capped with eroding limestone, as pictured here at Mule Point on the north rim of the Parashant Canyon. The canyon walls are mapped Meriwhitica-Rock outcrop-Strych complex, 35 to 70 percent slopes.

Strych and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Meriwhitica

0 to 1 inch—light brown very gravelly loam
1 to 6 inches—light brown, calcareous very gravelly loam
6 inches—limestone bedrock

Rock outcrop

Hard to extremely hard sedimentary and igneous rock formations. Rock types include basalt, limestone, sandstone, gypsite, gypsiferous shale, and conglomerates (fig. 8).

Strych

0 to 2 inches—brown very gravelly loam
2 to 10 inches—brown very gravelly loam
10 to 60 inches—light brown, calcareous very gravelly loam

Soil Properties and Qualities

Meriwhitica

Parent material: colluvium from sedimentary formations
Depth class: very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 10 inches

Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Strych

Parent material: colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy, gypsic soils on steps and benches
- Moderately deep to deep, loamy soils on foot slopes
- Shallow to moderately deep, loamy, calcareous soils on back slopes and foot slopes

Similar inclusions:
- Areas of Strych soils where the precipitation ranges to 14 inches
- Areas of Meriwhitica soils that have a very flaggy fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Meriwhitica soils:
- Potential plant community—perennial grasses (such as Indian ricegrass, desert needlegrass, muttongrass, and blue grama); shrubs (such as Wyoming big sagebrush and Nevada Mormon tea); trees (such as Utah juniper and Colorado pinyon).

Dominant vegetation on the Strych soils:
- Potential plant community—perennial grasses (such as blue grama, galleta, and bottlebrush squirreltail); shrubs (such as big sagebrush and broom snakeweed).

Important forage species: Blue grama, bottlebrush squirreltail, galleta, Indian ricegrass, and Nevada Mormontea.
Major management factors: Steep slopes, droughtiness, and hazard of erosion on both soils; depth to bedrock in Meriwhitica soil.
General management considerations on the Meriwhitica and Strych soils:
- Typically steep slopes severely restrict use by livestock.
- Proper grazing distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes.
- Overgrazing lower slopes increases erosion.

Suitable management practices on the Meriwhitica and Strych soils:
- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tailed hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.
General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.

Interpretive Groups

Land capability classification: Meriwhitica and Strych—7E; Rock outcrop—8
Range site: Meriwhitica—Breaks, Calcareous 10-14" p.z.; Strych—Loamy Upland 10-14" p.z.; Rock outcrop—none

52—Meriwhitica-Rock outcrop-Strych complex, 35 to 70 percent slopes, warm

Setting

Landform: escarpments; cliffs and canyon walls
Landscape position: Meriwhitica—steps and benches; Strych—foot slopes; Rock outcrop—vertical and near-vertical rock walls of canyons and cliffs
Flooding: none
Slope range: Meriwhitica and Strych—35 to 70 percent; Rock outcrop—vertical and near vertical

Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Meriwhitica and Rock outcrop—10 to 14 inches; Strych—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Meriwhitica and similar soils: 40 percent
Rock outcrop and similar soils: 30 percent
Strych and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Meriwhitica

0 to 1 inch—light brown very gravelly loam
1 to 6 inches—light brown, calcareous very gravelly loam
6 inches—limestone bedrock

Rock outcrop

Hard to extremely hard sedimentary and igneous rock formations. Rock types include basalt, limestone, sandstone, gypsite, gypsiferous shale, and conglomerates.

Strych

0 to 2 inches—brown very gravelly loam
2 to 10 inches—brown very gravelly loam
10 to 60 inches—light brown, calcareous very gravelly loam

Soil Properties and Qualities

Meriwhitica

Parent material: colluvium from sedimentary formations
Depth class: very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 10 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Strych

Parent material: colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy, gypsic soils on steps and benches
- Moderately deep to deep, loamy soils on footslopes

Similar inclusions:
- Areas of Strych soils where the precipitation ranges to 14 inches
- Areas of Meriwhitica soils that have a very flaggy fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation of the Meriwhitica soils:
- Potential plant community—perennial grasses (such as needleandthread, desert needlegrass, and Indian ricegrass); shrubs (such as blackbrush and Nevada Mormontea); trees (such as Utah juniper and Colorado pinyon).

Dominant vegetation of the Strych soils:
- Potential plant community—perennial grasses (such as desert needlegrass); shrubs (such as blackbrush and Nevada Mormontea).

Important forage species: Desert needlegrass, Indian ricegrass, and Nevada Mormontea.
Major management factors: Steep slopes, droughtiness, very severe hazard of erosion in both soils; depth to bedrock in Meriwhitica soils.
General management considerations on the Meriwhitica and Strych soils:
- Typically steep slopes severely restrict use by livestock.
- Proper grazing distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes.
- Overgrazing lower slopes increases erosion.

Suitable management practices on the Meriwhitica and Strych soils:
- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tailed hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel,

gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.
General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.

Interpretive Groups

Land capability classification: Meriwhitica and Strych—7E; Rock outcrop—8
Range site: Meriwhitica—Breaks, Calcareous 10-14" p.z.; Rock outcrop—none; Strych—Loamy Upland, Calcareous 10-14" p.z.

53—Mespun complex, 2 to 10 percent slopes

Setting

Landform: wind reworked fan terraces
Landscape position: Mespun—somewhat stable dunes; Mespun, loamy fine sand substratum—interdune
Flooding: none
Slope range: Mespun—2 to 10 percent; Mespun, loamy fine sand substratum—2 to 5 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mespun fine sand and similar soils: 55 percent
Mespun loamy fine sand substratum and similar soils: 35 percent
Contrasting inclusions: 10 percent

Typical Profile

Mespun

0 to 6 inches—reddish yellow fine sand
6 to 60 inches—reddish yellow fine sand

Mespun, loamy fine sand substratum

0 to 2 inches—reddish yellow fine sand
2 to 34 inches—reddish brown loamy fine sand
34 to 54 inches—yellowish red sand
54 to 60 inches—yellowish red gravelly loamy sand

Soil Properties and Qualities

Mespun

Parent material: eolian
Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Mespun, loamy fine sand substratum

Parent material: eolian over mixed alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow, sandy soils over sandstone or mudstone occurring around Rock outcrops
- Moderately deep, sandy soils that have basalt rubble and gravel on the surface near foot slopes of adjacent volcanic hills
- Sandstone Rock outcrop

Similar inclusions:
- Deep, sandy soils over sandstone or mudstone
- Areas that have a surface texture of loamy fine sand, sand, and loamy sand

Use and Management

Rangeland

Dominant vegetation on the Mespun soil:
- Potential plant community—perennial grasses (such as sandhill muhly, Indian ricegrass, and sand dropseed); shrubs (such as sand sagebrush, big sagebrush, and Nevada Mormontea); trees (such as Utah juniper).

Dominant vegetation on the Mespun, loamy fine sand substratum soil:
• Potential plant community—perennial grasses (such as blue grama, needleandthread, sand dropseed, and Indian ricegrass); shrubs (such as big sagebrush, bitterbrush, and Nevada Mormontea); trees (such as Utah juniper).
Important forage species: Indian ricegrass, sand dropseed, and Nevada Mormontea.
Major management factors: Hazard of erosion, droughtiness, and seepage on both soils.
General management considerations on both soils:
• Low productivity and slow range recovery require special management.
• Overgrazing depletes vegetation and increases the hazard of erosion.
• Earthen water structures will have seepage problems.
Suitable management practices on both soils:
• Planned grazing systems are essential to maintain plant vigor and forage production.
• Fencing and deferred grazing are important in planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon; golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Both soils—7E
Range site: Mespun—Sandy Upland 10-14" p.z.; Mespun, loamy fine sand substratum—Sandy Loam Upland 10-14" p.z.

54—Moenkopie-Goblin complex, 5 to 50 percent slopes

Setting

Landform: Moenkopie—structural benches, plateaus, and mesas; Goblin—hills and escarpments
Landscape position: Moenkopie—summits and back slopes; Goblin—summits and back slopes
Flooding: none
Slope range: Moenkopie—5 to 30 percent; Goblin—25 to 50 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: Moenkopie—7 to 10 inches; Goblin—7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Moenkopie and similar soils: 40 percent
Goblin and similar soils: 35 percent
Contrasting inclusions: 25 percent

Typical Profile

Moenkopie

0 to 1 inch—brown channery fine sandy loam
1 to 8 inches—brown channery loam and loam
8 to 10 inches—pink, calcareous channery loam
10+ inches—extremely hard limestone bedrock

Goblin

0 to 1 inch—pink, gypsiferous gravelly fine sandy loam
1 to 10 inches—very pale brown, gypsiferous fine sandy loam
10 inches—rippable gypsite

Soil Properties and Qualities

Moenkopie

Parent material: formed in alluvium and eolian material from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Goblin

Parent material: colluvium and alluvium from gypsiferous shales (mudstone, siltstone, and gypsite), limestone and sandstone
Depth class: very shallow to shallow
Drainage class: well drained
Permeability: moderately rapid

Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Bedrock, exposures of limestone, sandstone, and gypsite
- Deep and moderately deep, loamy soils that have 15 to 60 percent rock fragments on back slopes and foot slopes
- Deep to shallow, loamy, fluventic soils in drainages
- Shallow, loamy soils over sandstone on summits

Similar inclusions:
- Areas where slopes exceed percentages given
- Areas that have many surface cobbles
- Areas of Goblin soils where the precipitation ranges to 11 inches

Use and Management

Rangeland

Dominant vegetation on the Moenkopie soil:
- Potential plant community—perennial grasses (such as Indian ricegrass, needleandthread, blue grama, and galleta); shrubs (such as winterfat, Nevada Mormontea, and fourwing saltbush).

Dominant vegetation on the Goblin soil:
- Potential plant community—perennial grasses (such as gyp dropseed and galleta); shrubs (such as Bigelow sagebrush, Nevada Mormontea, and fourwing saltbush).

Important forage species: Blue grama, Indian ricegrass, galleta, and fourwing saltbush.
Major management factors: Gypsum content and steep slopes on the Goblin soils; hazard of erosion, droughtiness, and depth to bedrock on both soils.
General management considerations on the Moenkopie soils:
- Achieving proper grazing distribution is difficult because of the lack of permanent water supplies.
- Overgrazing depletes vegetative cover and increases the rate of erosion.
- High competition for moisture from shrubby species makes desirable grasses slow to recover.

Suitable management practices on the Moenkopie soils:
- Improve grazing distribution by developing and maintaining permanent water supplies and fences.
- Control erosion and promote forage production with proper utilization.
- Provide rest periods during the growing season to maintain plant vigor and growth.

General management considerations on the Goblin soils:
- These soils are very fragile, and any activities such as stock trailing and vehicular traffic can result in serious losses from erosion.
- Because of unfavorable growing conditions on these soils, overgrazing will leave the ground bare and susceptible to erosion.
- The complex topography prevents proper grazing distribution.

Suitable management practices on the Goblin soils:
- Light stocking rates can be used on the lower slopes.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- When water is present this is the most important waterfowl and wading bird area in the survey area.
- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: Moenkopie and Goblin—7E
Range site: Moenkopie—Shallow Loamy 7-11" p.z.; Goblin—Gypsum Hills 7-11" p.z.

55—Moenkopie-Pennell-Rock outcrop complex, 10 to 50 percent slopes

Setting

Landform: plateaus and mesas
Landscape position: Moenkopie—summits; Pennell—summits and back slopes; Rock outcrop—all positions
Flooding: none
Slope range: Moenkopie and Pennell—10 to 30 percent; Rock outcrop—10 percent to vertical
Elevation: 4,000 to 5,000 feet

Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Moenkopie and similar soils: 30 percent
Pennell and similar soils: 25 percent
Rock outcrop and similar soils: 20 percent
Contrasting inclusions: 25 percent

Typical Profile

Moenkopie

0 to 1 inch—brown channery fine sandy loam
1 to 8 inches—brown loam
8 to 12 inches—pink, calcareous channery loam
12 inches—limestone bedrock

Pennell

0 to 5 inches—yellowish red, calcareous gravelly fine sandy loam
5 to 12 inches—light reddish brown, calcareous gravelly loam
12 inches—limestone bedrock

Rock outcrop

Hard limestone bedrock exposed to the surface and areas which may have a 1- to 4-inch thick layer of gravel, cobbles, and loamy materials over the bedrock.

Soil Properties and Qualities

Moenkopie

Parent material: alluvium and eolian materials from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: slow to moderate
Hazard of water erosion: slight to moderate
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Pennell

Parent material: mixed alluvium and eolian material from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow, loamy, gypsic Gypill soils on summits and back slopes
- Moderately deep, loamy, calcareous soils in swales

Similar inclusions:
- Soils that have more than 35 percent rock fragments
- Areas of Pennell soils where the precipitation ranges to 11 inches

Use and Management

Rangeland

Dominant vegetation on the Moenkopie and Pennell soils:
- Potential plant community—perennial grasses (such as Indian ricegrass and galleta); shrubs (such as fourwing saltbush and Nevada Mormontea).

Important forage species: Indian ricegrass, galleta, and fourwing saltbush.
Major management factors: Depth to bedrock, droughtiness, steepness of slope, and hazard of erosion on both soils.
General management considerations on the Moenkopie and Pennell soils:
- Complex slopes encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.
- Earthen water impoundments are limited because of shallow depth to bedrock.

Suitable management practices on the Moenkopie and Pennell soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.
- Constructing trails in steeply sloping areas increases access to livestock.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- When water is present this is the most important waterfowl and wading bird area in the survey area.
- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: Moenkopie and Pennell—7E; Rock outcrop—8
Range site: Moenkopie and Pennell—Shallow Loamy 7-11" p.z.; Rock outcrop—none

56—Nikey family-Ruesh family-Rock outcrop complex, 10 to 40 percent slopes

Setting

Landform: mesas
Landscape position: back slopes and foot slopes
Flooding: none
Slope range: Nikey family and Ruesh family—10 to 40 percent; Rock outcrop—20 percent to vertical
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Nikey family and similar soils: 35 percent.
Ruesh family and similar soils: 25 percent.
Rock outcrop: 25 percent
Contrasting inclusions: 15 percent

Reference Profile

Nikey family

Various; is usually moderately deep to very deep with a very cobbly, gravelly, or stony surface layer and sometimes throughout the profile. Textures range from a fine sandy loam to a clay loam. Calcium carbonate ranges from 10 to 35 percent. Gypsum content ranges from 0 to 5 percent in some subsurface horizons. Lithic or paralithic contact is basalt, gypsite, or gypsiferous mudstone.

One of the more common profiles of the Nikey family is:

0 to 2 inches—reddish brown very cobbly fine sandy loam
2 to 12 inches—reddish brown very cobbly loam
12 to 26 inches—yellowish red, calcareous gravelly loam
26 to 42 inches—yellowish red, calcareous gravelly sandy loam
42 to 50 inches—mudstone and shale

Ruesh family

Various; is usually moderately deep to deep over gypsiferous mudstone or gypsite. They usually have a very cobbly, gravelly, or stony surface layer and sometimes throughout the profile. Textures range from a fine sandy loam to a clay loam. Gypsum content ranges from 5 to 75 percent. Lithic or paralithic contact is gypsite or gypsiferous mudstone.

One of the more common profiles of the Ruesh family is:

0 to 2 inches—yellowish red very cobbly fine sandy loam
2 to 10 inches—yellowish red, gypsiferous cobbly fine sandy loam
10 to 19 inches—yellowish red, gypsiferous loam
19 to 28 inches—pink, gypsiferous loamy sand
28 to 40 inches—weathered, gypsiferous mudstone

Rock outcrop

Rock outcrop consists of exposed basalt, gypsite, gypsiferous mudstone or talus slopes of basalt rubble. Basalt is usually vertical exposures at the upper end of the escarpment capping the mesa above the escarpment.Gypsite and gypsiferous mudstone are exposed on the steep to very steep side slopes.Talus slopes consist of basalt cobble, stones, and boulders and have very little to no soil materials to sustain plant growth.

Soil Properties and Qualities

Nikey family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to very deep
Drainage class: well drained
Permeability: moderate to moderately rapid
Available water capacity: very low to low
Potential rooting depth: 30 to 60 inches
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Ruesh family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to deep
Drainage class: well drained
Permeability: moderately slow to moderately rapid
Available water capacity: very low to medium
Potential rooting depth: 20 to 60 inches
Runoff: rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, very gravelly loamy soils on foot slopes
- Shallow to moderately deep, very cobbly loamy soils on back slopes

Use and Management

Rangeland

Dominant vegetation on the Nikey family and Ruesh family soils:
- Potential plant community—perennial grasses (such as bush muhly and big galleta); shrubs (such as white ratany, white bursage, and Nevada Mormontea).

Important forage species: Bush muhly, big galleta, Nevada Mormontea, and annuals.
Major management factors: Gypsum content of the Ruesh family soils; depth to bedrock, steep slopes, droughtiness, and hazard of erosion in all the soils of this unit.
General management considerations on all the soils of this unit:
- Typically steep slopes restrict use by livestock.
- Proper distribution is often impossible to obtain.
- Heavy grazing occurs on the lower slopes of the unit.
- Overgrazing in these limited areas promotes erosion.

Suitable management practices on all the soils of this unit:
- Trails leading up the escarpment make the range at the top more accessible to the livestock.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Nikey family and Ruesh family—7E; Rock outcrop—8
Range site: Nikey family and Ruesh family—Basalt Slopes 6-9" p.z.; Rock outcrop—none

57—Nipton-Rock outcrop-Nickel family complex, 10 to 50 percent slopes

Setting

Landform: mountains
Landscape position: Nipton—colluvial back slopes; Rock outcrop—intermittently throughout; Nickel family—foot slopes
Flooding: none
Slope range: Nipton—25 to 50 percent; Rock outcrop—25 percent to vertical; Nickel family—10 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Nipton and similar soils: 45 percent
Rock outcrop and similar soils: 20 percent
Nickel family and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Nipton

0 to 2 inches—brown very gravelly coarse sandy loam
2 to 9 inches—brown very gravelly coarse sandy loam
9 inches—gneiss

Rock outcrop

Granite, gneiss, and schist dominate with inclusions of other metamorphic and intrusive igneous rocks.

Nickel family

Various; moderately deep to very deep, very stony, cobbly or gravelly throughout. Textures range from loamy sand to loam. Subsurface horizons are calcareous.

A common profile of Nickel family is:

0 to 1 inch—light yellowish brown very cobbly loam
1 to 8 inches—light yellowish brown, calcareous very gravelly loam
8 to 49 inches—very pale brown, calcareous very stony loam
49 inches—weathered gneiss

Soil Properties and Qualities

Nipton

Parent material: colluvium from igneous and metamorphic rocks
Depth class: very shallow to shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 14 inches
Runoff: rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Nickel family

Parent material: colluvium from igneous and metamorphic rocks
Depth class: moderately deep to very deep
Drainage class: well drained
Permeability: moderate to moderately rapid
Available water capacity: low
Potential rooting depth: 20 to 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy soils that have less than 35 percent rock fragments on toe slopes and valleys
- Deep and very deep, sandy soils that have 35 to 60 percent rock fragments on lower back slopes

Similar inclusions:
- Moderately deep to deep, calcareous loamy soils that have less than 35 percent rock fragments.
- Moderately deep to deep, loamy soils on slopes of less than 10 percent.

Use and Management

Rangeland

Dominant vegetation on the Nipton soil:
- Potential plant community—perennial grasses (such as bush muhly, desert needlegrass, black grama, and threeawn); shrubs (such as Nevada Mormontea, white ratany, and banana yucca).

Dominant vegetation on the Nickel family soil:
- Potential plant community—perennial grasses (such as big galleta); shrubs (such as Anderson wolfberry, creosotebush, and Nevada Mormontea).

Important forage species on the Nipton soil: bush muhly, desert needlegrass, black grama, and Nevada Mormontea.
Important forage species on the Nickel family soil: big galleta, Nevada Mormontea, and annuals.
Major management factors: Steep slopes, droughtiness, and erosion hazard on both soils, and depth to weathered bedrock on the Nipton soil.
General management considerations on the Nipton and Nickel family soils:
- Complex slopes and near vertical exposures of rock limit access to livestock.
- Heavy grazing occurs on the lower slopes.

Suitable management practices on the Nipton and Nickel family soils:
- Building trails in steeply sloping areas increases access to livestock.
- Development of permanent water supply is necessary for livestock to use the area.
- Planned grazing systems are essential for erosion control and maintaining plant vigor.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.

- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Nipton and Nickel family—7E; Rock outcrop—8
Range site: Nipton—Granitic Hills 9-12" p.z.; Rock outcrop—none;
Nickel family—Limy Upland 9-12" p.z.

58—Nutter-Gyppocket complex, 2 to 20 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Slope range: 2 to 20 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Nutter and similar soils: 40 percent
Gyppocket and similar soils: 40 percent
Contrasting inclusions: 20 percent

Typical Profile

Nutter

0 to 2 inches—light brown very gravelly loam
2 to 13 inches—light brown, calcareous very gravelly loam
13 to 23 inches—light brown, gypsiferous gravelly fine sandy loam
23 to 47 inches—pink and reddish yellow, gypsiferous very gravelly sandy loam and coarse sandy loam that has 35 to 65 percent gypsum
47 to 60 inches—pink, gypsiferous very gravelly loamy coarse sand that has 50 percent gypsum

Gyppocket

0 to 2 inches—pink very gravelly fine sandy loam
2 to 14 inches—pink, calcareous very gravelly sandy loam
14 to 49 inches—very pale brown and white, gypsiferous extremely gravelly loamy sand and loamy coarse sand that has 50 to 80 percent gypsum
49 to 59 inches—very pale brown, gypsiferous extremely cobbly loamy coarse sand that has 40 percent gypsum
59 to 60 inches—very pale brown, gypsiferous very gravelly coarse sand that has 15 percent gypsum

Soil Properties and Qualities

Nutter

Parent material: colluvium and alluvium from sedimentary formations
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Gyppocket

Parent material: colluvium and alluvium from sedimentary formations
Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep and deep, loamy, very gravelly or cobbly, calcareous soils on summits and back slopes
- Moderately deep and deep, loamy, very gravelly or cobbly soils that have moderate amounts of gypsum and carbonates throughout on summits and back slopes

Similar inclusions:
- Areas Gyppocket soils that have a common flooding hazard
- Areas of Nutter soils that have a very gravelly fine sandy loam or very gravelly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Nutter and Gyppocket soils:

• Potential plant community—perennial grasses (such as gyp dropseed, black grama, and galleta); shrubs (such as fourwing saltbush and Nevada Mormontea).
Important forage species: Blue grama, galleta, and black grama.
Major management factors: Slope, gypsum content, and droughtiness on both soils.
General management considerations on the Nutter and Gyppocket soils:
• Complex slopes encourage overgrazing of lower slopes.
• Steep-sided gullies limiting access by livestock occur on upper slopes.
• Drainageways can provide shelter, forage, and water, which encourages overgrazing and increases erosion hazard.
• Forage is limited by the high gypsum content and droughtiness.
Suitable management practices on the Nutter and Gyppocket soils:
• Planned grazing systems help control erosion and increase plant vigor and variety.
• Constructing trails in steeply sloping areas increases access to livestock.
• Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• When water is present this is the most important waterfowl and wading bird area in the survey area.
• Provides important foraging and lambing habitat for pronghorn antelope.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Erosion control.

Interpretive Groups

Land capability classification: Nutter and Gyppocket—7S
Range site: Nutter and Gyppocket—Gypsum Upland 7-11" p.z.

59—Padilla silt loam, 1 to 5 percent slopes

Setting

Landform: fan terraces
Landscape position: summits
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Padilla variant and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 1 inch—reddish brown silt loam
1 to 5 inches—reddish brown clay loam
5 to 40 inches—reddish brown clay
40 to 60 inches—reddish brown, calcareous clay

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: medium
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep and very deep, loamy Barx soils on small rises
• Deep and very deep, loamy, calcareous soils on back slopes
• Deep and very deep, loamy, fluventic soils along drainages
Similar inclusions:
• Areas that have a silty clay loam or clay loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such

as bottlebrush squirreltail, blue grama, and western wheatgrass); shrubs (such as big sagebrush and fourwing saltbush).
Important forage species: Blue grama, bottlebrush squirreltail, western wheatgrass, and fourwing saltbush.
Major management factors: Slow permeability and high shrink-swell potential.
General management considerations:
• Good accessibility and a good variety of palatable plants encourage a constant grazing pressure.
• Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.
• Grazing should be delayed until the soil has dried sufficiently to withstand trampling and prevent compaction.
Suitable management practices:
• Forage production may be increased with the use of spreader dikes and concentrated grazing for short periods followed by rest.
• Planned grazing systems help control erosion and increase plant vigor and variety.
• Brush management and reseeding may be suitable treatment in some areas.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: 6S
Range site: Clay Loam Upland 10-14" p.z.

60—Pocum-Childers-Ubank complex, 1 to 10 percent slopes

Setting

Landform: mesas
Landscape position: summits
Flooding: none
Slope range: 1 to 10 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Pocum and similar soils: 35 percent
Childers and similar soils: 25 percent
Ubank and similar soils: 15 percent
Contrasting inclusions: 25 percent

Typical Profile

Pocum

0 to 1 inches—light brown gravelly fine sandy loam
1 to 13 inches—light brown, calcareous gravelly loam
13 to 22 inches—lime-cemented, indurated pan
22 to 42 inches—pinkish white, weakly lime-cemented gravelly loam
42 inches—basalt bedrock

Childers

0 to 2 inches—brown very cobbly fine sandy loam
2 to 18 inches—light brown, calcareous very cobbly loam
18 to 21 inches—lime-cemented, indurated hardpan
21 to 30 inches—white and pink, strongly lime-cemented hardpan
30 inches—basalt bedrock

Ubank

0 to 2 inches—light reddish brown gravelly fine sandy loam
2 to 16 inches—light reddish brown loam
16 to 60 inches—pink and pinkish white, weakly to strongly lime-cemented gravelly loam

Soil Properties and Qualities

Pocum

Parent material: mixed alluvium and colluvium from volcanic rocks
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Childers

Parent material: mixed alluvium
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Ubank

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Shallow, loamy Pennell soils over bedrock on summits
- Deep, loamy, calcareous Strych soils on foot slopes

Similar inclusions:
- Moderately deep soils similar to Pocum and Childers soils
- Deep soils similar to Ubank soil that have an argillic horizon above the calcic horizon.

Use and Management

Rangeland

Dominant vegetation on the Pocum and Childers soils:
- Potential plant community—perennial grasses (such as galleta, Indian ricegrass, and bottlebrush squirreltail); shrubs (such as blackbrush, banana yucca, and Nevada Mormontea); trees (such as Utah juniper and singleleaf pinyon).

Dominant vegetation on the Ubank soil:
- Potential plant community—perennial grasses (such as galleta and blue grama); shrubs (such as blackbrush and Nevada Mormontea); trees (such as Utah juniper).

Important forage species: Galleta, Indian ricegrass, bottlebrush squirreltail, and annuals.
Major management factors: Droughtiness of all three soils and depth to pan on the Pocum and Childers soils.
General management considerations on all three soils:
- High lime content and low available water capacity contribute to low production of forage on this unit.
- Areas that are heavily infested with undesirable plants can be improved by mechanical treatments.

Suitable management practices on all three soils:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.
- Brush management and range seeding can be used to restore productivity.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Pocum, Childers, and Ubank—6S
Range site: Pocum, Childers, and Ubank—Shallow Upland, Calcareous 10-14" p.z.

61—Pocum-Spenlo complex, 1 to 10 percent slopes

Setting

Landform: mesas
Landscape position: summits
Flooding: none
Slope range: Pocum—1 to 10 percent; Spenlo—1 to 3 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: Pocum—10 to 14 inches; Spenlo—10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Pocum and similar soils: 65 percent
Spenlo and similar soils: 20 percent
Contrasting inclusions: 15 percent

Typical Profile

Pocum

0 to 2 inches—brown gravelly fine sandy loam
2 to 14 inches—brown, slightly calcareous gravelly loam
14 to 18 inches—indurated, lime-cemented hardpan
18 to 22 inches—pinkish white and pinkish gray, weakly lime-cemented gravelly loam
22 to 48 inches—indurated, lime-cemented hardpan alternating with weakly lime-cemented and indurated layers every foot or two
48 inches—basalt bedrock

Spenlo

0 to 6 inches—reddish brown loam
6 to 21 inches—reddish brown clay loam
21 to 60 inches—reddish brown, slightly calcareous clay loam

Soil Properties and Qualities

Pocum

Parent material: mixed alluvium and colluvium from volcanic rocks
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Spenlo

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Moderately deep, loamy soils that have 15 to 40 percent rock fragments in swales
- Shallow to moderately deep, loamy soils over bedrock on summits

Similar inclusions:
- Deep and very deep clayey soils
- Shallow soils that have 35 to 60 percent rock fragments over bedrock or a lime-cemented pan
- Areas of Spenlo soils where the precipitation ranges to 14 inches
- Areas of Spenlo soils that have calcium carbonate at depths of 21 to 35 inches

Use and Management

Rangeland

Dominant vegetation on the Pocum soils:
- Potential plant community—perennial grasses (such as bottlebrush squirreltail, Indian ricegrass, galleta, and blue grama); shrubs (such as big sagebrush, Nevada Mormontea, and rabbitbrush); trees (such as Utah juniper and singleleaf pinyon).

Dominant vegetation on the Spenlo soil:
- Potential plant community—perennial grasses (such as galleta, Indian ricegrass, and blue grama); shrubs (such as big sagebrush and fourwing saltbush).

Important forage species: Galleta, blue grama, Indian ricegrass, and fourwing saltbush.
Major management factors: Droughtiness and depth to pan for the Pocum soils, and hazard of erosion on both soils.
General management considerations on the Pocum soil:
- High lime content and low available water capacity contribute to the low production of forage on these soils.

Suitable management practices on the Pocum soil:
- Planned grazing systems help control erosion and increase plant vigor and variety.

General management considerations on the Spenlo soil:
- This soil tends to be overgrazed by livestock because of the proximity to water.
- If the shrubs are managed to create open areas, this soil produces a good stand of desirable grasses and forbs.

Suitable management practices on the Spenlo soil:
- This soil is suited to the construction of livestock impoundments.

• Livestock grazing should be managed to protect the soil from excessive erosion.
• Brush management, fencing, planned grazing systems, range seeding, and developing livestock watering facilities.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Pocum—6S; Spenlo—6C
Range site: Pocum—Basalt Upland 10-14" p.z.; Spenlo—Loamy Upland 10-14" p.z.

62—Pompeii family-Huevi complex, 2 to 15 percent slopes

Setting

Landform: fan terraces
Landscape position: Pompeii family—summits and shoulders; Huevi—back slopes
Flooding: none
Slope range: Pompeii family—2 to 7 percent; Huevi—5 to 15 percent
Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 72 to 78 degrees F
Frost-free period: 240 to 320 days

Composition

Pompeii family and similar soils: 45 percent
Huevi and similar soils: 30 percent
Contrasting inclusions: 25 percent

Typical Profile

Pompeii family

0 to 2 inches—light brown very gravelly sandy loam
2 to 6 inches—light brown, calcareous very gravelly sandy clay loam
6 to 9 inches—pink, calcareous very gravelly clay loam
9 to 60 inches—indurated, lime-cemented hardpan

Huevi

0 to 8 inches—reddish yellow very gravelly sandy loam
8 to 19 inches—pink, calcareous extremely gravelly coarse sandy loam
19 to 28 inches—pink, calcareous very gravelly loamy coarse sand
28 to 44 inches—pink, calcareous extremely gravelly sandy loam
44 to 60 inches—pink, weakly to strongly silica- and lime-cemented extremely gravelly loamy coarse sand

Soil Properties and Qualities

Pompeii family

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Huevi

Parent material: mixed alluvium and colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Riverwash, stratified sand-gravel-cobble in drainage channels
• Deep, very gravelly sandy soils along drainages

• Badland exposed on back slopes
Similar inclusions:
• Areas of Huevi soils that have a very gravelly loamy coarse sand surface texture

Use and Management

Rangeland

Dominant vegetation on the Pompeii family soils:
• Potential plant community—perennial grasses (such as bush muhly); shrubs (such as creosotebush, brittlebush, triangle bursage, and white bursage).
Dominant vegetation on the Pompeii family and Huevi soils:
• Potential plant community—perennial grasses (such as bush muhly); shrubs (such as creosotebush and white bursage).
Important forage species: Bush muhly and annuals.
Major management factors: Depth to pan on the Pompeii family soil, droughtiness on both soils.
General management considerations on the Pompeii family and Huevi soils:
• Winter and spring annuals provide the majority of the grazeable forage.
• These soils are easily traversed by livestock.
Suitable management practices on the Pompeii family and Huevi soils:
• Planned grazing systems are essential to maintain plant and forage production.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Provides important foraging habitat for raptors.
• Proposed critical habitat for desert tortoise.
• Important chuckwalla habitat.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.
• Control off-road vehicle use.

Interpretive Groups

Land capability classification: Pompeii family and Huevi—7S
Range site: Pompeii family—Limy Upland 3-6" p.z.; Huevi—Limy Upland, Deep 3-6" p.z.

63—Radnik loam, 1 to 5 percent slopes

Setting

Landform: flood plains
Flooding: occasional
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Frost-free period: 150 to 165 days

Composition

Radnik and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 3 inches—reddish yellow loam
3 to 60 inches—reddish yellow and light brown, stratified loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep and very deep loamy soils that have more than 15 percent rock fragments in drainages and on slopes greater than 5 percent
• Moderately deep and deep loamy soils on slopes greater then 5 percent
Similar inclusions:
• Very deep soils that have more than 18 percent clay
• Very deep soils that have less than 5 percent clay

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as galleta, western wheatgrass, blue grama, and Indian ricegrass); shrubs (such as big sagebrush and fourwing saltbush).

Important forage species: Western wheatgrass, galleta, blue grama, Indian ricegrass, and fourwing saltbush.
Major management factors: Flooding and moderate hazard of wind erosion.
General management considerations:
- This soil receives moisture from adjacent slopes.
- This unit is susceptible to overgrazing because of the availability of forage and water.
- Overgrazing depletes plant cover and increases the hazard of erosion.

Suitable management practices:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.
- Brush management should be used when unpalatable species have increased significantly.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: 6W
Range site: Loamy Bottom 10-14" p.z.

64—Riverwash-Torrifluvents complex, 1 to 3 percent slopes

Setting

Landform: Riverwash—stream channels; Torrifluvents—flood plains
Flooding: Riverwash—common, brief to very long; Torrifluvents—common, very brief
Slope range: 1 to 3 percent
Elevation: 1,500 to 5,000 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 53 to 72 degrees F
Frost-free period: 150 to 240 days

Composition

Riverwash and similar soils: 50 percent.
Torrifluvents and similar soils: 30 percent.
Contrasting inclusions: 20 percent

Typical Profile

Riverwash

Various; can be shallow to very deep stratified cobble, gravel, sand, and fines. Stones may occur when adjacent to steep cliffs and canyon walls.

Torrifluvents

Various; can be moderately deep to very deep, stratified gravel, sand, and fines. One of the more common profiles of Torrifluvents is:
0 to 40 inches—light brown, stratified sand, gravel, and loamy fine sand
40 inches—hard sandstone bedrock

Soil Properties and Qualities

Riverwash

Parent material: mixed alluvium
Depth class: shallow to very deep
Drainage class: excessively to very poorly drained
Permeability: slow to very rapid
Available water capacity: very low to high
Potential rooting depth: 10 to 60 inches or more
Runoff: very rapid
Hazard of water erosion: moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Torrifluvents

Parent material: mixed alluvium
Depth class: moderately deep to very deep
Drainage class: excessively to poorly drained
Permeability: rapid
Available water capacity: very low
Potential rooting depth: 20 to 60 inches or more
Runoff: medium to very rapid
Hazard of water erosion: severe
Hazard of wind erosion: slight to high
Shrink-swell potential: low to high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Shallow to deep, sandy to loamy soils that have rare flooding

Use and Management

Rangeland

Dominant vegetation on the Riverwash miscellaneous land type:
Potential plant community—dominantly no vegetation, but will occasionally produce annual grasses and herbs.
Dominant vegetation on the Torrifluvents soil:
Potential plant community—perennial grasses (such as bush muhly and big galleta); shrubs (such as catclaw acacia and creosotebush).
Important forage species: Bush muhly and big galleta.
Major management factors: Flooding and erosion hazard.
General management considerations on the Torrifluvents soils:
- This unit receives runoff from adjacent slopes.
- Livestock generally overgrazed this unit because of availability of water, ease of access, and abundance of forage.
- Overgrazing depletes vegetative cover and increases the hazard of erosion.

Suitable management practices on the Torrifluvents soils:
- Prevent overgrazing by fencing and controlling water availability.
- Provide rest periods during the growing season to maintain plant vigor and production.
- Control erosion and promote forage production with proper utilization.

Wildlife Habitat

Wildlife on these soils include black hawk, willow flycatcher, Gambel's quail, ferruginous hawk, mourning dove, golden eagle, beaver, water shrew, muskrat, ringtail, bobcat, kit fox, badger, desert tortoise, Gila monster, chuckwalla, sidewinder, Mojave rattlesnake, spadefoot toad, tiger salamander, and leopard frog.
General management considerations:
- Supports a narrow band of riparian vegetation providing seasonal habitat for mule deer and an important migration corridor for neotropical migratory birds.

Suitable management practices:
- Proper grazing use of vegetation to provide streambank stability and forage for wildlife.

Interpretive Groups

Land capability classification: Riverwash—8; Torrifluvents—7W
Range site: Riverwash—None; Torrifluvents—Sandy Wash 9-12" p.z.

65—Rizno-Bond-Rock outcrop complex, 4 to 25 percent slopes

Setting

Landform: plateau
Landscape position: Rizno—summits and back slopes; Bond—summits; Rock outcrop—intermittent throughout
Flooding: none
Slope range: Rizno—4 to 25 percent; Bond—4 to 12 percent; Rock outcrop—4 to 50 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Rizno and similar soils: 45 percent
Bond and similar soils: 20 percent
Rock outcrop and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Rizno

0 to 1 inch—reddish brown very channery sandy loam
1 to 6 inches—reddish brown and light reddish brown channery sandy loam and loam
6 inches—sandstone bedrock

Bond

0 to 1 inch—brown gravelly sandy loam
1 to 13 inches—reddish brown sandy clay loam
13 inches—sandstone bedrock

Rock outcrop

Gently sloping to vertical exposures of calcareous sandstone of the Supai formation.

Soil Properties and Qualities

Rizno

Parent material: mixed alluvium and eolian deposits from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low

Corrosivity: concrete—low; uncoated steel—high

Bond

Parent material: alluvium and eolian deposits from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight;
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, loamy soils on summits and back slopes
- Shallow to moderately deep, loamy, calcareous soils on summits and back slopes
- Moderately deep to deep, loamy soils in swales

Similar inclusions:
- Areas of Bond soils that have a sandy loam or loam surface texture
- Areas of Rizno soils that have a flaggy or very flaggy, sandy loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Rizno and Bond soils:
- Potential plant community—perennial grasses (such as sand dropseed and galleta); shrubs (such as blackbrush, Mexican cliffrose, and Nevada Mormontea).

Important forage species: Galleta, sand dropseed, and Nevada Mormontea.
Major management factors: Shallow depths, droughtiness, and hazard of erosion on the Rizno and Bond soils, and steep to vertical exposures of bedrock.
General management considerations on the Rizno and Bond soils:
- Vertical exposures of rock and steep-sided drainageways limit access to livestock.
- Densely populated blackbrush inhibits grazeable forage.

Suitable management practices on the Rizno and Bond soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Constructing trails in steeply sloping areas increases access to livestock.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Rizno—6S; Bond—6E; Rock outcrop—8
Range site: Rizno and Bond—Shallow Sandy Loam, Calcareous 10-14" p.z.; Rock outcrop—none

66—Robroost fine sandy loam, 1 to 3 percent slopes

Setting

Landform: fan terraces
Landscape position: summits
Flooding: none
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Robroost and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—reddish yellow fine sandy loam
2 to 8 inches—reddish yellow loam
8 to 55 inches—pink to reddish yellow strata ranging from sandy loam to loam with varying amounts of gypsum
55 to 60 inches—pink, gypsiferous gravelly loamy sand



Figure 9.—Areas of gypsic soils are highly susceptible to erosion. This 6- to 7-foot deep gully is cut into an area of Robroost fine sandy loam, 1 to 3 percent slopes, near Bundyville, Arizona.

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:

- Deep, gypsic, loamy, fluventic soils along drainages
- Deep, gypsic, gravelly and very gravelly loamy soils on back slopes

Similar inclusions:

- Soils that have 15 to 35 percent gravel on the surface
- Areas where the precipitation ranges to 11 inches
- Areas that have a sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:

- Potential plant community—perennial grasses (such as Indian ricegrass, galleta, and gyp dropseed); shrubs (such as winterfat and fourwing).

Important forage species: Galleta, Indian ricegrass, winterfat, and fourwing saltbush.
Major management factors: Droughtiness, gypsum content, and hazard of erosion (fig. 9).
General management considerations:
• Overgrazing depletes vegetation and increases the hazard of erosion.
• Range recovery is very slow.
Suitable management practices:
• Light stocking rates should be used to control erosion and promote forage production.
• Improve grazing distribution by providing and maintaining permanent water supplies.
• Provide rest periods during the growing season to maintain plant vigor and production.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• When water is present this is the most important waterfowl and wading bird area in the survey area.
• Provides important foraging and lambing habitat for pronghorn antelope.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Erosion control.

Interpretive Groups

Land capability classification: 7E
Range site: Gypsum Fan 7-11" p.z.

67—Ruesh very gravelly fine sandy loam, 3 to 20 percent slopes

Setting

Landform: fan terraces
Landscape position: summits
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Ruesh and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—reddish yellow very gravelly fine sandy loam
2 to 12 inches—reddish yellow, calcareous loam
12 to 29 inches—white and pink, gypsiferous sandy loam that has 40 to 80 percent crystalline gypsum as sand-size particles
29 to 32 inches—white crystalline gypsum
32 to 40 inches—pink, gypsiferous sandy loam that has 50 percent crystalline gypsum
40 to 60 inches—white and pink very cobbly sandy loam that has 80 percent gypsum

Soil Properties and Qualities

Parent material: mixed alluvium and colluvium from sedimentary formations high in gypsum
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep, loamy, calcareous, Grapevine soils in swales
• Deep and moderately deep, loamy, fluventic soils along drainages
Similar inclusions:
• Areas of soils that have less than 40 percent calcium carbonate equivalent plus gypsum
• Areas of soils that are less than 60 inches deep over gypsiferous mudstone
• Areas of soils that have a gravelly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as big galleta and gyp dropseed); shrubs (such as winterfat, creosotebush, Nevada Mormontea, and white bursage).
Important forage species: Big galleta, Nevada Mormontea, and annuals (fig. 10).
Major management factors: Droughtiness and gypsum content.
General management considerations:



Figure 10.—Gypsic soils are not good forage producers. This area of Ruesh very gravelly fine sandy loam shows a high percentage of non-usable plants.

- Overgrazing depletes vegetation and increases the hazard of erosion.
- Range recovery is very slow.
- Production of vegetation for livestock forage is limited.

Suitable management practices:

- Light stocking rates should be used to control erosion and promote forage production.
- Improve grazing distribution by providing and maintaining permanent water supplies.
- Provide rest periods during the growing season to maintain plant vigor and production.
- Planned grazing systems are essential in proper grazing management.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:

- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7S
Range site: Gypsum Fan 7-11" p.z.

68—Sedillo very cobbly loam, 1 to 8 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and shoulders
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 135 to 150 days

Composition

Sedillo and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—light reddish brown very cobbly loam
2 to 18 inches—light reddish brown and reddish brown very cobbly clay loam
18 to 55 inches—reddish brown and reddish yellow, calcareous very cobbly clay loam
55 to 60 inches—pink, calcareous, gypsiferous cobbly loam

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary and volcanic formations
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep to deep, very cobbly or stony loamy soils in and along drainage channels
- Deep and very deep, very cobbly or stony clayey soils in swales

Similar inclusions:
- Areas that have very stony surfaces
- Areas that have less than 35 percent rock fragments in the upper 20 inches
- Areas that have a loam surface texture

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as Indian ricegrass, western wheatgrass, blue grama, and galleta); shrubs (such as Wyoming big sagebrush and fourwing saltbush); trees (such as Utah juniper and singleleaf pinyon).

Important forage species: Sideoats grama, blue grama, galleta, western wheatgrass, and fourwing saltbush.
Major management factors: The presence of stones and cobbles on the surface and throughout the soil profile.
General management considerations:
- Stones, cobbles, and straight-sided, deep water drainage channels limit movement of livestock.
- Stone and cobble content of the soil makes it difficult to build earthen water structures.
- Earthen water structures that expose the gypsic soil material will have seepage and piping problems.
- Responds well to proper management.

Suitable management practices:
- Build trails for livestock on steep-sided water channels.
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Brush management improves deteriorated areas of range that are producing more woody shrubs than are present in the potential plant community.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, and coachwhip.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: 6S
Range site: Clay Loam Upland 10-14" p.z.

69—Showlow-Thunderbird complex, 2 to 25 percent slopes

Setting

Landform: mesas
Landscape position: summits and back slopes
Flooding: none
Slope range: Showlow—2 to 25 percent; Thunderbird—2 to 25 percent

Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Showlow and similar soils: 65 percent
Thunderbird and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Showlow

0 to 2 inches—dark reddish gray very cobbly clay loam
2 to 23 inches—dark reddish gray clay
23 to 41 inches—yellowish red stony clay
41 to 60 inches—yellowish red very cobbly clay

Thunderbird

0 to 2 inches—dark brown very cobbly clay loam
2 to 29 inches—dark brown clay
29 to 34 inches—reddish brown, calcareous gravelly clay and gravelly clay loam
34 inches—basalt bedrock

Soil Properties and Qualities

Showlow

Parent material: alluvium and colluvium from volcanic rocks
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Thunderbird

Parent material: alluvium and colluvium from basalt
Depth class: moderately deep
Drainage class: well drained
Permeability: very slow
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop capping mesas and exposed on upper edge of escarpments
- Deep and very deep, clayey Albers soils on foot slopes

Similar inclusions:
- Areas of stony and bouldery surfaces on the Showlow and Thunderbird soils
- Areas of Showlow and Thunderbird soils that have a very cobbly loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Showlow and Thunderbird soils:
- Potential plant community—perennial grasses (such as bottlebrush squirreltail, blue grama, Indian ricegrass, and muttongrass); shrubs (such as big sagebrush and Nevada Mormontea); trees (such as Utah juniper and Colorado pinyon).

Important forage species: Bottlebrush squirreltail, blue grama, galleta, muttongrass, and Indian ricegrass.
Major management factors: Slope and depth to bedrock on Thunderbird soils; slow to very slow permeability and high shrink-swell potential on both soils.
General management considerations on the Showlow and Thunderbird soils:
- Complex slopes and vertical exposures of rock limit access to livestock in some areas and encourage overgrazing of less sloping areas.
- Overgrazing depletes vegetative cover, increases erosion, and allows undesirable plants to increase.
- If managed for firewood production, care should be taken to keep trails and roads to a minimum.

Suitable management practices on the Showlow and Thunderbird soils:
- Brush management and reseeding may be suitable treatment in some areas.
- Planned grazing systems help increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Fuelwood Production

- The Showlow and Thunderbird soils can produce about 6 cords of fuelwood per acre.

General management considerations on the Showlow and Thunderbird soils:

• Reduce risk of erosion by proper installation and maintenance of access roads.

Wildlife Habitat

Wildlife on these soils include piniyon jay, Steller's jay, western bluebird, common flicker, common raven, dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, rock squirrel, piniyon mouse, deer mouse, cougar, northern whiptail lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:

• Supports a plant community of pinyon-juniper woodland with an understory of perennial grasses, forbs, and shrubs.

• Provides important habitat for mule deer.

Suitable management practices:

• Proper grazing use of vegetation to provide forage for wildlife.

• Develop water for wildlife.

Interpretive Groups

Land capability classification: Showlow and Thunderbird—6S

Range site: Showlow and Thunderbird—Clay Loam Upland, Gravelly (PIED, JUOS) 13-17" p.z.

70—Showlow very cobbly clay loam, 1 to 15 percent slopes

Setting

Landform: hills
Landscape position: back slopes
Flooding: none
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 135 to 150 days

Composition

Showlow and similar soils: 75 percent
Contrasting inclusions: 25 percent

Typical Profile

Rock fragments on surface: 25 percent cobble and 30 percent gravel
0 to 3 inches—brown very cobbly clay loam
3 to 42 inches—brown silty clay
42 to 60 inches—reddish brown and pink very gravelly clay loam

Soil Properties and Qualities

Parent material: alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:

• Moderately deep and deep, very cobbly clayey soils on back slopes

• Moderately deep and deep, very cobbly loamy soils that have moderate amounts of gypsum in the subsoil on back slopes

• Rock outcrop

Similar inclusions:

• Areas that have slopes greater than 15 percent

• Areas with less than 35 percent rock fragments on the surface

Use and Management

Rangeland

Dominant vegetation:

• Potential plant community—perennial grasses (such as western wheatgrass, bottlebrush squirreltail, blue grama, and sideoats grama); shrubs (such as big sagebrush, fourwing saltbush, and broom snakeweed); trees (such as Utah juniper and Gambel oak).

Important forage species: Western wheatgrass, blue grama, sideoats grama, galleta, and fourwing saltbush.

Major management factors: Slow permeability and high shrink-swell.

General management considerations:

• Good accessibility and a variety of palatable plants encourage a constant grazing pressure during the growing season.

• If this unit is managed for fuelwood production, care should be taken to keep trails and roads to a minimum.

• Reduce risk of erosion by proper installation and maintenance of access roads.

Suitable management practices:

• Proper woodland grazing.

• Fencing will help distribute livestock grazing and limit overgrazing.

Fuelwood Production

• This unit can produce about 4 to 6 cords of fuelwood per acre.

General management considerations:

• Reduce risk of erosion by proper installation and maintenance of access roads.
• Motorized vehicles easily become stuck in this soil when it is moist.

Wildlife Habitat

Wildlife on these soils include golden eagle, road runner, dark-eyed junco, turkey vulture, western kingbird, pinyon jay, rock wren, kangaroo rat, woodrat, rock squirrel, gray fox, mule deer, pronghorn antelope, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.
General management considerations:
• Supports a plant community of scattered trees that has an understory of perennial grasses, forbs, and shrubs.
• Area provides escape cover for pronghorn antelope and mule deer.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Develop water for wildlife.

Interpretive Groups

Land capability classification: 6S
Range site: Clay Loam Upland, Gravelly (PIED, JUOS) 13-17" p.z.

71—Sponiker loam, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: summits
Flooding: none
Elevation: 5,800 to 8,000 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 135 days

Composition

Sponiker and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

1 inch thick surface coverage of pine needles
0 to 3 inches—dark brown loam
3 to 8 inches—dark brown clay loam
8 to 60 inches—dark brown and reddish brown clay

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Shallow to moderately deep, loamy soils on rises
• Rock outcrop
• Moderately deep to deep, clayey soils on summits
Similar inclusions:
• Areas that have a clay loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as prairie junegrass, blue grama, and bottlebrush squirreltail); shrubs (such as big sagebrush and Gambel oak); trees (such as Ponderosa pine and Colorado pinyon).
Important forage species: Prairie junegrass, blue grama, and bottlebrush squirreltail.
Major management factors: Slow permeability and high shrink-swell potential.
General management considerations:
• If managed for timber or firewood, care should be taken to keep trails and roads to a minimum.
• Motorized vehicles are easily stuck in this soil when it is moist.
• Good accessibility and good variety of palatable plants encourage a constant grazing pressure during the growing season.
Suitable management practices:
• Thinning of trees increases forage, creates open areas for wildlife and livestock, and enhances wood production.
• Planned grazing systems increase plant vigor and variety.

Woodland

• With a site index of 65, this soil can produce about 276 board feet per acre of ponderosa pine lumber.

Wildlife Habitat

Wildlife on these soils include Steller's jay, common flicker, western tanager, white-breasted nuthatch, northern goshawk, screech owl, Cooper's hawk, wild turkey, red crossbill, western bluebird, mule deer,

coyote, Abert squirrel, black bear, porcupine, deer mouse, cougar, short-horned lizard, gopher snake, and great basin rattlesnake.
General management considerations:
- Supports a diverse plant community of conifers with an understory of perennial grasses, forbs, and shrubs.
- Provides important habitat for cavity-nesting birds.

Suitable management practices:
- Preserve snags for cavity-nesting birds
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns

Interpretive Groups

Land capability classification: 6C
Range site: Loamy Terrace (PIPO) 17-25" p.z.

72—Springerville-Delenbaw complex, 3 to 25 percent slopes

Setting

Landform: mesas
Landscape position: Springerville—summits; Delenbaw—back slopes and foot slopes
Flooding: none
Slope range: Springerville—3 to 10 percent; Delenbaw—3 to 25 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Springerville and similar soils: 55 percent
Delenbaw and similar soils: 25 percent
Contrasting inclusions: 20 percent

Typical Profile

Springerville

0 to 1 inches—dark reddish brown very cobbly clay loam
1 to 9 inches—dark reddish gray clay loam
9 to 27 inches—dark reddish gray clay
27 to 32 inches—reddish brown, calcareous gravelly clay loam
32 to 42 inches—yellowish red, calcareous gravelly clay loam
42 inches—basalt bedrock

Delenbaw

0 to 2 inches—dark reddish gray very cobbly loam
2 to 10 inches—dark reddish gray very cobbly clay loam
10 to 30 inches—reddish brown very cobbly clay
30 to 36 inches—reddish brown gravelly clay
36 to 52 inches—reddish yellow and reddish brown very cobbly clay loam
52 to 61 inches—yellowish red very cobbly clay loam

Soil Properties and Qualities

Springerville

Parent material: alluvium and colluvium from basalt
Depth class: deep
Drainage class: well drained
Permeability: very slow
Available water capacity: moderate to high
Potential rooting depth: 40 to 59 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Delenbaw

Parent material: alluvium and colluvium from volcanic rocks
Depth class: very deep
Drainage class: well drained
Permeability: very slow
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Moderately deep to shallow, loamy soils that are strongly calcareous in the lower layers on back slopes

Similar inclusions:
- Areas of Springerville soils that are on slopes of less than 3 percent and greater than 10 percent
- Areas of Delenbaw soils that have a very gravelly surface

• Areas of Springerville soils that have a cobbly or very cobbly, loam or silty clay loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Springerville and Delenbaw soils:
• Potential plant community—perennial grasses (such as prairie junegrass, sideoats grama, blue grama, and muttongrass); shrubs (such as Stansbury cliffrose and big sagebrush); trees (such as Utah juniper and singleleaf pinyon).
Important forage species: Prairie junegrass, blue grama, and Stansbury cliffrose.
Major management factors: Slope and depth to bedrock on both soils, and hazard of erosion on the Delenbaw soils.
General management considerations on the Springerville and Delenbaw soils:
• Proper grazing distribution is often difficult to obtain.
• Overgrazing depletes cover, increases erosion, and allows undesirable plants to increase.
• These soils are not easily traversed by livestock because of slope and stones and cobbles on the surface.
• Water impoundments are shallow and depend on summer rains.
Suitable management practices on the Springerville and Delenbaw soils:
• Planned grazing systems are essential to maintain plant vigor and forage production.
• Development of permanent water supplies is important parts of a planned grazing system.
• If trees and shrubs are managed to create open areas, these soils produce a good stand of desirable grasses.
• Fencing and deferred grazing are important parts of planned grazing systems.
• Areas where brush is managed by prescribed burning, chemical, or mechanical methods may be subject to a greater hazard of erosion.

Woodland

Dominant woodland species on the Springerville and Delenbaw soils:
• Potential woodland species: Utah juniper, singleleaf pinyon, and Gambel oak.
Major management factors on the Springerville and Delenbaw soils:
Depth to bedrock, stones, and cobbles on surface, and clayey, very sticky subsoils which limit equipment access when moist.
General management considerations on the Springerville and Delenbaw soils:
• Stones and cobbles on the surface and moderately steep slopes limit access for fuelwood harvesting.
• Harvesting should be done when soils are somewhat dry so equipment will not destroy soil structure and increase soil erosion.
• If harvesting is done during dry season, care must be taken to prevent forest fires.
Suitable management practices on the Springerville and Delenbaw soils:
• Thinning of thick stands of trees increases vigor and growth.
• Fuelwood harvesting may be a consideration.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, western bluebird, common flicker, common raven, dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, rock squirrel, piniyon mouse, deer mouse, cougar, northern whiptail lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.
General management considerations:
• Supports a plant community of pinyon-juniper woodland with an understory of perennial grasses, forbs, and shrubs.
• Provides important habitat for mule deer.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Develop water for wildlife.

Interpretive Groups

Land capability classification: Springerville and Delenbaw—6S
Range site: Springerville and Delenbaw—Clay Loam Upland, Gravelly (PIED, JUOS) 13-17" p.z.

73—Strych very gravelly loam, 2 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Strych and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—light brown very gravelly loam
2 to 9 inches—light brown very gravelly loam
9 to 24 inches—pink, calcareous very gravelly loam
24 to 48 inches—reddish yellow and pink, calcareous extremely gravelly loam
48 to 60 inches—light brown, calcareous very gravelly clay loam

Soil Properties and Qualities

Parent material: alluvium and colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy soils that have common flooding along drainageways
- Bedrock
- Shallow, very gravelly loamy Mellenthin soils on slope breaks

Similar inclusions:
- Deep, loamy soils that have less than 35 percent rock fragments
- Areas of moderately deep soils
- Areas where precipitation ranges to 14 inches

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as galleta, bottlebrush squirreltail, blue grama, and desert needlegrass), shrubs (such as fourwing saltbush, big sagebrush, and Nevada Mormontea).

Important forage species: Galleta, bottlebrush squirreltail, and fourwing saltbush.
Major management factors: Low available water capacity and high amounts of calcium carbonate.
General management considerations:
- Because of high content of lime, these soils limit plant diversity and forage production.
- These soils are easily traversed by livestock.
- Care should be taken not to overgraze and allow sagebrush to dominate these soils.

Suitable management practices:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.
- Brush management, contour furrowing, and range seeding can be used to restore productivity of this soil.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip, and sidewinder.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: 6S
Range site: Loamy Upland 10-14" p.z.

74—Tanbark family-Strych family-Rock outcrop complex, 10 to 40 percent slopes

Setting

Landform: mesas
Landscape position: back slopes and foot slopes
Flooding: none
Slope range: Tanbark family and Strych family—10 to 40 percent; Rock outcrop—20 percent to vertical
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Frost-free period: 150 to 165 days

Composition

Tanbark family and similar soils: 25 percent
Strych family and similar soils: 25 percent
Rock outcrop: 25 percent
Contrasting inclusions: 25 percent

Reference Profile

Tanbark family

Various; is usually shallow to moderately deep over gypsiferous mudstone or gypsite. They usually have a very cobbly, gravelly, or stony surface layer and sometimes throughout the profile. Textures range from a fine sandy loam to a clay loam. Gypsum content ranges from 5 to 75 percent. Lithic or paralithic contact is gypsite or gypsiferous mudstone.

One of the more common profiles of the Tanbark family is:

0 to 2 inches—light reddish brown very cobbly fine sandy loam
2 to 14 inches—white and reddish yellow, gypsiferous fine sandy loam
14 to 40 inches—interbedded, gypsiferous mudstone and gypsite

Strych family

Various; is usually moderately deep to very deep, very cobbly, gravelly, or stony throughout the profile. Textures range from a fine sandy loam to a clay loam. Calcium carbonate ranges from 10 to 35 percent. Gypsum content ranges from 0 to 5 percent in some subsurface horizons. Lithic or paralithic contact is basalt, gypsite or gypsiferous mudstone.

One of the more common profiles of the Strych family is:

0 to 3 inches—light reddish brown extremely cobbly fine sandy loam
3 to 13 inches—yellowish red very cobbly loam
13 to 26 inches—light reddish brown, calcareous very cobbly loam
26 to 46 inches—light reddish brown, calcareous very cobbly clay loam
46 inches—interbedded gypsite and mudstone

Rock outcrop

Rock outcrop consists of exposed basalt, gypsite, gypsiferous mudstone or talus slopes of basalt rubble. Basalt is usually vertical exposures at the upper end of the escarpment capping the mesa above the escarpment. Gypsite and gypsiferous mudstone are exposed on the steep to very steep side slopes. Talus slopes consist of basalt cobble, stones, and boulders and have very little to no soil materials to sustain plant growth.

Soil Properties and Qualities

Tanbark family

Parent material: colluvium from sedimentary and igneous formations
Depth class: shallow to moderately deep
Drainage class: well drained
Permeability: moderate to moderately rapid
Available water capacity: low to very low
Potential rooting depth: 10 to 40 inches
Runoff: rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Strych family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to very deep
Drainage class: well drained
Permeability: moderately slow to moderately rapid
Available water capacity: low to medium
Potential rooting depth: 20 to 60 inches
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:

- Deep and very deep, loamy soils on back slopes and foot slopes
- Shallow to moderately deep, gravelly and very gravelly loamy soils on benches

Use and Management

Rangeland

Dominant vegetation on the Tanbark family soils:

- Potential plant community—perennial grasses (such as gyp dropseed, galleta, and blue grama); shrubs (such as blackbrush, Mexican cliffrose, and Wyoming big sagebrush); trees (such as Utah juniper and singleleaf pinyon).

Dominant vegetation on the Strych family soils:

- Potential plant community—perennial grasses (such as bottlebrush squirreltail, galleta, and blue grama); shrubs (such as blackbrush, Mexican cliffrose, and Wyoming big sagebrush); trees (such as Utah juniper and singleleaf pinyon).

Important forage species: Blue grama, galleta, bottlebrush squirreltail, and Stansbury cliffrose.
Major management factors: Gypsum content in Tanbark family soils; depth to bedrock, steep slopes, droughtiness, and hazard of erosion in all soils of this unit.
General management considerations on all soils of this unit:

- Typically steep slopes restrict use by livestock.
- Proper grazing distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes of the unit.
- Overgrazing in these limited areas promotes erosion.
- Vegetation suitable for use as livestock forage is limited.

Suitable management practices on all soils:
- Trails leading up the break make the range at the top more accessible to the livestock.
- These soils should be managed with adjacent areas.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, black-chinned sparrow, roadrunner, red-tail hawk, mourning dove, prairie falcon, peregrine falcon, golden eagle, kangaroo rat, woodrat, antelope ground squirrel, gray fox, bighorn sheep, mule deer, cougar, badger, red-spotted toad, canyon tree frog, desert tortoise, Gila monster, chuckwalla, sidewinder, speckled rattlesnake, and desert iguana.

General management considerations:
- Supports a sparse plant community of perennial grasses, forbs, and shrubs.
- Steep slopes and low rainfall make this area prone to water erosion.
- Provides important forage and lambing area for desert bighorn sheep.
- Proposed critical habitat for desert tortoise.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.

Interpretive Groups

Land capability classification: Tanbark family and Strych family—7E; Rock outcrop—8

Range site: Tanbark family and Strych family—Basalt Slopes, Calcareous 10-14" p.z.; Rock outcrop—none

75—Tanbark loam, 15 to 75 percent slopes

Setting

Landform: hills and escarpments
Landscape position: summits and back slopes
Flooding: none
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Tanbark and similar soils: 80 percent.
Contrasting inclusions: 20 percent.

Typical Profile

0 to 1 inch—white, gypsiferous loam with 60 percent crystalline gypsum
1 to 17 inches—white and pinkish white, gypsiferous sandy loam with about 70 percent crystalline gypsum
17 to 20+ inches—white and pinkish white gypsite

Soil Properties and Qualities

Parent material: colluvium and alluvium from gypsiferous shales (mudstone, siltstone, and rock-like gypsum), limestone, and sandstone.
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe to very severe
Hazard of wind erosion: moderate
Shrink-swell potential: low
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Riverwash
- Shallow, very gravelly loamy Mellenthin soils on summits and benches
- Moderately deep, gravelly and very gravelly loamy, gypsic soils on foot slopes
- Rock outcrop—limestone, sandstone, and shales (mudstone, siltstone, and gypsite)

Similar inclusions:
- Soils that are very shallow or moderately deep over gypsite

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as gyp dropseed, Indian ricegrass, and threeawn); shrubs (such as Bigelow sagebrush, rubber rabbitbrush, and Nevada Mormontea); trees (such as Utah juniper).

Important forage species: Indian ricegrass and annuals.

Major management factors: Gypsum content, depth to bedrock, steep slopes, droughtiness, and hazard of erosion.
General management considerations:
• These soils are very fragile, and any activities such as stock trailing and vehicular traffic can result in serious losses from erosion.
• Because of unfavorable growing conditions on these soils, overgrazing will leave the ground bare and highly susceptible to erosion.
• The complex topography prevents proper grazing distribution.
Suitable management practices:
• Light stocking rates can be used on the lower slopes.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip, and sidewinder.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: 7E
Range site: Gypsum Hills, Ccalcareous 10-14" p.z.

76—Tassi-Rizno complex, 5 to 35 percent slopes

Setting

Landform: structural benches
Landscape position: summits and back slopes
Flooding: none
Slope range: Tassi—5 to 15 percent; Rizno—5 to 35 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Tassi and similar soils: 70 percent
Rizno and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Tassi

0 to 1 inch—light brown very gravelly loam
1 to 10 inches—light brown, calcareous gravelly loam
10 to 12 inches—indurated, lime-cemented hardpan
12 to 28 inches—white and pinkish white, strongly lime-cemented hardpan
28 inches—limestone bedrock

Rizno

0 to 1 inch—reddish brown very channery sandy loam
1 to 6 inches—reddish brown channery sandy loam and loam
6 inches—calcareous sandstone bedrock

Soil Properties and Qualities

Tassi

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Rizno

Parent material: mixed alluvium and eolian from sedimentary formations
Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:

- Rock outcrop
- Shallow to deep, very gravelly loamy, calcareous soils on back slopes
- Shallow to deep, loamy soils on back slopes

Similar inclusions:
- Areas of Rizno soils that have cobbly and very cobbly sandy loam surface textures
- Areas of Tassi soils that have a very gravelly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Tassi soils:
- Potential plant community—perennial grasses (such as blue grama, galleta, and Indian ricegrass); shrubs (such as blackbrush, Mexican cliffrose, and Nevada Mormontea).

Dominant vegetation on the Rizno soils:
- Potential plant community—perennial grasses (such as desert needlegrass, galleta, and sand dropseed); shrubs (such as blackbrush, Mexican cliffrose, and Nevada Mormontea).

Important forage species: Indian ricegrass, desert needlegrass, sand dropseed, galleta, and annuals.
Major management factors: Shallow depths and droughtiness of both soils and hazard of erosion on the Rizno soils.
General management considerations on the Tassi and Rizno soils:
- Vertical exposures of rock and steep-sided drainageways limit access to livestock.
- Densely populated blackbrush inhibits grazeable forage.

Suitable management practices on the Tassi and Rizno soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Constructing trails in steeply sloping areas increases access to livestock.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip, and sidewinder.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Tassi—6S; Rizno—7E
Range site: Tassi—Shallow Upland, Calcareous 10-14" p.z.; Rizno—Shallow Sandy Loam, Calcareous 10-14" p.z.

77—Tonopah gravelly loamy fine sand, 1 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and back slopes
Flooding: none
Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 60 to 70 degrees F
Frost-free period: 220 to 260 days

Composition

Tonopah and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 3 inches—light brown gravelly loamy fine sand
3 to 8 inches—reddish yellow, calcareous gravelly loamy fine sand
8 to 60 inches—pink and reddish yellow, calcareous very gravelly loamy sand

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow, loamy Bard family and Cave soils over a hardpan on summits
- Moderately deep to very deep, loamy to sandy, fluventic soils along drainages
- Deep, sandy Arada family soils as dunes on summits

Similar inclusions:
• Areas that have gravelly loamy sand and very gravelly loamy fine sand surface textures

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community: perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as creosotebush, Nevada Mormontea, and white bursage).
Important forage species: Indian ricegrass, big galleta, Nevada Mormontea, and annuals.
Major management factors: Droughtiness, high lime content, and hazard of erosion.
General management considerations:
• High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage on this soil.
• This soil is easily traversed by livestock.
• This soil is limited for livestock watering ponds and other water impoundments because of the seepage potential.
• Grazing is mostly limited to winter and spring annuals.
Suitable management practices:
• Planned grazing systems help control erosion and increase plant vigor and variety.
• Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• Provides important foraging habitat for raptors.
• Proposed critical habitat for desert tortoise.
• Important chuckwalla habitat.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Full suppression of wildfire.
• Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Limy Upland, Deep 6-9" p.z.

78—Torriorthents-Calciorthids-Rock outcrop complex, 10 to 40 percent slopes

Setting

Landform: mesa escarpments
Landscape position: colluvial back slopes and foot slopes
Flooding: none
Slope range: Torriorthents and Calciorthids—10 to 40 percent; Rock outcrop—20 percent to vertical
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Torriorthents and similar soils: 40 percent
Calciorthids and similar soils: 30 percent
Rock outcrop and similar soils: 15 percent
Contrasting inclusions: 15 percent

Reference Profile

Torriorthents

Various; is usually shallow to moderately deep, very cobbly, gravelly, or stony throughout the profile. Textures range from loamy sand to loam with varying amounts of lime and gypsum.

One of the more common profiles of Torriorthents is:
0 to 2 inches—light brown very cobbly loamy sand
2 to 12 inches—light reddish brown gravelly loamy sand
12 to 24 inches—light reddish brown, calcareous gravelly sandy loam
24 inches—weathered mudstone

Calciorthids

Various; is usually shallow to deep, very cobbly, gravelly, or stony throughout the profile. Textures range from sandy loam to loam. Subsurface horizons are calcareous and may be weakly lime cemented.

One of the more common profiles of Calciorthids is:
0 to 2 inches—brown very cobbly fine sandy loam
2 to 12 inches—light brown, calcareous very gravelly loam
12 to 24 inches—pink, calcareous gravelly sandy loam
24 inches—weathered mudstone

Rock outcrop

Steep to vertical or near vertical exposures of basalt capping escarpments along mesas and plateaus. May also occur periodically on down the escarpment.

Soil Properties and Qualities

Torriorthents

Parent material: colluvium and eolian materials from sedimentary and igneous formations
Depth class: shallow to moderately deep
Drainage class: well to somewhat excessively drained
Permeability: moderate to moderately rapid
Available water capacity: very low to low
Potential rooting depth: 10 to 40 inches
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—medium; uncoated steel—high

Calciorthids

Parent material: colluvium from sedimentary and igneous formations
Depth class: shallow to moderately deep
Drainage class: well to somewhat excessively drained
Permeability: moderate to moderately rapid
Available water capacity: very low to low
Potential rooting depth: 10 to 40 inches
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low to medium; uncoated steel—high

Inclusions

Contrasting inclusions:
- Talus slopes (basalt rubble)
- Exposed sandstone or mudstone
- Shallow to deep, sandy soils over mudstone as dunes on back slopes and foot slopes
- Shallow to deep, loamy, fluventic soils in drainages

Use and Management

Rangeland

Dominant vegetation on the Torriorthents soils:
- Potential plant community—perennial grasses (such as big galleta, desert needlegrass, sand dropseed, threeawn, and bush muhly); shrubs (such as Nevada Mormontea, white bursage, Joshua-tree, and creosotebush).

Dominant vegetation on the Calciorthids soils:
- Potential plant community—perennial grasses (such as big galleta, black grama, and desert needlegrass); shrubs (such as creosotebush, white bursage, and Nevada Mormontea).

Important forage species: Sand dropseed, big galleta, black grama, bush muhly, desert needlegrass, Nevada Mormontea, and annuals.
Major management factors: Depth to bedrock or hardpan, slope, and hazard of erosion.
General management considerations on all the soils:
- High lime content, low available water capacity, and the inhibiting influence of creosotebush contribute to the low production of forage.
- Steep slopes and vertical rock walls limit access to livestock.

Suitable management practices on all the soils:
- Constructing trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Torriorthents and Calciorthids—7E; Rock outcrop—8
Range site: Torriorthents—Basalt Slopes 6-9" p.z.; Calciorthids—Limy Upland 6-9" p.z.; Rock outcrop—none

79—Tours silt loam, 1 to 3 percent slopes

Setting

Landform: flood plains and alluvial fans
Flooding: occasional, very brief

Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Tours and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 8 inches—reddish brown and yellowish red silt loam
8 to 63 inches—yellowish red, stratified silty clay loam

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary and igneous formations
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Corrosivity: concrete—moderate; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, loamy, fluventic Ives soils on flood plains
- Deep and very deep, loamy, gypsic, Robroost soils on foot slopes
- Deep, loamy, nonflooded soils above the flood plain

Similar inclusions:
- Soils that have a silty clay loam surface
- Soils that have 15 to 25 percent gravel on the surface

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as blue grama, alkali sacaton, galleta, blue grama, and western wheatgrass); shrubs (such as fourwing saltbush and winterfat).

Important forage species: Alkali sacaton, blue grama, western wheatgrass, fourwing saltbush, and winterfat.
Major management factors: Flooding and hazard of erosion.
General management considerations:
- This unit receives runoff from adjacent slopes.
- Livestock generally overgraze this unit because of availability of water, ease of access, and abundance of feed.
- Overgrazing depletes vegetative cover and increases the hazard of erosion.
- Grazing should be delayed until the soil has sufficiently dried to prevent trampling and compaction.

Suitable management practices:
- Prevent overgrazing by fencing and controlling water availability.
- Provide rest periods during the growing season to maintain plant vigor and production.
- Control erosion and promote forage production with proper utilization.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- When water is present, this is the most important waterfowl and wading bird area in the survey area.
- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: 7W
Range site: Clayey Bottom 7-11" p.z.

80—Tsezhin family-Ashfork family-Rock outcrop complex, 10 to 70 percent slopes

Setting

Landform: mesas
Landscape position: back slopes and foot slopes
Flooding: none
Slope range: Tsezhin family—10 to 70 percent; Ashfork family—10 to 40 percent; Rock outcrop—10 percent to vertical
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 47 to 56 degrees F
Frost-free period: 120 to 165 days

Composition

Tsezhin family and similar soils: 30 percent
Ashfork family and similar soils: 25 percent
Rock outcrop: 20 percent
Contrasting inclusions: 25 percent

Reference Profile

Tsezhin family

Various; moderately deep to deep, very cobbly, gravelly, or stony throughout the profile. Textures range from loam to clay loam. Lithic or paralithic contact is basalt, gypsite, or gypsiferous mudstone.

One of the more common profiles of the Tsezhin family is:

0 to 4 inches—reddish brown very cobbly loam
4 to 14 inches—reddish brown very cobbly clay loam
14 to 33 inches—light reddish brown, calcareous very cobbly clay loam
33 inches—weathered, gypsiferous mudstone

Ashfork family

Various; moderately deep to deep, very cobbly, gravelly, or stony surface layer and sometimes throughout the profile. Textures range from loam to clay. Lithic or paralithic contact is basalt, gypsite or gypsiferous mudstone.

One of the more common profiles of the Ashfork family is:

1 inch to 0—organic mat of decomposing pine and juniper needles
0 to 2 inches—dark reddish brown very cobbly loam
2 to 8 inches—dark reddish brown cobbly loam
8 to 38 inches—reddish brown clay
38 to 41 inches—reddish brown cobbly clay
41 inches—basalt bedrock

Rock outcrop

Rock outcrop consists of exposed basalt, gypsite, gypsiferous mudstone or talus slopes of basalt rubble. Basalt usually occurs as vertical exposures at the upper end of the escarpment capping the mesa above the escarpment and as small benches down the side. Gypsite and gypsiferous mudstone are exposed on the steep to very steep side slopes. Talus slopes consist of basalt cobble, stones, and boulders and have very little to no soil materials to sustain plant growth.

Soil Properties and Qualities

Tsezhin family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to deep
Drainage class: well drained
Permeability: slow to moderate
Available water capacity: low to moderate
Potential rooting depth: 20 to 60 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: moderate
Corrosivity: concrete—moderate; uncoated steel—high

Ashfork family

Parent material: colluvium from sedimentary and igneous formations
Depth class: moderately deep to deep
Drainage class: well drained
Permeability: slow to very slow
Available water capacity: moderate to high
Potential rooting depth: 20 to 60 inches
Runoff: rapid to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: moderate to high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:

- Shallow to moderately deep loamy soils that have 15 to 65 percent rock fragments on back slopes and foot slopes
- Shallow to moderately deep, loamy soils that have 15 to 65 percent rock fragments and 0 to 10 percent gypsum on back slopes and foot slopes
- Moderately deep to deep, loamy soils that have 15 to 65 percent rock fragments and 5 to 35 percent calcium carbonate on back slopes and foot slopes

Use and Management

Rangeland

Dominant vegetation on the Tsezhin family and Ashfork family soils:

- Potential plant community—perennial grasses (such as prairie junegrass and bottlebrush squirreltail); shrubs (such as yellowleaf silktassel, pointleaf manzanita, and Utah serviceberry); trees (such as singleleaf pinyon and Utah juniper).

Important forage species: Prairie junegrass and bottlebrush squirreltail.
Major management factors: Slope, hazard of erosion, and large rocks.
General management considerations on all the soils of this unit:

- Typically steep slopes restrict use by livestock.
- Proper distribution is often impossible to obtain.
- Heavy grazing occurs on lower slopes of the unit.

• Overgrazing in these limited areas promotes erosion.
Suitable management practices on all the soils of this unit:
• Construction of trails on steeply sloping areas increases accessibility by livestock.
• Fencing, using planned grazing systems, and developing livestock watering facilities.

Wildlife Habitat

Wildlife on these soils include scrub jay, bushtit, long-eared owl, ash-throated flycatcher, rufous-sided towhee, American kestrel, mule deer, coyote, woodrat, brush mouse, great basin pocket mouse, cottontail, gray fox, cougar, striped whiptail, short-horned lizard, gopher snake, striped whipsnake, and great basin rattlesnake.
General management considerations:
• Supports a plant community of chaparral with an understory of perennial grasses, forbs, and shrubs.
• Provides crucial summer habitat for mule deer.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Tsezhin family and Ashfork family—7E; Rock outcrop—8
Range site: Tsezhin family and Ashfork family—Basalt Slopes 13-17" p.z.; Rock outcrop—none

81—Tsezhin very cobbly sandy loam, 5 to 15 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and shoulders
Flooding: none
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 56 degrees F
Frost-free period: 120 to 165 days

Composition

Tsezhin and similar soils: 75 percent
Contrasting inclusions: 25 percent

Typical Profile

0 to 2 inches—brown very cobbly sandy loam
2 to 6 inches—brown very cobbly loam
6 to 37 inches—reddish yellow very cobbly clay loam
37 to 45 inches—yellowish red very cobbly sandy clay loam
45 to 60 inches—white, weakly lime-cemented very cobbly sandy loam

Soil Properties and Qualities

Parent material: colluvium and alluvium from granite, gneiss, and limestone
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep, very gravelly or very cobbly loamy soils that have a high content of lime throughout the profile; on back slopes
• Moderately deep to deep, very gravelly or very cobbly loamy soils in drainages
• Steeply sloping areas along drainageways
Similar inclusions:
• Areas that have very stony surfaces
• Areas that have bouldery and very bouldery surfaces
• Areas that have a loam surface texture

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as sideoats grama, black grama, and desert needlegrass); shrubs (such as desert ceanothus, pointleaf manzanita, and turbinella oak); trees (such as Utah juniper).
Important forage species: desert ceanothus, sideoats grama, and annuals.
Major management factors: Steepness of side slopes into drainages, large rock fragments on the surface, and low available water capacity.
General management considerations:
• Steep side slopes into drainages limit livestock movement.
• Large rock fragments on surface severely limit any mechanical brush control or reseeding.
• Browse is provided for deer as well as livestock.
• Grazing is mostly limited to winter and spring annuals.

Suitable management practices:
- Construction of trails up steep-sided drainages help livestock movement for grazing.
- Development of permanent water supply for livestock is important.
- Planned grazing systems are essential to maintain plant vigor, forage production, and controlling erosion by maintaining plant cover.

Wildlife Habitat

Wildlife on these soils include scrub jay, bushtit, long-eared owl, ash-throated flycatcher, rufous-sided towhee, American kestrel, mule deer, coyote, woodrat, brush mouse, great basin pocket mouse, cottontail, gray fox, cougar, striped whiptail, short-horned lizard, gopher snake, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of chaparral with an understory of perennial grasses, forbs, and shrubs.
- Provides crucial summer habitat for mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: 6S
Range site: Loamy Upland 13-17" p.z.

82—Twist loam, 2 to 10 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and shoulders
Flooding: none
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 59 degrees F
Frost-free period: 165 to 180 days

Composition

Twist and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—light reddish brown loam
2 to 15 inches—reddish yellow and yellowish red loam and clay loam
15 to 37 inches—reddish yellow and pink, weakly lime-cemented sandy clay loam
37 to 58 inches—reddish yellow, gypsiferous sandy loam
58 to 60 inches—white gypsum

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight to moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, loamy, calcareous Dera soils on summits and back slopes
- Moderately deep, loamy soils that have high gypsum content on summits and back slopes
- Deep, loamy Ives soils along drainages

Similar inclusions:
- Soils that lack gypsum within 40 inches of surface
- Soils that have a gravelly loam or gravelly fine sandy loam surface layer

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as bottlebrush squirreltail, gyp dropseed, sand dropseed, black grama, and galleta); shrubs (such as fourwing saltbush, winterfat, and Mormontea).

Important forage species: Galleta, black grama, sand dropseed, and winterfat.
Major management factors: Hazard of erosion.
General management considerations:
- Good accessibility, a variety of palatable plants, and availability of water encourage a constant grazing pressure.
- Overgrazing depletes the plant cover and increases the hazard of erosion.
- Ground cover should be maintained or improved to reduce risk of erosion.
- Readily responds to proper management.

Suitable management practices:
- Fencing, using planned grazing systems, and developing livestock watering facilities.

Wildlife Habitat

Wildlife on these soils include horned lark, Gambel's quail, roadrunner, mourning dove, red-tail hawk, prairie falcon, peregrine falcon, golden eagle, white-crowned

sparrow, kangaroo rat, woodrat, rock squirrel, kit fox, badger, gray fox, mule deer, cougar, coyote, chuckwalla, leopard lizard, northern whiptail lizard, coachwhip, and sidewinder.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: 7S
Range site: Sandy Loam Upland 7-11" p.z.

83—Twist very cobbly loam, 1 to 8 percent slopes

Setting

Landform: fan terraces
Landscape position: summits
Flooding: none
Slope range: 1 to 8 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Twist and similar soils: 75 percent
Contrasting inclusions: 25 percent

Typical Profile

0 to 2 inches—light reddish brown very cobbly loam
2 to 11 inches—light reddish brown clay loam
11 to 25 inches—light reddish brown, calcareous clay loam
25 to 60 inches—pink, light reddish brown and reddish yellow, gypsiferous cobbly loam

Soil Properties and Qualities

Parent material: mixed alluvium from volcanic and sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: moderate
Corrosivity: concrete—high; uncoated steel—high

Inclusions

Contrasting inclusions:
• Deep and very deep, very cobbly and stony loamy, gypsic Nutter soils on summits and back slopes
• Deep and very deep, loamy, gypsic Robroost soils on small rises along summits
Similar inclusions:
• Areas that have stony or very stony surfaces
• Areas that have gravelly or very gravelly surfaces

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as black grama, bottlebrush squirreltail, Indian ricegrass, and galleta); shrubs (such as fourwing saltbush, winterfat, and Nevada Mormontea).
Important forage species: Indian ricegrass, galleta, bottlebrush squirreltail, fourwing saltbush, and winterfat.
Major management factors: The presence of stones and cobbles on the surface and throughout the soil profiles.
General management considerations:
• Stones, cobbles, and straight-sided, deep water drainage channels limit movement of livestock.
• Stone and cobble content of the soil make it difficult to build earthen water structures.
• Earthen water structures will have seepage and piping problems because of the gypsum content of the soils.
Suitable management practices:
• Planned grazing systems are essential to maintain plant vigor and forage production.
• Build trails for livestock on steep-sided water channels.

Wildlife Habitat

Wildlife on these soils include horned lark, white-faced ibis, mourning dove, waterfowl, northern harrier, red-tail hawk, prairie falcon, great blue heron, woodrat, antelope ground squirrel, kit fox, badger, pronghorn antelope, gray fox, coyote, gopher snake, whiptail lizard, and great basin rattlesnake.
General management considerations:
• Supports a plant community of perennial grasses, forbs, and shrubs.
• When water is present this is the most important waterfowl and wading bird area in the survey area.

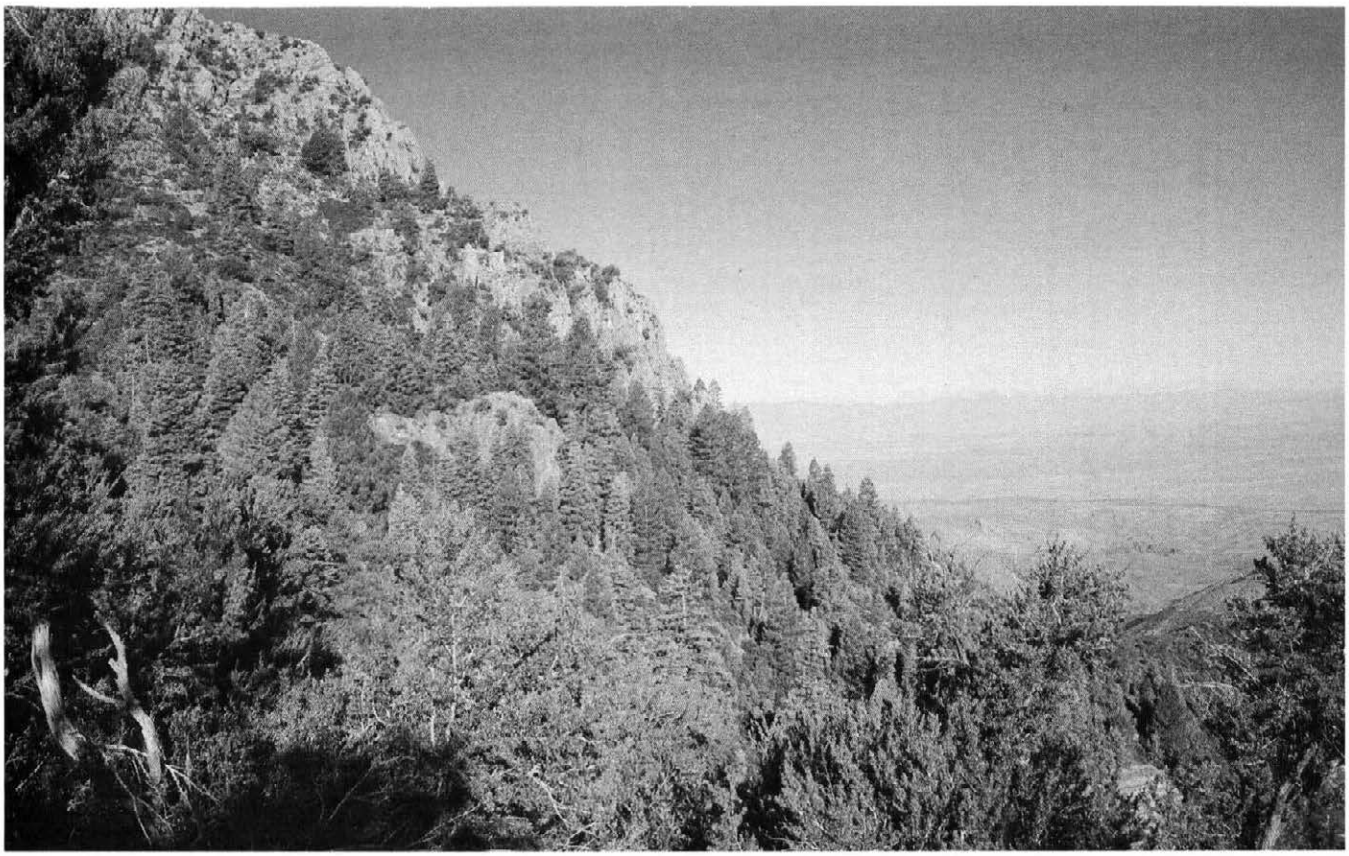


Figure 11.—The Virgin Mountains, in the Virgin Peak-Rock outcrop complex, 10 to 70 percent slopes, are very steep granite and gneiss mountains with pine, spruce, and fir trees above 7,000 feet and pine, juniper, and chaparral brush below that elevation.

- Provides important foraging and lambing habitat for pronghorn antelope.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Erosion control.

Interpretive Groups

Land capability classification: 7S
Range site: Clay Loam Upland 7-11" p.z.

84—Virgin Peak-Rock outcrop complex, 10 to 70 percent slopes

Setting

Landform: mountains
Landscape position: Virgin Peak—back slopes; Rock outcrop—intermittently throughout
Flooding: none
Slope range: Virgin Peak—10 to 70 percent; Rock outcrop—50 percent to near vertical (fig. 11)
Elevation: 5,000 to 8,000 feet
Mean annual precipitation: 16 to 20 inches
Mean annual air temperature: 45 to 56 degrees F
Frost-free period: 120 to 165 days

Composition

Virgin Peak and similar soils: 45 percent
Rock outcrop and similar soils: 30 percent
Contrasting inclusions: 25 percent

Typical Profile

Virgin Peak

0 to 2 inches—dark brown very gravelly loam
2 to 7 inches—brown very gravelly loam
7 to 17 inches—weathered gneiss
17 inches—gneiss bedrock

Rock outcrop

Granite, gneiss, and schist dominate with inclusions of all other related metamorphic and intrusive igneous rocks.

Soil Properties and Qualities

Virgin Peak

Parent material: colluvium from granite and gneiss
Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: moderate to very rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep, very gravelly and cobbly, loamy soils on foot slopes
- Moderately deep and deep, very gravelly and cobbly, loamy soils on fan terraces

Similar inclusions:
- Areas of loamy soils that have less than 35 percent rock fragments
- Areas of loamy soils on slopes less than 35 percent
- Areas of very gravelly fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Virgin Peak soil:
- Potential plant community—perennial grasses (such as prairie junegrass, bottlebrush squirreltail, sideoats grama, and desert needlegrass); shrubs (such as turbinella oak, silktassel, pointleaf manzanita, and buckbrush ceanothus); trees (such as singleleaf pinyon).

Important forage species: Buckbrush ceanothus, prairie junegrass, sideoats grama, and bottlebrush squirreltail.
Major management factors: Steep slopes, droughtiness, hazard of erosion, and depth to bedrock.
General management considerations on the Virgin Peak soil:
- Typically steep slopes restrict use by livestock.
- Heavy grazing occurs on the lower slopes.
- Overgrazing on lower slopes increases erosion.

Suitable management practices on the Virgin Peak soil:
- Building trails in steeply sloping areas increases access to livestock.
- Development of livestock watering facilities increases use of area.

Wildlife Habitat

Wildlife on these soils include scrub jay, bushtit, long-eared owl, ash-throated flycatcher, rufous-sided towhee, American kestrel, mule deer, coyote, woodrat, brush mouse, great basin pocket mouse, cottontail, gray fox, cougar, striped whiptail, short-horned lizard, gopher snake, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of chaparral with an understory of perennial grasses, forbs, and shrubs.
- Provides crucial summer habitat for mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: Virgin Peak—7E; Rock outcrop—8
Range site: Virgin Peak—Granitic Hills 16-20" p.z.; Rock outcrop—none

85—Whiskey silt loam, 1 to 4 percent slopes

Setting

Landform: stream terraces
Landscape position: summits
Flooding: none
Elevation: 5,800 to 7,000 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Whiskey and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 5 inches—brown silt loam
5 to 60 inches—dark brown loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, clayey soils on summits
- Deep, loamy soils that have more than 35 percent rock fragments along drainages

Similar inclusions:
- Moderately deep, loamy soils
- Soils that have slopes greater than 4 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as blue grama, needleandthread, and galleta); shrubs (such as fourwing saltbush, Mormontea, and Mexican cliffrose); trees (such as Utah juniper).

Important forage species: Blue grama, needleandthread, galleta, and fourwing saltbush.
Major management factors: hazard of erosion.
General management considerations:
- Livestock prefer this soil because of accessibility and the availability of water.
- This soil can be highly productive and responds well to good management.
- Livestock should be managed to maintain the desired plant community to protect the soil from excessive erosion.

Suitable management practices:
- Proper grazing use.
- Planned grazing systems.
- Fencing.
- Deferred grazing.
- Water development.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, western bluebird, common flicker, common raven, dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, rock squirrel, pinyon mouse, deer mouse, cougar, northern whiptail lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of pinyon-juniper woodland with an understory of perennial grasses, forbs, and shrubs.
- Provides important habitat for mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Develop water for wildlife.

Interpretive Groups

Land capability classification: 6S
Range site: Loamy Upland, Gravelly (PIED, JUOS) 13-17" p.z.

86—Winkel-Rock outcrop complex, 2 to 35 percent slopes

Setting

Landform: plateaus and mesas
Landscape position: Winkel—summits and shoulders; Rock outcrop—steep sides and shoulders of small canyons
Flooding: none
Slope range: Winkel—2 to 12 percent; Rock outcrop—25 percent to vertical
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Winkel and similar soils: 65 percent
Rock outcrop and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Winkel

0 to 2 inches—light brown very gravelly loam
2 to 5 inches—light brown very gravelly loam
5 to 13 inches—light brown, calcareous very cobbly loam
13 to 32 inches—indurated, lime-cemented hardpan
32 inches—basalt bedrock

Rock outcrop

Hard to extremely hard basalt bedrock exposed to the surface and areas which may have a 1- to 4-inch

thick layer of gravel, cobbles, and loamy materials over the bedrock.

Soil Properties and Qualities

Winkel

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rubbleland (talus slopes)
- Moderately deep and deep, very gravelly loamy soils on back slopes and swales
- Moderately deep and deep, very gravelly loamy or sandy soils on back slopes and swales

Similar inclusions:
- Areas of Winkel soils that have gravelly, very gravelly or very cobbly loam or sandy loam surface textures

Use and Management

Rangeland

Dominant vegetation on the Winkel soil:
- Potential plant community—perennial grasses (such as desert needlegrass, big galleta, and Indian ricegrass); shrubs (such as creosotebush, white bursage, white ratany, wolfberry, and Joshua-trees).

Important forage species: Indian ricegrass, big galleta, black grama, and annuals.
Major management factors: Slope, droughtiness, high lime content, and shallow depths.
General management considerations on the Winkel soil:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices on the Winkel soil:
- Constructing trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Winkel—7S; Rock outcrop—8
Range site: Winkel—Limy Upland 6-9" p.z.; Rock outcrop—none

87—Winkel-Rock outcrop complex, 2 to 35 percent slopes, moist

Setting

Landform: plateaus and mesas
Landscape position: Winkel—summits and shoulders; Rock outcrop—steep sides and shoulders of small canyons
Flooding: none
Slope range: Winkel—2 to 12 percent; Rock outcrop—25 percent to vertical
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Winkel and similar soils: 65 percent
Rock outcrop and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Winkel

0 to 2 inches—light brown very gravelly loam
2 to 5 inches—light brown very gravelly loam
5 to 13 inches—light brown, calcareous very cobbly loam
13 to 32 inches—indurated, lime-cemented pan
32 inches—basalt bedrock

Rock outcrop

Hard to extremely hard basalt bedrock exposed to the surface and areas which may have a 1- to 4-inch thick layer of gravel, cobbles, and loamy materials over the bedrock.

Soil Properties and Qualities

Winkel

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rubbleland (talus slopes)
- Moderately deep and deep, very gravelly loamy soils on back slopes and swales
- Moderately deep and deep, very gravelly, loamy or sandy soils on back slopes and swales

Similar inclusions:
- Areas of Winkel soils that have a gravelly, very gravelly or very cobbly, loam or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Winkel soil:
- Potential plant community—perennial grasses (such as desert needlegrass, big galleta, and Indian ricegrass); shrubs (such as blackbrush, Mormontea, and banana yucca).

Important forage species: Indian ricegrass, big galleta, Mormontea, and annuals.
Major management factors: Slope, droughtiness, high lime content, and shallow depths.
General management considerations on the Winkel soil:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices on the Winkel soil:
- Constructing trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Winkel—7S; Rock outcrop—8
Range site: Winkel—Shallow Upland 9-12" p.z.; Rock outcrop—none

88—Winkel very gravelly loam, 2 to 25 percent slopes

Setting

Landform: plateaus and mesas
Landscape position: summits and shoulders
Flooding: none
Elevation: 1,600 to 4,500 feet

Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Winkel and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—light brown very gravelly loam
2 to 5 inches—light brown very gravelly loam
5 to 13 inches—light brown, calcareous very cobbly loam
13 to 32 inches—indurated, lime-cemented hardpan
32 inches—basalt bedrock

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, very gravelly loamy Meadview soils on back slopes
- Deep, very gravelly sandy Arizo soils along drainages
- Moderately deep and deep, loamy to sandy, fluventic soils along drainages

Similar inclusions:
- Areas of soils moderately deep to the pan
- Areas of soils that have bedrock above 20 inches
- Areas that have surface textures that are gravelly, very gravelly or very cobbly loam or sandy loam

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as big galleta, desert needlegrass, and Indian ricegrass); shrubs (such as creosotebush, white bursage, white ratany, and Joshua-trees).

Important forage species: Indian ricegrass, big galleta, and annuals.
Major management factors: Droughtiness, shallow depth to pan, slope, high lime content, and hazard of erosion.
General management considerations:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7S
Range site: Limy Upland 6-9" p.z.

89—Winkel very gravelly loam, 2 to 25 percent slopes, moist

Setting

Landform: plateaus and mesas
Landscape position: summits and shoulders
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Winkel and similar soils: 80 percent

Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—light brown very gravelly loam
2 to 5 inches—light brown very gravelly loam
5 to 13 inches—light brown, calcareous very cobbly loam
13 to 32 inches—indurated, lime-cemented hardpan
32 inches—basalt bedrock

Soil Properties and Qualities

Parent material: mixed alluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep, very gravelly loamy Meadview soils on back slopes
- Deep, very gravelly sandy Arizo soils on back slopes and along drainages
- Moderately deep and deep, loamy to sandy, fluventic soils along drainages

Similar inclusions:
- Areas of soils moderately deep to the hardpan
- Areas of soils that have bedrock above 20 inches
- Areas that have surface textures of gravelly, very gravelly, or very cobbly loam or sandy loam

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as big galleta, desert needlegrass, and Indian ricegrass); shrubs (such as blackbrush, Mormontea, and Joshua-trees).

Important forage species: Indian ricegrass, big galleta, Mormontea, and annuals.
Major management factors: Droughtiness, shallow depth to pan, slope, high lime content, and hazard of erosion.
General management considerations:
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage.
- Grazing is mostly limited to winter and spring annuals.

Suitable management practices:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Development of permanent water supplies and fencing are an important part of planned grazing systems.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.
General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7S
Range site: Shallow Upland 9-12" p.z.

90—Wutoma-Lozinta complex, 15 to 50 percent slopes

Setting

Landform: cinder cones
Landscape position: soils are intermingled on back slopes
Flooding: none
Slope range: 15 to 50 percent
Elevation: 6,000 to 7,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 135 to 150 days

Composition

Wutoma and similar soils: 60 percent
Lozinta and similar soils: 30 percent

Contrasting inclusions: 10 percent

Typical Profile

Wutoma

0 to 2 inches—dark brown extremely gravelly loam
2 to 12 inches—brown extremely gravelly loam
12 to 60 inches—loose cinders

Lozinta

0 to 2 inches—brown very gravelly loam
2 to 28 inches—dark grayish brown and brown very gravelly loam
28 to 60 inches—loose cinders

Soil Properties and Qualities

Wutoma

Parent material: eolian and residuum
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Lozinta

Parent material: alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop as welded cinders and basalt
- Shallow and moderately deep, very gravelly loamy soils over bedrock on summits and back slopes

Similar inclusions:
- Loamy soils that have loose cinders at greater than 40 inches
- Area that has cobble-sized rock fragments on surface and in profile
- Areas more moist with stands of ponderosa pine trees.
- Areas of Lozinta soils that have a very gravelly fine sandy loam surface texture
- Areas of Wutoma soils that have a very gravelly or extremely gravelly loam or fine sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Wutoma and Lozinta soils:
- Potential plant community—perennial grasses (such as muttongrass, blue grama, needleandthread, bottlebrush squirreltail, and galleta); shrubs (such as fourwing saltbush, and big sagebrush); trees (such as Colorado pinyon and Utah juniper).

Important forage species: Blue grama, needleandthread, bottlebrush squirreltail, muttongrass, and fourwing saltbush.
Major management factors: Steep slopes, low and very low available water holding capacity, and hazard of erosion on both soils.
General management considerations on the Wutoma and Lozinta soils:
- When ingested, ponderosa pine needles may cause stillbirths or calves that die soon after birth.
- Livestock may also be poisoned by browsing on Gambel oak.
- Ponderosa pine and Gambel oak are the dominant vegetation on these two soils in the higher elevations. Livestock should be watched more closely during times of stress such as drought or lack of an alternate feed source.
- Steep slopes and loose soils severely limit use for fuelwood harvesting or logging.

Suitable management practices on the Wutoma and Lozinta soils:
- Thinning of thick stands of trees increases vigor and growth of undergrowth.

Fuelwood Production

- This unit can produce about 2 to 4 cords of fuelwood per acre.

General management considerations:
- Reduce risk of erosion by proper installation and maintenance of access roads.
- Steep slopes and loose cinders make equipment movement difficult and increase erosion.

Wildlife Habitat

Wildlife on these soils include Steller's jay, common

flicker, western tanager, white-breasted nuthatch, northern goshawk, screech owl, Cooper's hawk, wild turkey, red crossbill, western bluebird, mule deer, coyote, Abert squirrel, black bear, porcupine, deer mouse, cougar, short-horned lizard, gopher snake, and great basin rattlesnake.
General management considerations:
• Supports a diverse plant community of conifers with an understory of perennial grasses, forbs, and shrubs.
• Provides important habitat for cavity-nesting birds.
Suitable management practices:
• Preserve snags for cavity-nesting birds.
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Wutoma and Lozinta—7E
Range site: Wutoma and Lozinta—Cinder Hills (PIED, JUOS) 13-17" p.z.

91—Yellowhorse family silty clay, 0 to 3 percent slopes

Setting

Landform: plateaus
Landscape position: mountain meadow, basins
Flooding: occasional (ponding)
Elevation: 5,800 to 7,000 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 135 days

Composition

Yellowhorse family and similar soils: 90 percent
Contrasting inclusions: 10 percent

Typical Profile

0 to 3 inches—brown silty clay
3 to 41 inches—brown silty clay
41 to 60 inches—brown, calcareous silty clay

Soil Properties and Qualities

Parent material: mixed alluvium from volcanic and sedimentary formations
Depth class: deep and very deep
Drainage class: moderately well to somewhat poorly drained
Permeability: very slow
Available water capacity: low to moderate
Potential rooting depth: 45 to more than 70 inches
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
• Moderately deep, clayey Yellowhorse soils in mountain meadow basins
• Very deep, clayey, poorly drained soils in low areas of the basins
• Shallow, clayey Luzena family soils over bedrock around edge of the basins
Similar inclusions:
• Soils that have a few cobbles and gravel on the surface

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—perennial grasses (such as Arizona fescue, bottlebrush squirreltail, western wheatgrass, spike muhly, and muttongrass); shrubs (such as big sagebrush and black sagebrush); trees (such as Utah juniper and Colorado pinyon).
Important forage species: Western wheatgrass, spike muhly, Arizona fescue, and muttongrass.
Major management factors: Very slow permeability and ponding of water.
General management considerations:
• Livestock may be poisoned by browsing Gambel oak.
• Livestock can get stuck in the mud when soils are saturated.
Suitable management practices:
• Reseeding can be used to restore deteriorated areas.
• Development of livestock water supply and allowing for surface drainage will enhance plant production.

Wildlife Habitat

Wildlife on these soils include Steller's jay, common flicker, western tanager, white-breasted nuthatch, northern goshawk, screech owl, Cooper's hawk, wild turkey, red crossbill, western bluebird, mule deer, coyote, Abert squirrel, black bear, porcupine, deer mouse, cougar, short-horned lizard, gopher snake, and great basin rattlesnake.
General management considerations:
• Supports a diverse plant community of conifers with an understory of perennial grasses, forbs, and shrubs.
• Provides important habitat for cavity-nesting birds.

Suitable management practices:
- Preserve snags for cavity-nesting birds.
- Proper grazing use of vegetation to provide forage for wildlife.
- Prescribed burns.

Interpretive Groups

Land capability classification: 6W
Range site: Meadow 17-25" p.z.

92—Yellowhorse-Luzena family complex, 1 to 10 percent slopes

Setting

Landform: mesas
Landscape position: summits
Flooding: none
Slope range: Yellowhorse and Luzena family—1 to 10 percent
Elevation: 6,600 to 7,200 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 135 days

Composition

Yellowhorse and similar soils: 50 percent
Luzena family and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Yellowhorse

0 to 2 inches—reddish brown cobbly loam
2 to 10 inches—reddish brown clay loam
10 to 24 inches—reddish brown clay
24 inches—basalt bedrock

Luzena family

0 to 2 inches—reddish brown very cobbly loam
2 to 16 inches—dark reddish brown clay
16 to 19 inches—dark reddish brown gravelly clay
19 inches—basalt bedrock

Soil Properties and Qualities

Yellowhorse

Parent material: alluvium and colluvium from volcanic rocks
Depth class: moderately deep
Drainage class: well drained
Permeability: very slow
Available water capacity: very low to low
Potential rooting depth: 20 to 40 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Luzena family

Parent material: alluvium and colluvium from volcanic rocks
Depth class: shallow
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep and deep, loamy to clayey soils that have more than 35 percent rock fragments on summits
- Moderately deep and deep, loamy to clayey soils on slopes of more than 10 percent
- Rock outcrop

Similar inclusions:
- Clayey soils that are deeper than 40 inches to bedrock
- Clayey soils that do not have a dark surface layer
- Areas of Luzena family soils that have a very cobbly clay loam surface texture
- Areas of Yellowhorse soils that have a cobbly clay loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Yellowhorse and Luzena family soils:
- Potential plant community—perennial grasses (such as blue grama, bottlebrush squirreltail, and prairie junegrass); shrubs (such as big sagebrush and Utah serviceberry); trees (such as ponderosa pine, Utah juniper, and pinyon pine).

Important forage species: Blue grama, bottlebrush squirreltail, and prairie junegrass.
Major management factors: Depth to bedrock, stones, and cobbles on surface.
General management considerations on the Yellowhorse and Luzena family soils:
- When ingested, ponderosa pine needles may cause stillbirths or calves that soon die after birth.

• Livestock may also be poisoned by browsing on Gambel oak.
• Ponderosa pine and Gambel oak are the dominant vegetation on these two soils. Livestock should be watched more closely during times of stress such as drought or lack of an alternate feed source.
Suitable management practices on the Yellowhorse and Luzena family soils:
• Brush management and range seeding can be used to restore productivity.
• Seedlings provide an excellent food source once they are established.

Woodland

• This unit can produce about 270 to 280 board feet per acre of ponderosa pine lumber.
Dominant woodland species on the Yellowhorse and Luzena family soils:
• Potential woodland species—ponderosa pine, Utah juniper, pinyon pine, and Gambel oak
Major management factors on the Yellowhorse and Luzena family soils:
• Depth to bedrock, stones, and cobbles on surface, and clayey, very sticky subsoils which limit equipment access when moist.
General management considerations on the Yellowhorse and Luzena family soils:
• Stones and cobbles on the surface limit access for logging equipment.
• Harvesting should be done when soils are somewhat dry so equipment will not destroy soil structure and increase soil erosion.
• If harvesting is done during dry season, care must be taken to prevent forest fires.
Suitable management practices on the Yellowhorse and Luzena family soils:
• Thinning of thick stands of trees increases vigor and growth.
• Timber harvesting may not be practical because of the size of the mesa, but firewood harvesting may be a consideration.

Wildlife Habitat

Wildlife on these soils include Steller's jay, common flicker, western tanager, white-breasted nuthatch, northern goshawk, screech owl, Cooper's hawk, wild turkey, red crossbill, western bluebird, mule deer, coyote, Abert squirrel, black bear, porcupine, deer mouse, cougar, short-horned lizard, gopher snake, and great basin rattlesnake.
General management considerations:
• Supports a diverse plant community of conifers with an understory of perennial grasses, forbs, and shrubs.
• Provides important habitat for cavity-nesting birds.
Suitable management practices:
• Preserve snags for cavity-nesting birds.
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Yellowhorse—7S; Luzena family—6S
Woodland site: Yellowhorse and Luzena family—Basalt Upland (PIPO) 17-25" p.z.

93—Yumtheska-Katzine-Rock outcrop complex, 2 to 30 percent slopes

Setting

Landform: limestone hills
Landscape position: Yumtheska—summits and back slopes; Katzine—foot slopes; Rock outcrop—anywhere in unit
Flooding: none
Slope range: Yumtheska—2 to 20 percent; Katzine—5 to 30 percent;
Rock outcrop—2 to 100 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 150 days

Composition

Yumtheska and similar soils: 50 percent
Katzine and similar soils: 20 percent
Rock outcrop and similar soils: 20 percent
Contrasting inclusions: 10 percent

Typical Profile

Yumtheska

0 to 2 inches—brown very gravelly loam
2 to 13 inches—brown, calcareous very gravelly loam
13 inches—limestone bedrock

Katzine

0 to 8 inches—brown very gravelly loam
8 to 20 inches—light brown, calcareous very gravelly loam
20 to 31 inches—light brown, calcareous gravelly loam
31 to 60 inches—pink, calcareous very gravelly loam

Rock outcrop

Consists of areas of exposed limestone bedrock.

Soil Properties and Qualities

Yumtheska

Parent material: alluvium and colluvium
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to very rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Katzine

Parent material: alluvium and colluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Moderately deep to deep, loamy soils in drainages

Similar inclusions:
- Shallow to moderately deep, loamy soils on hillsides
- Areas of Katzine soils that have a very gravelly fine sandy loam surface texture
- Areas of Yumtheska soils that have a very gravelly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Yumtheska soil:
- Potential plant community—perennial grasses (such as muttongrass, blue grama, prairie junegrass, and bottlebrush squirreltail); shrubs (such as big sagebrush, Mexican cliffrose, and Utah serviceberry); trees (such as Colorado pinyon and Utah juniper).

Dominant vegetation on the Katzine soil:
- Potential plant community—perennial grasses (such as blue grama, muttongrass, and prairie junegrass); shrubs (such as big sagebrush and Utah serviceberry); trees (such as Colorado pinyon and Utah juniper).

Important forage species: Muttongrass, blue grama, prairie junegrass, and bottlebrush squirreltail on the Yumtheska soils; blue grama, muttongrass, and prairie junegrass on the Katzine soil.

Major management factors: Depth to bedrock and droughty on the Yumtheska soil; slopes on the Katzine soil.

General management considerations on the Yumtheska soil:
- Shallow soil depths and slope severely limit management practices such as brush management, reseeding, and development of water impoundments.

Suitable management practices on the Yumtheska soil:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Fencing and deferred grazing are important in planned grazing systems.
- Fuelwood harvesting can open up areas to forage production.

General management considerations on the Katzine soil:
- Slopes and small area size limit management practices.

Suitable management practices on the Katzine soil:
- Planned grazing systems are essential to maintain plant vigor and forage production.
- Development of water impoundment areas helps in livestock distribution.
- Fuelwood harvesting helps to open up areas to less woody species and increases forage production.

Fuelwood Production

- The Yumtheska soils can produce about 3 to 5 cords per acre.
- The Katzine soils can produce about 5 to 10 cords per acre.

Suitable management considerations on the Yumtheska and Katzine soils:
- Reduce risk of erosion by proper installation and maintenance of access roads.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, mountain bluebird, green-tailed towhee, dark-eyed junco, red-tailed hawk, American kestrel, mule deer, coyote, woodrat, cottontail, pinyon mouse, deer mouse, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of pinyon-juniper woodland with an understory of perennial grasses, forbs, and shrubs.
- Area provides escape cover for pronghorn antelope and mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Develop water for wildlife.
- Brush management—prescribed burns and chaining.
- Brush management must retain thermal and escape cover for wildlife and create habitat diversity.

Interpretive Groups

Land capability classification: Yumtheska and Katzine—6S; Rock outcrop—8
Range site: Yumtheska—Limestone Slopes (PIED, JUOS) 13-17" p.z.; Katzine—Loamy Upland, Gravelly (PIED, JUOS) 13-17" p.z.; Rock outcrop—none

94—Yumtheska-Katzine-Rock outcrop complex, 5 to 50 percent slopes, moist

Setting

Landform: mountain
Landscape position: Yumtheska—summits and back slopes; Katzine—foot slopes; Rock outcrop—summits and back slopes
Flooding: none
Slope range: Yumtheska—5 to 50 percent; Katzine—5 to 50 percent;
Rock outcrop—20 percent to vertical
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 56 degrees F
Frost-free period: 120 to 165 days

Composition

Yumtheska and similar soils: 50 percent
Katzine and similar soils: 20 percent
Rock outcrop and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Yumtheska

0 to 1 inch—grayish brown very gravelly loam
1 to 10 inches—dark grayish brown, calcareous very gravelly loam
10 inches—limestone bedrock

Katzine

0 to 2 inches—brown extremely gravelly loam
2 to 11 inches—dark brown very cobbly loam
11 to 22 inches—brown, calcareous very cobbly loam
22 to 60 inches—brown, calcareous very cobbly sandy loam

Rock outcrop

Extremely hard limestone.

Soil Properties and Qualities

Yumtheska

Parent material: alluvium and colluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Katzine

Parent material: alluvium and colluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: slight to very severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Shallow to moderately deep, gravelly and very gravelly loamy soils on back slopes
- Moderately deep to deep, loamy soils along drainages

Similar inclusions:
- Areas between 6,500 and 8,000 feet elevation on mountain peaks

Use and Management

Rangeland

Dominant vegetation on the Yumtheska soils:
- Potential plant community—perennial grasses (such as prairie junegrass, muttongrass, and blue grama); shrubs (such as Utah serviceberry, Mexican cliffrose, and silktassel); trees (such as Colorado pinyon and Gambel oak).

Dominant vegetation on the Katzine soils:
• Potential plant community—perennial grasses (such as prairie junegrass, muttongrass, and blue grama); shrubs (such as mountain big sagebrush, Utah serviceberry, and yellowleaf silktassel); trees (such as singleleaf pinyon).
Important forage species: Prairie junegrass, blue grama, muttongrass, and cliffrose.
Major management factors: Hazard of erosion and slope on both soils; depth to bedrock and droughtiness on Yumtheska soil.
General management considerations on the Yumtheska and Katzine soils:
• This unit produces year-round browse for wildlife.
• This unit contains areas of thick vegetative cover that make it difficult for livestock or humans to traverse.
• Water is scarce in these areas.
Suitable management practices on the Yumtheska and Katzine soils:
• Construction of trails on steeply sloping and thickly vegetated areas increases access.
• Development of water impound areas helps in use of area by livestock and wildlife.

Wildlife Habitat

Wildlife on these soils include scrub jay, bushtit, long-eared owl, ash-throated flycatcher, rufous-sided towhee, American kestrel, mule deer, coyote, woodrat, brush mouse, great basin pocket mouse, cottontail, gray fox, cougar, striped whiptail, short-horned lizard, gopher snake, striped whipsnake, and great basin rattlesnake.
General management considerations:
• Supports a plant community of chaparral with an understory of perennial grasses, forbs, and shrubs.
• Provides crucial summer habitat for mule deer.
Suitable management practices:
• Proper grazing use of vegetation to provide forage for wildlife.
• Prescribed burns.

Interpretive Groups

Land capability classification: Yumtheska and Katzine—7E; Rock outcrop—8
Range site: Yumtheska and Katzine—Limestone Slopes (PIED, JUOS) 13-17" p.z.; Rock outcrop—none

95—Yumtheska-Natank complex, 10 to 45 percent slopes

Setting

Landform: plateaus and mesas
Landscape position: Yumtheska—back slopes and summits; Natank—foot slopes and summit depressions
Flooding: none
Slope range: Yumtheska—10 to 45 percent; Natank—10 to 20 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 135 to 150 days

Composition

Yumtheska and similar soils: 65 percent
Natank and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Yumtheska

0 to 2 inches—brown very gravelly loam
2 to 14 inches—dark brown and light gray, calcareous very gravelly loam
14 inches—limestone bedrock

Natank

0 to 1 inch—brown very gravelly loam
1 to 6 inches—dark brown gravelly clay loam
6 to 17 inches—strong brown gravelly clay
17 to 28 inches—strong brown, calcareous gravelly clay loam
28 inches—limestone bedrock

Soil Properties and Qualities

Yumtheska

Parent material: alluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to very rapid

Hazard of water erosion: slight to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Natank

Parent material: alluvium from sedimentary formations
Depth class: moderately deep
Drainage class: well drained
Permeability: slow
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: medium to rapid
Hazard of water erosion: slight to moderate
Hazard of wind erosion: slight
Shrink-swell potential: high
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Deep to moderately deep, very gravelly loamy soils on back slopes
- Moderately deep to deep, very gravelly loamy to sandy, fluventic soils along drainages

Similar inclusions:
- Areas of Yumtheska soils that have a very gravelly sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Yumtheska soil:
- Potential plant community—perennial grasses (such as muttongrass, prairie junegrass, blue grama, and bottlebrush squirreltail); shrubs (such as big sagebrush and Mexican cliffrose); trees (such as Utah juniper and singleleaf pinyon).

Dominant vegetation on the Natank soil:
- Potential plant community—perennial grasses (such as prairie junegrass, blue grama, western wheatgrass, and galleta); shrubs (such as big sagebrush); trees (such as Utah juniper and Colorado pinyon).

Important forage species: Blue grama, prairie junegrass, muttongrass, bottlebrush squirreltail, and western wheatgrass.
Major management factors: High shrink-swell of the Natank soil, rapid runoff, depth to bedrock, and droughtiness on both soils.
General management considerations on the Yumtheska and Natank soils:
- Complex slopes and vertical exposures of rock limit access to livestock and encourage overgrazing of less sloping areas.
- Brush management treatments are limited by slope and depth to bedrock.

Suitable management practices on the Yumtheska and Natank soils:
- Planned grazing systems help control erosion and increase plant vigor and variety.
- Spot treatment of heavily infested areas of undesirable plants can be done where soils are deeper than 20 inches and slopes are not steep.
- Reseeding treated areas is recommended to shorten recovery time and control erosion.

Fuelwood Production

- The Yumtheska and Natank soils can produce about 6 cords of fuelwood per acre with a site index of 50.

General management considerations on the Yumtheska and Natank soils.:
- Moderate to severe erosion hazard and steep slopes limit motorized vehicle use.
- Reduce risk of erosion by proper installation and maintenance of access roads.

Wildlife Habitat

Wildlife on these soils include pinyon jay, Steller's jay, mountain bluebird, green-tailed towhee, dark-eyed junco, red-tail hawk, American kestrel, mule deer, coyote, woodrat, cottontail, pinyon mouse, deer mouse, cougar, northern whiptail lizard, leopard lizard, short-horned lizard, striped whipsnake, and great basin rattlesnake.

General management considerations:
- Supports a plant community of pinyon-juniper woodland with an understory of perennial grasses, forbs, and shrubs.
- Area provides escape cover for pronghorn antelope and mule deer.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Develop water for wildlife.
- Brush management—prescribed burns and chaining.
- Brush management must retain thermal and escape cover for wildlife and create habitat diversity.

Interpretive Groups

Land capability classification: Yumtheska—7E; Natank—6S
Range site: Yumtheska—Limestone Slopes (PIED, JUOS) 13-17" p.z.; Natank—Clay Loam Upland, Gravelly (PIED, JUOS) 13-17" p.z.

96—Yurm family-Meadview association, 15 to 40 percent slopes

Setting

Landform: fan terraces and mesas
Landscape position: Yurm family—summits and shoulders; Meadview—back slopes, foot slopes and swales on summits
Flooding: none
Slope range: Yurm family—15 to 25 percent; Meadview—20 to 40 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Yurm family and similar soils: 50 percent
Meadview and similar soils: 25 percent
Contrasting inclusions: 25 percent

Typical Profile

Yurm family

0 to 2 inches—brown very cobbly sandy loam
2 to 16 inches—light brown, calcareous very cobbly loam
16 to 60 inches—indurated, lime-cemented hardpan

Meadview

0 to 11 inches—light brown and pink very gravelly sandy loam
11 to 23 inches—pink, weakly lime-cemented very gravelly sandy loam
23 to 60 inches—pink, weakly lime-cemented extremely gravelly sandy loam

Soil Properties and Qualities

Yurm family

Parent material: alluvium and colluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Meadview

Parent material: mixed alluvium and colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, very gravelly sandy, calcareous soils on back slopes
- Moderately deep to deep, very gravelly loamy to sandy, fluventic soils in drainages
- Exposed very strongly lime-cemented conglomerate

Similar inclusions:
- Moderately deep soils similar to Yurm family
- Areas of soils on steep to very steep side slopes similar to Yurm family
- Areas of soils weakly to strongly lime-cemented similar to Meadview
- Areas of Meadview soils that have a very cobbly sandy loam or very gravelly fine sandy loam surface texture
- Areas of Yurm family soils that have a very gravelly or very cobbly loam or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Yurm family soils:
- Potential plant community—perennial grasses (such as desert needlegrass and big galleta); shrubs (such as creosotebush, Mormontea and white bursage).

Dominant vegetation on the Meadview soils:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as creosotebush, Mormontea, white ratany, and white bursage).

Important forage species: Indian ricegrass, big galleta, desert needlegrass, and Mormontea.
Major management factors: Shallow depths of the Yurm family soils; slope, droughtiness, and hazard of erosion on both soils.
General management considerations on the Yurm family and Meadview soils:

- Typically steep slopes severely restrict use by livestock.
- Proper grazing distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes.
- Overgrazing lower slopes increases erosion.

Suitable management practices on the Yurm family and Meadview soils:

- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:

- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:

- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Yurm family—7S; Meadview—7E
Range site: Yurm family—Limy Upland 6-9" p.z.; Meadview—Limy Upland, Deep 6-9" p.z.

97—Yurm family-Meadview association, 15 to 40 percent slopes, moist

Setting

Landform: fan terraces and mesas
Landscape position: Yurm family—summits and shoulders; Meadview—back slopes and foot slopes, and swales on mesas
Flooding: none
Slope range: Yurm family—15 to 25 percent; Meadview—20 to 40 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Yurm family and similar soils: 50 percent
Meadview and similar soils: 25 percent
Contrasting inclusions: 25 percent

Typical Profile

Yurm family

0 to 2 inches—brown very cobbly sandy loam
2 to 16 inches—light brown, calcareous very cobbly loam
16 to 60 inches—indurated, lime-cemented hardpan

Meadview

0 to 11 inches—light brown very gravelly sandy loam
11 to 23 inches—pink, weakly lime-cemented very gravelly sandy loam
23 to 60 inches—pink, weakly lime-cemented extremely gravelly sandy loam

Soil Properties and Qualities

Yurm family

Parent material: alluvium and colluvium from sedimentary formations
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Meadview

Parent material: mixed alluvium and colluvium from sedimentary formations
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: very low to low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Deep and very deep, very gravelly sandy, calcareous soils on back slopes
- Moderately deep to deep, very gravelly loamy to sandy, fluventic soils in drainages
- Exposed very strongly lime-cemented conglomerate

Similar inclusions:
- Moderately deep soils similar to Yurm family
- Areas of soils on steep to very steep side slopes similar to Yurm family
- Areas of soils that are weakly to strongly lime-cemented similar to Meadview
- Areas of Meadview soils that have a very cobbly sandy loam or very gravelly fine sandy loam surface texture
- Areas of Yurm family soils that have a very cobbly or very gravelly loam or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation on the Yurm family soils:
- Potential plant community—perennial grasses (such as desert needlegrass and big galleta); shrubs (such as blackbrush, Mormontea, and banana yucca).

Dominant vegetation on the Meadview soils:
- Potential plant community—perennial grasses (such as big galleta and Indian ricegrass); shrubs (such as blackbrush, creosotebush, and Mormontea).

Important forage species: Indian ricegrass, big galleta, and desert needlegrass.

Major management factors: Shallow depths of the Yurm family soils; slope, droughtiness, and hazard of erosion on both soils.

General management considerations on the Yurm family and Meadview soils:
- Typically steep slopes severely restrict use by livestock.
- Proper grazing distribution is often difficult to obtain.
- Heavy grazing occurs on the lower slopes.
- Overgrazing lower slopes increases erosion.
- Ground cover should be maintained or improved to reduce risk of erosion.

Suitable management practices on the Yurm family and Meadview soils:
- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: Yurm family—7S; Meadview—7E

Range site: Yurm family—Shallow Upland 9-12" p.z.; Meadview—Sandy Loam, Gravelly 9-12" p.z.

98—Yurm family very gravelly loam, 15 to 35 percent slopes

Setting

Landform: fan terraces
Landscape position: summits and shoulders
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Yurm family and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—brown very gravelly loam
2 to 16 inches—light brown, calcareous very gravelly loam
16 to 60 inches—indurated, lime-cemented hardpan

Soil Properties and Qualities

Parent material: alluvium and colluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate

Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low
Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Deep to very deep, very gravelly loamy, calcareous soils on back slopes
- Moderately deep to deep, loamy to very gravelly sandy, fluventic soils along drainages

Similar inclusions:
- Moderately deep soils to a hardpan
- Areas that have a surface texture of very cobbly or very gravelly loam or sandy loam

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as desert needlegrass and big galleta); shrubs (such as creosotebush, white bursage, and Mormontea).

Important forage species: Desert needlegrass, big galleta, Mormontea, and annuals.
Major management factors: Depth to hardpan, droughtiness, slope, and hazard of erosion.
General management considerations:
- Vertical exposures of conglomerate and steep-sided drainageways limit access to livestock.
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage on this soil.
- Drainageways provide shelter, forage, and water, if developed.

Suitable management practices:
- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Limy Upland 6-9" p.z.

99—Yurm family very gravelly loam, 15 to 35 percent slopes, moist

Setting

Landform: fan terraces
Landscape position: summits and shoulders
Flooding: none
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 240 days

Composition

Yurm family and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—brown very gravelly loam
2 to 16 inches—light brown, calcareous very gravelly loam
16 to 60 inches—indurated, lime-cemented hardpan

Soil Properties and Qualities

Parent material: alluvium and colluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: low

Corrosivity: concrete—low; uncoated steel—high

Inclusions

Contrasting inclusions:
- Rock outcrop
- Deep to very deep, very gravelly loamy, calcareous soils on back slopes
- Moderately deep to deep, loamy to very gravelly sandy, fluventic soils along drainages

Similar inclusions:
- Moderately deep soils to a hardpan
- Areas that have a very gravelly or very cobbly loam or sandy loam surface texture

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—perennial grasses (such as desert needlegrass and big galleta); shrubs (such as blackbrush, banana yucca, creosotebush, and Mormontea).

Important forage species: Desert needlegrass, black grama, big galleta, Mormontea, and annuals.

Major management factors: Depth to hardpan, droughtiness, slope, and hazard of erosion.

General management considerations:
- Vertical exposures of conglomerate and steep-sided drainageways limit access to livestock.
- High lime content, low available water capacity, and the inhibiting influence of the creosotebush contribute to the low production of forage on this soil.
- Drainageways provide shelter, forage, and water, if developed.

Suitable management practices:
- Building trails in steeply sloping areas increases access to livestock.
- Planned grazing systems help control erosion and increase plant vigor and variety.

Wildlife Habitat

Wildlife on these soils include Gambel's quail, red-tail hawk, mourning dove, prairie falcon, black-chinned sparrow, roadrunner, kangaroo rat, woodrat, kit fox, antelope ground squirrel, badger, desert tortoise, Arizona night lizard, coachwhip, Gila monster, chuckwalla, sidewinder, desert iguana, leopard frog, tiger salamander, and spadefoot toad.

General management considerations:
- Supports a plant community of perennial grasses, forbs, and shrubs.
- Provides important foraging habitat for raptors.
- Proposed critical habitat for desert tortoise.
- Important chuckwalla habitat.

Suitable management practices:
- Proper grazing use of vegetation to provide forage for wildlife.
- Full suppression of wildfire.
- Control off-road vehicle use.

Interpretive Groups

Land capability classification: 7E
Range site: Shallow Upland 9-12" p.z.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

No soil areas mapped in this survey met the Prime Farmland criteria in 1994 when the field work was completed.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The estimated yields of the main crops and pasture plants are listed for each soil, the system of land capability classification used by the Natural Resources Conservation Service is explained, and prime farmland is described.

Planners of management systems for individual fields or farms should consider the detailed

information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (USDA 1961). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numbers 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a letter, *E, W, S,* or *C,* to the class numeral, for example, 2E. The letter *E* shows that the main hazard is the 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 very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *W, S,* or *C* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Larry Ellicott, range conservationist, wrote this section.

About 83 percent of the land in the survey area is rangeland. This section describes some of the general vegetative communities and the principles of range management, and defines range site and condition.

Lands along the Virgin River and from Mud Mountain down the Grand Wash Cliffs are in the Grand Canyon Desert Shrub (Land Resource Unit D30B) (USDA 1981). These, the warmest and most arid parts of the survey area, are characterized by the presence of creosotebush and associated species of low shrubs such as white bursage, Anderson wolfberry, and spiny hopsage. Cacti are represented by a variety of hedgehogs, chollas, beavertail cactus, and Mojave pricklypear. Many ephemeral species, mainly winter annuals and some summer annuals, occur also. Good rains during October and November provide mass seed germination of these winter annuals.

Lands roughly bounded by Main Street, Poverty Mountain, Diamond Butte, and Grassy Mountain and along the Grand Wash Bench are in the Colorado Plateau Sagebrush - Grassland (Land Resource Unit D35C). It is characterized by large expanses of Wyoming big sagebrush with areas of Utah juniper, and Colorado and singleleaf pinyon pine. Serious gully erosion occurs in local areas, and increased density of sagebrush is a problem. Some typical grasses are galleta, Indian ricegrass, blue grama, and needleandthread. Seral communities within this type are heavily influenced by two forces, grazing and fire. After fire, the non-sprouting sagebrush may be replaced by sprouting species of rabbitbrush,

snakeweed, and annual species such as cheatgrass and Russian thistle.

Lands in the Hurricane Wash west of the Hurricane Cliffs to a line between Seegmiller Mountain and Diamond Butte are in the Colorado Plateau Cold Desert Grassland (Land Resource Unit D35D). This area is characterized by high desert low shrub and grassland communities. Species diversity is generally low for this type, and one shrub dominates in each major plant community. Another feature that sets this desert apart from other deserts is the absence of typical desert plants along minor waterways. Because of physiological adaptation to the conditions imposed by gypsiferous soils, which are prominent in the area, the desert plants (some of the Atriplex species) in this zone have evolved a tolerance to low temperatures. The ability to accumulate salts as a means of surviving on saline soils may have given the plants their ability to withstand the cool climate.

Lands along the top of the Virgin Mountains are in the Arizona Interior Chaparral (Land Resource Unit D38A), and those on top and east of the Grand Wash Cliffs from Wolf Hole Mountain to the Hidden Hills are in the Grand Canyon Woodland Shrub (Land Resource Unit D39C). Also included is the area from Snap Point to Yellow John Mountain (complex of the D38A and D39C). These lands are characterized as the transition from Arizona Chaparral to Great Basin Conifer Woodland. There are chaparral plants such as manzanita, turbinella oak, and desert ceanothus. There are also areas of Utah juniper and singleleaf pinyon. Understory species include blue grama, prairie junegrass, snakeweed, bottlebrush squirreltail, and needleandthread. In places that have burned, manzanita has become established as a nearly monoculture plant community, especially on Mount Bangs.

Production of high quality forage conserves and protects soil, moisture, and plant resources. A harvest of high quality forage can be insured by maintaining the native vegetation or by improving it to its highest potential. Grasses manufacture the food they need to grow, flower, and reproduce. If the plants are properly managed, they will remain healthy and vigorous.

Effective management of rangeland depends upon many factors. The season of use, intensity of use, kinds and distribution of grazing animals, and a knowledge of the resource capability are very important management considerations.

The primary objective in range management is to control grazing so that the plants growing on a site are similar in kind and amount to the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the maximum potential meets grazing needs, provides for wildlife habitat, and protects the soil and water resources.

The forage plants in many parts of the survey area have been depleted by excessive and untimely use. There has been a general reduction on cool-season grasses and a general increase in woody, non-forage plants. Productivity of forage plants generally is below the potential of the soils. Uneven livestock distribution has created localized overuse and underuse of forage. Gully erosion is extensive on some flood plain and stream terrace soils, and sheet erosion occurs on some of the upland soils.

Many areas that were once open grassland have been encroached upon by juniper trees. Adequate fuel, which the herbaceous plants once provided, is now inadequate to carry the natural fires that once controlled the encroachment of juniper. Broom snakeweed, a half-shrub, has also dramatically increased, particularly on the shallow soils. These woody plants compete for soil moisture with forage plants that should dominate the sites.

Abnormal amounts of woody plants, excessive erosion, and the abundance of toxic plants are all symptoms of a deteriorated range condition. However, a systematic range improvement program can help correct this situation.

Shrubs and trees can be managed in a number of ways. Several mechanical forms of brush management have been used in the survey area. Large areas of juniper have been mechanically treated. Chaining, cabling, or pushing of trees has met with mixed success. The use of herbicides, particularly on shrubby plants, is effective if soil moisture and other growing conditions are satisfactory. Seeding should be done after brush management in areas where understory vegetation is lacking.

Gully erosion has a profound effect on forage production of flood plain and stream terrace soils. These soils are potentially the most productive in the survey area. When the plant cover on these soils deteriorates, they are more susceptible to erosion. Some sites receive extra runoff from adjacent areas and readily respond to management. The best treatment of these sites is to allow them to be rested from livestock grazing. Other suitable treatment practices for these sites are water spreading and grade stabilization structures. The improvement of many of these sites can be accelerated by seeding locally adapted forage plants.

Gully erosion can be partially controlled by adequate treatment and management of the upland soils that

contribute runoff to the lower lying areas. Severely depleted upland sites may require range seeding of adapted species to increase the ground cover. Increasing the plant cover slows water runoff, increases moisture infiltration, improves growing conditions, and reduces sheet erosion.

Management of the rangeland resources in this area should be directed toward meeting the native plant requirements. Critical growth stages in the native plant community must be recognized and considered when selecting a grazing management program. A systematic grazing program should include proper stocking levels and protection from continuous use. Livestock distribution can be improved by fencing and developing additional water facilities; however, livestock watering ponds are not dependable and can cause grazing distribution problems. Wells, pipelines, storage tanks, and spring developments are a much more dependable means of providing water. Fences should be used to divide pastures into manageable units. Fences and watering facilities can be used to force animals to use areas that might otherwise be underused.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils, vegetation, and water. All of the soils in this survey area that are used for grazing are grouped into range sites. A range site is the product of all environmental factors responsible for its development. It is a distinctive kind of rangeland that has the capability of producing a characteristic native plant community. A characteristic native plant community consists of a balance of grasses, forbs, and shrubs that make up the potential plant community. Over time on undisturbed sites, a mixture of plants best adapted for growing on a site has developed. This group of plants is called the potential natural or climax plant community. This plant community differs in kind, amount, and proportion from plant communities on other range sites. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, calcium carbonate or salt content and topographic position are also important.

Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not automatically establish a value of the present plant community for any given site.

Table 6 shows, for each soil, the range site and the total annual production of vegetation in favorable, normal and unfavorable years. Total annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is twigs, flowers, and/or fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture. Dry weight is the total annual yield per acre reduced to a common percent of air dry moisture.

Woodland

Larry Ellicott, NRCS Range Conservationist, wrote this section.

Woodland Overstory Vegetation

About 21 percent of the land area in the survey area is woodland. This section describes some of the general characteristics and vegetative communities and the principles of woodland management.

In this survey area, the woodlands are generally characterized by the presence of juniper and pinyon species, also known as the PJ zone. Species most commonly found are Utah juniper (juniperus osteosperma), singleleaf pinyon (pinus monophylla), and Colorado pinyon (pinus edulis). Two areas in the survey area—Black Rock Mountain and Mount Dellenbaugh—have ponderosa pine (pinus ponderosa) stands.

The junipers are generally more prevalent than pinyons, but either may appear as an essentially pure stand. Junipers tend to be at lower elevations and lower precipitation levels than the pinyons. The pinyons tend to be between the juniper zone and the ponderosa pine zone. Soils most likely to be occupied by these woodlands are generally shallow, rocky, and steeper. In the driest parts of the woodland zone below 6,500 feet elevation, the junipers will also be found on deeper soils. Junipers have invaded large areas of former grassland in part because of the absence of natural fires and mismanagement of competing species. This is not necessarily true of the pinyons.

Typical understory plants are big sagebrush, (Artemisia spp.), blue grama (bouteloua gracilis), threadleaf groundsel (senecio longilobus), and

snakeweed (gutierrezia sarothrae). Big sagebrush will often dominate in areas of deeper soils, forming parks in the woodland. In the western part of the survey area where the woodland borders the Mohave Desert, some of the low desert plants such as blackbrush (coleogyne ramosissima) occur in the understory. Also, in some areas the understory has interior chaparral species such as turbinella oak (quercus turbinella) and Wright silktassel (garrya wrightii).

Two small stands of ponderosa pine (pinus ponderosa) occur in the survey area. One is on Black Rock Mountain. This is a sparse stand and has an understory of Gambel oak (quercus gambelii), junipers and pinyons, cliffrose (cowania mexicana), and grasses such as blue grama (bouteloua gracilis) and western wheatgrass (agropyron smithii). The other stand, around and on Mount Dellenbaugh, is larger and in the past has been logged. The understory species are similar in composition to those of Black Rock Mountain.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the ordination symbol, a number, indicates the potential productivity of the soils for important trees. The number 3 indicates very high productivity; 2, medium; 1, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter x indicates stoniness or rockiness; w, excessive water in or on the soil; t, toxic substances in the soil; d, restricted root depth; c, clay in the upper part of the soil; s, sandy texture; f, high content of coarse fragments in the soil profile; and r, steep slopes. The letter o indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, slight, moderate, and severe indicate the degree of the major soil limitations to be considered in management.

Ratings of the erosion hazard indicate the risk of loss of soil in well managed woodland. The risk is slight if the expected soil loss is small, moderate if measures are needed to control erosion during logging and road construction, and severe if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of equipment limitation reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of slight indicates that use of equipment is not limited to a particular kind of equipment or time of year; moderate indicates a short seasonal limitation or a need for some modification in management or in equipment; and severe indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of slight indicates that the expected mortality is less than 25 percent; moderate, 25-50 percent; and severe, more than 50 percent.

Ratings of windthrow hazard are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of slight indicates that few trees may be blown down by strong winds; moderate, that some trees will be blown down during periods of excessive soil wetness and strong winds; and severe, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of plant competition indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of slight indicates little or not competition from other plants; moderate indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; severe indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The potential productivity of merchantable or common trees on a soil is expressed as a site index. This index is the average height, in feet, that dominant and codominant trees of a give species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Woodland Understory Vegetation

Understory vegetation consists of grasses, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support

grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation varies with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Table 8 shows, for each soil suitable for woodland use, the potential for producing understory vegetation. The total production of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4.5 feet. It is expressed in pounds per acre of air dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 8 also list the common names of the characteristic vegetation on each soil and the percentage composition, by air dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11, and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and

boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

David W. Seery, NRCS wildlife biologist, wrote this section.

The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. Soils also affect the construction of water impoundments. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

There are five main areas containing wildlife habitat in this survey area. These are discussed and listed below:

Hillslopes, terraces, and plateaus.

Soils in these areas produce pinyon-juniper woodlands and grasslands on their gently undulating terraces and plateaus. Shallow soils with grasses and shrubs are on the side slopes and edges. Many birds and animals use pinyon nuts for food. Hawks and owls nest in juniper trees. Mule deer hide in the woodlands. Woodpeckers and bluebirds use holes in trees for nesting.

Wide alluvial valleys.

The floodplains and streams should have hardwood trees such as cottonwood, willow, ash, and walnut. Many of these trees have been removed and could be replaced in streambeds, where soil is wet. These areas are used by crows, rabbits, owls, skunks, snakes, and songbirds.

Fan terraces and stream terraces are broad areas between the floodplains and the plateaus. These upland sites are the home of antelope, badger, prairie dog, desert tortoise, and hawks. These grasslands are also used by cattle, sheep, and horses.

Breaks.

These are the steep, broken lands on the edges of mesas and mountains. Breaks are geologic eroding areas that have ridges, crevices, gullies, and some vertical rock walls with small caves and ledges. Many different kinds of plants grow on breaks but not in large amounts. The variety of plant life and the broken topography attract a large variety of wildlife. Deer can hide in the breaks and feed on the browse. A fox must run only a short distance to be out of danger. Scattered trees and ledges are hunting perches for hawks and eagles.

Rock outcrop.

These are the bluffs and cliffs on canyon walls and mesa edges. These soils produce no vegetation but are important to many species of wildlife. Eagles, hawks, owls, and swallows nest on ledges. Bats roost in cracks and caves. Foxes, bobcats and cougars have dens in overhangs and caves.

Mountains.

The mountains in the survey area cover a variety of habitats from chaparral, pinyon-juniper woodlands to high mountain ponderosa pine and Douglas fir forests. These are home to wild turkey, mule deer, squirrels, blue jays, and bighorn sheep.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria

were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to

bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Subsidence Caused by Gypsum

John M. Harrington, NRCS design engineer, wrote this section

Gypsum is often associated with other more soluble minerals (Dana 1954). Consequently, when gypsum is encountered, other minerals may be present that may contribute to potential settlement. This could be an important consideration when evaluating sites for structures.

Gypsum is partially soluble in water, and therefore soils containing gypsum are subject to settlement by leaching. The National Soils Handbook (USDA 1996) indicates that soils containing 10 percent or more of gypsum may subside because of percolating water. This could be a problem around building foundations. An effective treatment to prevent leaching of gypsum is to prevent water from getting to the strata containing the gypsum. Directing drainage water away from structures so that the water does not percolate down through the soils can reduce the amount of settlement. Sandy soils that readily soak up water can be topped with fine-grained soils that tend to shed water.

Similar treatments can be effective for roads. Crowning and importing road base material can protect the underlying materials from percolating water. If a high concentration of gypsum is near or at the surface of the road base, initial compaction of the material can be a problem because the material is weak, especially when moist. Removal to a suitable depth and replacement with select material for compaction may solve the problem.

Gypsum affects building foundations not only by subsidence but also as a result of corrosion from sulfates. The presence of sulfates (gypsum is a sulfate) in concentrations of much less than 10 percent can be detrimental to the concrete. Air-entrained concrete, increased cement content, and fly ash are all beneficial in making concrete more durable to sulfate attack. The best solution to protect concrete from soils containing concentrations greater than 1 or 2 percent of sulfates is to over-excavate the soils and backfill them with material that is low in sulfates (USDI 1975).

Gypsum should be avoided for dikes or pond sites. Gypsum concentrations of less than 2 or 3 percent are normally considered acceptable for water impoundments, but concentrations of 10 percent or greater usually cannot be used (USDA, EWP Tech. Guide No. 4).

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the

solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is

determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In Table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of

the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture (1991). These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(ASTM 1993)* and the system adopted by the American Association of State Highway and Transportation Officials *(AASHTO 1986)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 14.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The

percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount

and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface,

and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, apparent, or artesian; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well

drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(USDA 1975, 1992)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent*, , the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, nonacid, mesic Typic Haplaquents.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(USDA 1993)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(USDA 1975)*. Unless otherwise indicated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Akinville Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: fan terrace
Parent material: alluvium and colluvium from sedimentary formations high in gypsum and calcium carbonate
Slope range: 2 to 20 percent
Elevation: 1,600 to 4,500 feet

Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, gypsic, thermic Typic Gypsiorthids

Typical Pedon

Akinville very gravelly fine sandy loam in an area of Akinville-Mokaac association, 2 to 20 percent slopes; about 0.6 miles south of Arizona-Utah state line; just west of the Hurricane cliffs; about 1,100 feet north and 1,600 feet east of the southwest corner of section 31, T.42 N., R.9 W.; Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 5/4) very gravelly fine sandy loam, dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine vesicular and few very fine tubular pores; 50 percent gravel and 10 percent cobbles; slightly effervescent, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk1—2 to 10 inches; light brown (7.5YR 6/4) very gravelly loam, dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 30 percent gravel and 10 percent cobbles; strongly effervescent with calcium carbonate segregated as few fine irregular soft masses, seams, and pendants on rock fragments, 18 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bk2—10 to 18 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 30 percent gravel and 10 percent cobbles; violently effervescent with calcium carbonate segregated as common fine irregular soft masses, seams, and pendants on rock fragments, 23 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bky—18 to 32 inches; light brown (7.5YR 6/4) very gravelly sandy loam, strong brown (7.5YR 5/6) moist; massive; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; many very fine irregular pores; 30 percent gravel, 10 percent cobbles, and 5 percent stones; violently effervescent with calcium carbonate segregated as common fine irregular soft masses, seams and pendants on rock fragments, 37 percent calcium carbonate equivalent; 10 percent crystalline gypsum occurs as pendants on rock fragments; moderately alkaline (pH 8.4); abrupt smooth boundary.

By1—32 to 48 inches; light brown (7.5YR 6/4) very gravelly sandy loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; many fine and very fine irregular pores; 50 percent gravel and 10 percent cobbles; strongly effervescent, 28 percent calcium carbonate equivalent; 25 percent crystalline gypsum occurs as pendants on rock fragments; slightly alkaline (pH 7.8); abrupt smooth boundary.

By2—48 to 60 inches; reddish yellow (7.5YR 6/6) extremely gravelly loamy sand, strong brown (7.5YR 5/6) moist; single grained; loose; many fine and very fine irregular pores; 60 percent gravel, 10 percent cobbles; strongly effervescent, 38 percent calcium carbonate equivalent; 20 percent crystalline gypsum occurs as pendants on rock fragments; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to calcic horizon: 1 to 10 inches
Depth to gypsic horizon: 15 to 35 inches
Average rock fragments: 30 to 60 percent gravel, 5 to 15 percent cobbles, 0 to 10 percent stones

A horizon:
Color—light brown, pink, or reddish yellow
Value—6 or 7 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to strong
Calcium carbonate—5 to 25 percent

Bk horizon:
Texture—very gravelly loam or sandy loam
Color—light brown, pink, or reddish yellow
Value—6 or 7 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent
Calcium carbonate—20 to 40 percent

By horizon:
Texture—very and extremely gravelly loamy sand, sandy loam, or loam
Color—light brown, brown, pink, reddish yellow, or strong brown
Value—5 through 7 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong
Calcium carbonate—20 to 40 percent
Gypsum—5 to 60 percent

Albers Series

Depth class: very deep
Drainage class: well drained
Permeability: very slow
Landform: stream terraces in mountain valleys
Parent material: alluvium from sedimentary and volcanic formations
Slope range: 0 to 1 percent
Elevation: 6,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: fine, montmorillonitic, mesic Aridic Haplusterts

Typical Pedon

Albers silty clay, 0 to 1 percent slopes; in Penn Valley about 4 miles northwest of Yellow John Mountain; about 2,600 feet south and 1,100 feet east of the northwest corner of section 6, T.32 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; common very fine roots; many fine irregular pores; 10 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

Bw—2 to 6 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; strong medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; noneffervescent; slightly alkaline (pH 7.4); clear smooth boundary.

Bss1—6 to 18 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky and very plastic; common fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; few slickensides and many pressure faces; 2 percent gravel; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bss2—18 to 47 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky and very plastic; few fine and very fine roots; few fine and very fine tubular and interstitial pores; common slickensides and many pressure faces; 2 percent gravel; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bk—47 to 60 inches; strong brown (7.5YR 5/6) clay, strong brown (7.5YR 4/6) moist; strong medium angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; very few very fine tubular and interstitial pores; many pressure faces; 10 percent gravel; slightly effervescent with calcium carbonate segregated as common fine flakes, 5 percent calcium carbonate equivalent; slightly alkaline (pH 7.8).

Range in Characteristics

Rock fragments: 0 to 15 percent gravel

A horizon:
- Color—brown or dark brown
- Value—4 or 5, dry or moist
- Chroma—2 or 3, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Effervescence—none to slight
- Rock fragments—0 to 5 percent gravel

Bss horizon:
- Texture—clay or silty clay
- Color—brown, dark brown, dark grayish brown, or very dark grayish brown
- Value—4 or 5, dry or moist
- Chroma—2 or 3, dry or moist
- Effervescence—none to slight
- Rock fragments—0 to 5 percent gravel

Bk horizon:
- Texture—clay or clay loam
- Color—brown, dark brown, or strong brown
- Hue—10YR, 7.5YR
- Value—4 or 5, dry or moist
- Chroma—3 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 2 to 15 percent calcium carbonate equivalent
- Rock fragments—0 to 15 percent gravel

Anasazi Family

Depth class: moderately deep
Drainage class: well drained
Permeability: moderate
Landform: plateaus
Parent material: eolian and mixed alluvium
Slope range: 1 to 8 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F

Classification: coarse-loamy, mixed, mesic Ustollic Calciorthids

Typical Pedon

Anasazi family fine sandy loam in an area of Bisoodi-Anasazi family complex, 1 to 8 percent slopes; about 6 miles south by southwest of Diamond Butte; about 2,200 feet south and 300 feet west of the northeast corner of section 31, T.36 N., R.10 W., Mohave County, Arizona.

A—0 to 1 inch; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine vesicular and common fine tubular pores; 10 percent gravel; slightly effervescent; moderately alkaline (pH 8.2) abrupt smooth boundary.

Bw1—1 to 3 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 5 percent gravel; slightly effervescent; moderately alkaline (pH 8.2) clear smooth boundary.

Bw2—3 to 12 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 5 percent gravel; strongly effervescent with disseminated calcium carbonate, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.4) clear smooth boundary.

Bk1—12 to 19 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent with common fine flakes and coatings of calcium carbonate on rock fragments, 20 percent calcium carbonate equivalent; moderately alkaline (pH 8.4) clear smooth boundary.

Bk2—19 to 34 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent with common fine flakes and coatings of calcium carbonate on rock fragments, 25 percent calcium carbonate equivalent; strongly alkaline (pH 8.6) abrupt smooth boundary.

2R—34 inches; very hard limestone bedrock with a 1- to 2-centimeter thick secondary accumulation of weakly cemented calcium carbonate on top of the bedrock.

Range in Characteristics

Depth to base of cambic horizon: 10 to 15 inches
Depth to calcic horizon: 10 to 15 inches
Depth to bedrock: 20 to 40 inches
Rock fragments: 0 to 35 percent gravel

A horizon:
- Color—pink or light brown
- Value—6 through 8 dry, 4 through 6 moist
- Chroma—3 or 4, dry or moist
- Effervescence—slight to strong, 1 to 15 percent calcium carbonate equivalent

Bw horizons:
- Texture—fine sandy loam, sandy loam, loam, or gravelly loam
- Color—light brown or brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Effervescence—slight to strong, 1 to 15 percent calcium carbonate equivalent

Bk horizons:
- Texture—loam, gravelly loam, or fine sandy loam
- Color—pink or light brown
- Value—6 through 8 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—moderately or strongly alkaline
- Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent

Arada Family

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Landform: fan terraces
Parent material: mixed alluvium and eolian deposits
Slope range: 1 to 10 percent
Elevation: 1,600 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 60 to 70 degrees F
Classification: sandy, mixed, thermic Typic Calciorthids

Typical Pedon

Arada family loamy fine sand in an area of Arada loamy fine sand, 1 to 10 percent slopes; about 4 miles

north of Beaver Dam; about 1,800 feet north and 1,100 feet east of the southwest corner of section 9, T.41 N., R.15 W., Mohave County, Arizona.

A—0 to 3 inches; light brown (7.5YR 6/4) loamy fine sand, strong brown (7.5YR 5/6) moist; weak thin platy structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; many very fine vesicular and few fine tubular pores; 5 percent fine and medium gravel; slightly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

C1—3 to 10 inches; light brown (7.5YR 6/4) loamy sand, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine and common fine roots; common very fine irregular and few fine and very fine tubular pores; 3 percent fine and medium gravel; strongly effervescent with calcium carbonate segregated as few fine flakes and common fine seams, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

C2—10 to 26 inches; reddish yellow (7.5YR 7/6) loamy sand, strong brown (7.5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine and few medium roots; common very fine irregular and few fine and very fine tubular pores; 3 percent fine and medium gravel; strongly effervescent with calcium carbonate segregated as few fine flakes and common fine seams, 7 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bk—26 to 49 inches; light brown (7.5YR 6/4) loamy sand, strong brown (7.5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine and few medium roots; common very fine irregular and few fine and very fine tubular pores; 5 percent fine and medium gravel; strongly effervescent with calcium carbonate segregated as common fine pendants on gravel and common fine seams, 9 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); abrupt smooth boundary.

2Bk—49 to 60 inches; reddish yellow (7.5YR 7/6) gravelly loamy coarse sand, strong brown (7.5YR 5/6) moist; single grained; loose; common fine and very fine roots; common very fine irregular and few fine and very fine tubular pores; 30 percent fine gravel; strongly effervescent with calcium carbonate segregated as common fine pendants on gravel and common fine seams, 14 percent calcium carbonate equivalent; strongly alkaline (pH 8.8).

Range in Characteristics

Depth to calcic horizon: 20 to 35 inches
Rock fragments: 0 to 10 percent gravel

A horizon:
- Texture—loamy sand or loamy fine sand
- Color—light brown, reddish yellow, brown, or light reddish brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—none to slight

C and Bk horizons:
- Texture—loamy sand, loamy fine sand, or fine sand
- Color—reddish yellow, light brown, or light reddish brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—strong to violent, 5 to 20 percent calcium carbonate equivalent

2Bk horizon:
- Texture—gravelly loamy coarse sand, gravelly sandy loam, or sandy loam
- Color—reddish yellow, pink, pinkish white, or white
- Value—5 through 8, dry or moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—strong to violent, 10 to 40 percent calcium carbonate equivalent

Arizo Series

Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Landform: flood plains and alluvial fans
Parent material: mixed alluvium
Slope range: 1 to 5 percent
Elevation: 1,800 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: sandy-skeletal, mixed, thermic Typic Torriorthents

Typical Pedon

Arizo gravelly sandy loam, 1 to 5 percent slopes, nonflooded; about 10 miles south by southwest of Littlefield, Arizona; about 2,300 feet north and 1,600 feet west of the southeast corner of section 21, T.39 N., R.16 W., Mohave County, Arizona.

A1—0 to 3 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; many very fine vesicular and common fine tubular and irregular pores; 25 percent gravel; slightly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

A2—3 to 8 inches; very pale brown (10YR 7/4) gravelly loamy sand, yellowish brown (10YR 5/4) moist; weak medium platy structure; slightly hard, very friable; nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and irregular pores; 30 percent gravel; slightly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

C1—8 to 17 inches; very pale brown (10YR 7/4) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and irregular pores; 35 percent gravel; strongly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

C2—17 to 60 inches; very pale brown (10YR 7/4) stratified sand and gravel (average texture very gravelly loamy sand), yellowish brown (10YR 5/4) moist; single grained; loose; common fine and very fine roots; common fine and very fine irregular pores; 50 percent gravel; strongly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary

Range in Characteristics

Rock fragments: 35 to 75 percent

A horizon:
- Texture—cobbly, very cobbly, gravelly; or very gravelly sandy loam or loamy sand
- Color—light brown, very pale brown, or light yellowish brown
- Hue—7.5YR, 10YR
- Value—6 or 7 dry, 5 or 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—slight to strong
- Rock fragments—0 to 35 percent cobbles; 10 to 50 percent gravel

C and Bk horizons:
- Texture—very to extremely gravelly or very cobbly sand and loamy sand
- Color—pale brown, light brown, or very pale brown
- Hue—7.5YR, 10YR
- Value—6 or 7 dry, 5 or 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, less than 10 percent calcium carbonate equivalent
- Rock fragments—0 to 35 percent cobbles; 25 to 65 percent gravel

Ashfork Family

Depth class: moderately deep to deep
Drainage class: well drained
Permeability: slow to very slow
Landform: mesa
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 47 to 56 degrees F
Classification: fine, montmorillonitic, mesic Aridic Argiustolls

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Ashfork family in an area of Tsezhin family-Ashfork family-Rock outcrop complex, 10 to 70 percent slopes; about 25 miles southwest of St. George, Utah, on the east side of Black Rock Mountain; about 200 feet north and 1,400 feet east of the southwest corner of section 18, T.39 N., R.13 W., Mohave County, Arizona.

Oi—1 to 0 inches; organic mat of decomposing pine and juniper needles.

A—0 to 2 inches; dark reddish brown (5YR 3/2) very cobbly loam, dark reddish brown (5YR 2.5/2) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; many fine and very fine irregular pores; 15 percent gravel and 20 percent cobbles; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

Bw—2 to 8 inches; dark reddish brown (5YR 3/2) cobbly loam, dark reddish brown (5YR 2.5/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel and 10 percent cobbles; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bt1—8 to 38 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; strong medium angular blocky structure; very hard, very

firm, very sticky and plastic; common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; common pressure faces; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bt2—38 to 41 inches; reddish brown (5YR 4/3) cobbly clay, dark reddish brown (5YR 3/3) moist; strong medium angular blocky structure; very hard, very firm, very sticky and plastic; common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; common pressure faces; 10 percent gravel and 10 percent cobbles; slightly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

2R—41 inches; basalt bedrock.

Range in Characteristics

Depth to bedrock: 20 to 60 inches

A horizon:
- Color—reddish brown, dark brown, or dark reddish brown
- Hue—5YR, 7.5YR
- Value—3 through 5, dry or moist
- Chroma—2 through 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Rock fragments—5 to 20 percent gravel; 5 to 20 percent cobbles; 0 to 10 percent stones

B horizon:
- Texture—clay or clay loam
- Color—reddish brown, brown, or dark brown
- Hue—5YR, 7.5YR
- Value—3 through 5, dry or moist
- Chroma—2 through 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Effervescence—slight to none
- Rock fragments—0 to 15 percent gravel; 0 to 15 percent cobbles

Bard Family

Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 8 percent
Elevation: 1,600 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 60 to 70 degrees F
Classification: loamy, carbonatic, thermic, shallow Typic Paleorthids

Typical Pedon

Bard family gravelly loamy sand in an area of Bard family-Tonopah-Arada family association, 1 to 10 percent slopes; about 6 miles west by northwest of Littlefield, Arizona; about 100 feet north and 2,300 feet east of the southwest corner of section 33, T.41 N., R.16 W., Mohave County, Arizona.

A1—0 to 2 inches; pink (5YR 8/4) gravelly loamy sand, reddish yellow (5YR 6/6) moist; moderate fine platy structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; many very fine vesicular and common fine tubular pores; 20 percent gravel-sized hardpan fragments; violently effervescent; strongly alkaline (pH 8.6); clear smooth boundary.

A2—2 to 5 inches; pink (5YR 8/4) loamy sand, reddish yellow (5YR 6/6) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common very fine vesicular and common fine tubular pores; 10 percent gravel-sized hardpan fragments; violently effervescent, 22 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bk1—5 to 11 inches; reddish yellow (5YR 6/6) gravelly sandy loam, yellowish red (5YR 5/6) moist; massive; soft, very friable, very slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 15 percent hardpan fragments; violently effervescent, calcium carbonate segregated in few fine soft masses and seams, 39 percent calcium carbonate equivalent; strongly alkaline (pH 8.8); clear smooth boundary.

Bk2—11 to 17 inches; reddish yellow (5YR 6/6) gravelly sandy loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; 20 percent gravel-sized hardpan fragments; violently effervescent, calcium carbonate segregated in common fine and medium masses and seams, 43 percent calcium carbonate equivalent; strongly alkaline (pH 8.8); abrupt smooth boundary.

Bkm—17 to 60 inches; pinkish white and pink (5YR 8/2 and 7/3) indurated hardpan with laminated upper boundary; interbedded with weakly to strongly cemented materials.

Range in Characteristics

Depth to calcic horizon: 1 to 5 inches
Depth to petrocalcic horizon: 14 to 20 inches

Hardpan and rock fragments: average 5 to 15 percent

A horizon:
- Texture—gravelly loamy sand, gravelly fine sandy loam, and loamy fine sand
- Color—pink and light reddish brown
- Value—6 through 8 dry, 5 or 6 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—strong to violent
- Hardpan and rock fragments—5 to 30 percent

Bk horizon:
- Texture—gravelly sandy loam and gravelly fine sandy loam
- Color—pink, light reddish brown, and reddish yellow
- Value—6 through 8 dry, 5 or 6 moist
- Chroma—3 through 6, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—30 to 45 percent calcium carbonate equivalent
- Hardpan and rock fragments—5 to 35 percent

Barx Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 5 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: fine-loamy, mixed, mesic Ustollic Haplargids

Typical Pedon

Barx fine sandy loam in an area of Barx fine sandy loam, 1 to 5 percent slopes; about 3 miles south of Wolf Hole Mountain; about 1,200 feet south and 2,400 feet east of the northwest corner of section 4, T.38 N., R.12 W., Mohave County, Arizona.

A—0 to 1 inch; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine vesicular pores; 5 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bt—1 to 5 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; few faint clay films lining pores; 5 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Btk1—5 to 13 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 5 percent gravel; strongly effervescent, few fine calcium carbonate seams, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Btk2—13 to 21 inches; reddish brown (5YR 5/4) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 10 percent gravel; violently effervescent, common fine calcium carbonate seams and thin coatings on rock fragments, 26 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk—21 to 33 inches; pinkish white (5YR 8/2) loam, pink (5YR 7/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; 10 percent gravel; violently effervescent, horizon engulfed with calcium carbonate, 38 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2Btkb—33 to 50 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) moist; strong fine and medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; many very fine and fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 5 percent gravel; violently effervescent, many medium soft calcium carbonate masses and coatings on rock fragments, 26 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

2Bkb—50 to 60 inches; light reddish brown (5YR 6/4) sandy loam, reddish brown (5YR 4/4) moist;

strong medium subangular blocky structure; very hard, firm, nonsticky and nonplastic; few very fine and fine tubular and interstitial pores; 5 percent gravel; violently effervescent, common fine calcium carbonate seams and coatings on faces of peds and rock fragments, 24 percent calcium carbonate equivalent; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to calcic horizon: 12 to 24 inches
Rock fragments: 0 to 20 percent gravel, averages 0 to 10 percent

A horizon:
Texture—fine sandy loam or gravelly fine sandy loam
Color—light reddish brown or reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Effervescence—none to strong, 0 to 5 percent calcium carbonate equivalent
Rock fragments—0 to 20 percent gravel

Bt and Btk horizons:
Texture—clay loam or sandy clay loam
Color—light reddish brown or reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Effervescence—slight to violent, 3 to 30 percent calcium carbonate equivalent

Bk horizon:
Texture—loam, sandy loam or sandy clay loam
Color—pink, pinkish white, or light reddish brown
Value—6 through 8, dry or moist
Chroma—2 through 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 39 percent calcium carbonate equivalent
Rock fragments—0 to 15 percent gravel

Berzatic Family

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate to moderately rapid
Landform: escarpments, cliffs, and canyon walls
Parent material: colluvium from sedimentary formations
Slope range: 35 to 70 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: loamy-skeletal, mixed (calcareous), mesic Lithic Torriorthents

Typical Pedon

Berzatic family extremely cobbly sandy loam in an area of Berzatic family-Rock outcrop-Goblin complex, 35 to 70 percent slopes; in Trail Canyon about 1 mile north of Parashant Canyon; about 1,400 feet south and 1,600 feet west of the northeast corner of section 2, T.33 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 5/4) extremely cobbly loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common very fine vesicular pores; 40 percent gravel, 40 percent cobbles, and 10 percent stones; strongly effervescent, 13 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

C—2 to 6 inches; brown (7.5YR 5/4) extremely cobbly loam, brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 40 percent gravel, 40 percent cobbles, and 10 percent stones; strongly effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2R—6 inches; limestone bedrock.

Range in Characteristics

Depth to bedrock: 5 to 20 inches
Rock fragments: average 35 to 90 percent; 15 to 50 percent gravel, 15 to 50 percent cobbles, 5 to 20 percent stones

A horizon:
Texture—loamy or sandy loam
Color—brown, light brown or pale brown
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 5 to 20 percent calcium carbonate equivalent

C horizon:
Texture—loam or sandy loam
Color—brown, light brown or pale brown
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—moderately alkaline
Effervescence—strong to violent, 15 to 25 percent calcium carbonate equivalent

Bisoodi Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: plateau
Parent material: eolian and alluvium
Slope range: 1 to 8 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy, mixed, mesic Lithic Ustollic Calciorthids

Typical Pedon

Bisoodi channery loam in an area of Bisoodi-Anasazi family complex, 1 to 8 percent slopes; about 2 miles northeast of Poverty Knoll; about 100 feet south and 1,000 feet west of the northeast corner of section 31, T.36 N., R.10 W., Mohave County, Arizona.

A—0 to 1 inch; light brown (7.5YR 6/4) channery loam, brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine vesicular pores; 20 percent channers; strongly effervescent, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bw—1 to 6 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent channers; strongly effervescent, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—6 to 17 inches; pink (7.5YR 7/4) loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent channers; violently effervescent, calcium carbonate segregated as few fine masses and thin coatings on ped faces, 39 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt wavy boundary.

2R—17 inches; limestone bedrock with 1- to 2-centimeter thick calcium carbonate coatings on upper surface of rock.

Range in Characteristics

Depth to calcic horizon: 1 to 8 inches
Depth to bedrock: 6 to 20 inches
Rock fragments: 5 to 20 percent

A horizon:
Texture—loam or fine sandy loam
Color—light brown or light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 1 to 20 percent calcium carbonate equivalent

Bk horizon:
Texture—loam or fine sandy loam
Color—light brown or pink
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 39 percent calcium carbonate equivalent

R horizon:
Extremely hard limestone or calcareous sandstone bedrock

Blind Family

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium and colluvium dominated by granite and gneiss
Slope range: 5 to 15 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, mixed, thermic Typic Haplargids

Typical Pedon

Blind family very cobbly sandy loam in an area of Blind family-Shelley complex, 5 to 15 percent slopes, moist; about 3 miles south of Littlefield, Arizona; about 500 feet south and 1,000 feet east of the northwest corner of section 21, T.40 N., R.15 W., Mohave County, Arizona.

A—0 to 3 inches; pink (7.5YR 7/4) very cobbly sandy loam, brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine vesicular and common very fine tubular pores; 20 percent stones, 10 percent cobbles, and 20 percent gravel; noneffervescent;

moderately alkaline (pH 8.2); abrupt smooth boundary.

Bt—3 to 16 inches; pink (7.5YR 7/4) very cobbly loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular and interstitial pores; few faint clay films lining pores; 15 percent stones, 25 percent cobbles, and 15 percent gravel; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2Btk1—16 to 28 inches; reddish yellow (5YR 6/6) very gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; common very fine and fine roots; common very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 10 percent cobbles and 25 percent gravel; strongly effervescent, many calcium carbonate fillings in pores, common coatings on faces of peds and pendants on rock fragments; moderately alkaline (pH 8.4); clear smooth boundary.

2Btk2—28 to 50 inches; light brown (7.5YR 6/4) very cobbly sandy loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine and fine roots; common very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 10 percent stones, 15 percent cobbles, and 20 percent gravel; violently effervescent, common medium calcium carbonate seams, common coatings on faces of peds and pendants on rock fragments, some weak cementation; moderately alkaline (pH 8.4); clear smooth boundary.

2Bk—50 to 60 inches; very pale brown (10YR 7/3) very cobbly loamy sand, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine and fine roots; common very fine tubular and interstitial pores; 10 percent stones, 15 percent cobbles, and 20 percent gravel; strongly effervescent, common fine calcium carbonate seams, common coatings on faces of peds and pendants on rock fragments; strongly alkaline (pH 8.6).

Range in Characteristics

Depth to lower boundary of argillic horizon: 15 to 50 inches
Depth to calcic horizon: 15 to 25 inches
Rock fragments: 35 to 60 percent

A horizon:
Texture—very stony sandy loam or very cobbly sandy loam
Color—pink, light brown, and light reddish brown
Hue—5YR, 7.5YR
Value—6 or 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—none to slight

Bt and Btk horizon:
Texture—very stony loamy or very gravelly loam or very cobbly sandy clay loam
Color—pink, light reddish brown, and light brown
Hue—5YR, 7.5YR
Value—6 or 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to violent

Bk horizon:
Texture—very stony or very cobbly sandy loam or loamy sand
Color—pink, light brown, pale brown, and very pale brown
Hue—5YR, 7.5YR, 10YR
Value—6 or 7 dry, 4 through 6 moist
Chroma—3 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—moderate to violent

Bond Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus
Parent material: alluvium and eolian deposits from sedimentary formations
Slope range: 4 to 12 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy, mixed, mesic lithic Ustollic Haplargids

Typical Pedon

Bond gravelly sandy loam in an area of Rizno-Bond-Rock outcrop complex, 4 to 25 percent slopes; about 35 miles south by southwest of Littlefield, Arizona; about 1,300 feet west and 1,800 feet north of the southeast corner of section 26, T.35 N., R.14 W., Mohave County, Arizona.

A—0 to 1 inch; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine

granular structure; slightly hard, very friable; few medium roots; common fine pores; 30 percent gravel; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bt1—1 to 8 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm, very sticky and very plastic; few medium roots; common very fine tubular pores; 10 percent gravel; few faint clay films on ped faces and lining pores; noneffervescent; slightly alkaline (pH 7.8); clear wavy boundary.

Bt2—8 to 13 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate very fine subangular blocky structure; hard, firm, very sticky and very plastic; few medium roots; few very fine tubular pores; 10 percent gravel; few faint clay films on ped faces and lining pores; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

2R—13 inches; sandstone bedrock.

Range in Characteristics

Depth to base of argillic horizon: 6 to 20 inches
Depth to bedrock: 6 to 20 inches

A horizon:
Texture—gravelly sandy loam, sandy loam, or loam
Color—brown and light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Rock fragments—5 to 35 percent channers

Bt horizon:
Texture—sandy clay loam or loam
Color—reddish brown or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Rock fragments—0 to 15 percent channers

Boquillas Family

Depth class: moderately deep
Drainage class: well drained
Permeability: slow
Landform: mesas
Parent material: alluvium and colluvium
Slope range: 25 to 50 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Classification: fine, montmorillonitic, mesic Aridic Argiustolls

Typical Pedon

Boquillas family extremely cobbly clay loam in an area of Boquillas family-Showlow complex, 25 to 50 percent slopes; southwest side of Poverty Mountain; about 500 feet north and 2,200 feet west of the southeast corner of section 26, T.35 N., R.12 W., Mohave County, Arizona.

A—0 to 3 inches; dark brown (7.5YR 4/4) extremely cobbly clay loam, dark brown (7.5YR 3/3) moist; weak fine granular structure; hard, firm, sticky and plastic; common fine roots; few very fine tubular pores; 60 percent cobbles and 20 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

Bt—3 to 10 inches; dark brown (7.5YR 4/4) gravelly clay, dark brown (7.5YR 3/3) moist; moderate fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; few very fine tubular pores; few faint clay films on faces of peds and lining pores; 20 percent gravel and 10 percent cobbles; noneffervescent in matrix and slightly effervescent on common faint calcium carbonate coatings on underside of rock fragments; slightly alkaline (pH 7.4); clear wavy boundary.

Btk—10 to 13 inches; reddish brown (5YR 5/4) gravelly clay, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; few very fine tubular pores; few faint clay films on faces of peds and lining pores; 20 percent gravel and 10 percent cobbles; common krotovinas; slightly effervescent in matrix and violently effervescent on many faint calcium carbonate coatings on underside of rock fragments; slightly alkaline (pH 7.6); clear wavy boundary.

2Bk—13 to 23 inches; light reddish brown (5YR 6/4) gravelly clay loam, reddish brown (5YR 5/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; few very fine tubular pores; 20 percent gravel; strongly effervescent in matrix and violently effervescent on many prominent calcium carbonate coatings on underside of rock fragments; slightly alkaline (pH 7.6); abrupt smooth boundary.

2Cr—23 inches; weathered, interbedded limestone, sandstone and mudstone.

Range in Characteristics

Depth to bedrock: 20 to 40 inches
Some pedons are noncalcareous to within 5 inches of bedrock

Rock fragments: 5 to 35 percent

A horizon:
- Texture—clay loam, silty clay loam, or loam
- Color—dark brown or dark yellowish brown
- Hue—10YR, 7.5YR
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—2 or 3, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Rock fragments—15 to 30 percent gravel; 35 to 60 percent cobbles; 0 to 5 percent stones

Bt horizon:
- Texture—clay or clay loam
- Color—dark brown, reddish brown, or dark reddish brown
- Hue—5YR, 7.5YR
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Effervescence—none to slight in matrix; strong to violent on calcium carbonate features
- Rock fragments—10 to 25 percent gravel; 5 to 15 percent cobbles

Bk horizon:
- Texture—clay loam or clay
- Color—light reddish brown, reddish brown, or brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—strong to violent
- Rock fragments—15 to 25 percent gravel; 0 to 10 percent cobbles

Calciorthids

Depth class: shallow to moderately deep
Drainage class: well to somewhat excessively drained
Permeability: moderate to moderately rapid
Landform: escarpments
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: Calciorthids

Reference Pedon

Note: Profile described is a reference profile for the soils with this great group Soil Taxanomic name. Textures and depths may vary greatly from those described.

Calciorthids in an area of Torriorthents-Calciorthids-Rock outcrop complex, 10 to 40 percent slopes; in the Pakoon area just north of the Lake Mead Recreational Area; about 950 feet south and 2,400 feet west of the northeast corner of section 2, T. 35 N., R. 16 W.; Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR) 5/4) very cobbly fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine vesicular pores; 15 percent gravel and 25 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk1—2 to 12 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; 35 percent gravel and 5 percent cobbles; violently effervescent, calcium carbonate segregated as seams and pendants on rock fragments, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—12 to 24 inches; pink (7.5YR 7/4) gravelly sandy loam, light brown (7.5YR 6/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular pores; 20 percent gravel; violently effervescent, engulfed in calcium carbonate, 25 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Cr—24 inches; weathered mudstone.

Range in Characteristics

Depth to bedrock: 10 to 40 inches
Depth to calcic horizon: 1 to 4 inches
Rock fragments: 5 to 40 percent gravel, 2 to 35 percent cobbles, 0 to 5 percent stones

A horizon:
- Texture—loam or fine sandy loam
- Color—light brown, brown, or light reddish brown
- Hue—5YR, 7.5YR
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—3 through 6, dry or moist
- Effervescence—slight to violent, 5 to 15 percent calcium carbonate equivalent

Bk horizon:
- Texture—sandy loam, loam or sandy clay loam
- Color—pink, light reddish brown, pinkish white, or light brown

Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 10 to 25 percent calcium carbonate equivalent

Carrizo Series

Depth class: very deep
Drainage class: excessively drained
Permeability: very rapid
Landform: flood plains
Parent material: mixed alluvium
Slope range: 1 to 5 percent
Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 70 to 78 degrees F
Classification: sandy-skeletal, mixed, hyperthermic Typic Torriorthents

Typical Pedon

Carrizo very gravelly loamy sand in an area of Carrizo complex, 1 to 5 percent slopes; about 40 miles south of Littlefield, Arizona; about 960 feet south and 2,145 feet west of the northeast corner of section 27, T.34 N., R.16 W., Mohave County, Arizona.

A—0 to 3 inches; reddish yellow (7.5YR 7/6) very gravelly loamy sand, dark brown (7.5YR 4/4) moist; moderate thin platy structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine and very fine irregular pores; 40 percent gravel and 15 percent cobbles; slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

C1—3 to 27 inches; pinkish gray (7.5YR 7/2) very gravelly coarse sand, brown (7.5YR 5/2) moist; single grained; loose; common fine roots; many fine and very fine irregular pores; 45 percent gravel and 10 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

C2—27 to 42 inches; pinkish gray (7.5YR 6/2) very gravelly coarse sand, dark brown (7.5YR 4/2) moist; single grained; loose; few very fine roots; many fine and very fine irregular pores; 45 percent gravel and 5 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

Ck—42 to 60 inches; pinkish gray (7.5YR 7/3) very gravelly loamy sand, dark brown (7.5YR 4/3) moist; single grained; loose; few very fine roots; many fine and very fine irregular pores; 35 percent gravel and 5 percent cobbles; violently effervescent, common calcium carbonate coatings on rock fragments, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: 35 to 60 percent

A horizon:
Texture—very gravelly loamy sand and very cobbly loamy sand
Color—reddish yellow or light brown
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—5 to 10 percent calcium carbonate equivalent
Rock fragments—15 to 40 percent gravels, 15 to 40 percent cobbles

Bk horizon:
Texture—very gravelly or very cobbly stratified coarse and and loamy sand
Color—pinkish gray, light brown, or pink
Reaction (pH)—moderately to strongly alkaline
Effervescence—slight to strong, 5 to 15 percent calcium carbonate equivalent

C horizons:
Texture—very gravelly or very cobbly coarse sand and loamy sand
Color—pinkish gray, light brown, or pink.
Hue—7.5YR, 10YR
Value—6 or 7 dry, 4 through 6 moist
Chroma—2 through 4, dry or moist
Effervescence—slight to strong, 5 to 15 percent calcium carbonate equivalent

Cave Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 10 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy, mixed, thermic, shallow Typic Paleorthids

Typical Pedon

Cave gravelly fine sandy loam in an area of Cave-Harrisburg-Grapevine complex, 1 to 15 percent

slopes; about 2 miles north of Beaver Dam, Arizona, just 4 miles south of the Arizona-Utah state line; about 2,600 feet south and 1,000 feet west of the northeast corner of section 20, T.41 N., R.15 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, nonsticky and nonplastic; common very fine and few fine roots; many very fine vesicular, common fine and very fine tubular and interstitial pores; 25 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk—2 to 11 inches; strong brown (7.5YR 6/6) gravelly fine sandy loam, strong brown (7.5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 30 percent gravel; violently effervescent, 13 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bkm—11 to 60 inches; pinkish white (7.5YR 8/2), indurated calcium carbonate-cemented hardpan; indurated dense layer (0.5 to 2 inches thick) repeats every foot or two in the weakly to strongly cemented materials.

Range in Characteristics

Depth to petrocalcic horizon: 4 to 20 inches
Rock fragments: average 5 to 35 percent

A horizon:
- Texture—gravelly fine sandy loam or loam
- Color—light brown, brown, and strong brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 through 6, dry or moist
- Effervescence—less than 15 percent calcium carbonate equivalent
- Rock fragments—5 to 30 percent gravel, 0 to 20 percent cobbles, 0 to 10 percent stones

Bk horizons:
- Texture—fine sandy loam or loam
- Color—light brown, brown, or strong brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 10 to 25 percent calcium carbonate equivalent
- Rock fragments—less than 35 percent

Bkm horizon:
Indurated, calcium carbonate-cemented hardpan (petrocalcic) with laminar cap. This indurated laminar cap repeats every foot or two in the weakly to strongly cemented materials to a depth of 60 inches or more.

Chic Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: volcanic hills, cinder cones, and terraces
Parent material: colluvium and eolian
Slope range: 1 to 30 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: ashy-skeletal over fragmental or cindery, mixed, mesic Ustochreptic Calciorthids

Typical Pedon

Chic extremely gravelly loam in an area of Chic-Teesto-Rock outcrop complex, 1 to 30 percent slopes; about 3 miles south of Diamond Butte; about 900 feet south and 1,500 feet west of the northeast corner of section 17, T.36 N., R.10 W.; Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) extremely gravelly loam, brown (7.5YR 4/4) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine vesicular and few fine tubular pores; 60 percent gravel-sized cinders and 5 percent cobbles; slightly effervescent with disseminated calcium carbonate; moderately alkaline (pH 8.2); clear smooth boundary.

Bw—2 to 9 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel-sized cinders and 5 percent cobbles; slightly effervescent with disseminated calcium carbonate; moderately alkaline (pH 8.4); clear smooth boundary.

Bk1—9 to 15 inches; pink (7.5YR 7/4) extremely gravelly loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 65 percent gravel-sized cinders and 5 percent cobbles; violently effervescent with disseminated and segregated calcium carbonate as coatings and pendants on rock fragments, 19 percent calcium carbonate

equivalent; strongly alkaline (pH 8.6); clear smooth boundary.
Bk2—15 to 27 inches; pinkish white (7.5YR 8/2) extremely gravelly sandy loam, pink (7.5YR 7/4) moist; massive, weakly lime cemented; very hard, very firm, nonsticky and nonplastic; common very fine roots; few very fine tubular pores; 65 percent gravel-sized cinders and 5 percent cobbles; violently effervescent, 44 percent calcium carbonate equivalent; strongly alkaline (pH 9.0); clear wavy boundary.
2Ck—27 to 60 inches; loose, gravel-sized cinders with secondary calcium carbonate as coatings and pendants on cinders extending to 40 inches.

Range in Characteristics

Depth to calcic horizon: 5 to 15 inches
Depth to cinders: 20 to 40 inches
Rock fragments: 35 to 65 percent cinders, 0 to 10 percent cobbles

A horizon:
Texture—very gravelly or extremely gravelly loam
Color—light brown and brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to none, 0 to 5 percent calcium carbonate equivalent

Bw horizon:
Texture—very gravelly or extremely gravelly loam
Color—light brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to none, 0 to 10 percent calcium carbonate equivalent

Bk horizon:
Texture—very gravelly or extremely gravelly loam
Color—white, pinkish white, pink, or light brown
Value—5 through 8 dry, 4 through 8 moist
Chroma—0 or 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 75 percent calcium carbonate equivalent

Childers Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: mesas and plateaus
Landscape position: summits and back slopes
Parent material: mixed alluvium from volcanic and sedimentary formations
Slope range: 1 to 15 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed, mesic, shallow Ustochreptic Paleorthids

Typical Pedon

Childers very cobbly fine sandy loam in an area of Pocum-Childers-Ubank complex, 1 to 10 percent slopes; on West Mesa about 18 miles southeast of St. George, Utah; about 1,500 feet south and 1,900 feet east of the northwest corner of section 13, T.40 N., R.11 W.; Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 5/4) very cobbly fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy and weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common very fine vesicular and irregular pores; 20 percent gravel and 20 percent cobbles; strongly effervescent with disseminated calcium carbonate, 9 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bk—2 to 18 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine tubular pores; 30 percent gravel and 25 percent cobbles; violently effervescent with disseminated and segregated calcium carbonate as pendants and coatings on rock fragments, 37 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt wavy boundary.
Bkm1—18 to 21 inches; indurated, calcium carbonate-cemented hardpan with laminar cap; abrupt wavy boundary.
Bkm2—21 to 30 inches; white and pink (N 8/ and 7.5YR 8/4) strongly calcium carbonate-cemented hardpan, pink (7.5YR 8/4) moist; massive; extremely hard, extremely firm; abrupt irregular boundary.
2R—30 inches; basalt.

Range in Characteristics

Depth to calcic horizon: 1 to 3 inches
Depth to petrocalcic horizon: 10 to 20 inches
Depth to bedrock: 20 to 40 inches
Rock fragments: average 35 to 60 percent—15 to 40 percent gravel, 0 to 35 percent cobbles, 0 to 5 percent stones

A horizon:
Texture—sandy loam, fine sandy loam, and loam
Color—light brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to violent, 5 to 30 percent calcium carbonate equivalent

Bk horizon:
Texture—sandy loam and loam
Color—light brown, brown, or pink
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—2 through 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 40 percent calcium carbonate equivalent

Delenbaw Series

Depth class: very deep
Drainage class: well drained
Permeability: very slow
Landform: mesas
Parent material: alluvium and colluvium from volcanic rocks
Slope range: 3 to 25 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: clayey-skeletal, montmorillonitic, mesic Aridic Argiustolls

Typical Pedon

Delenbaw very cobbly loam in an area of Springerville-Delenbaw complex, 3 to 25 percent slopes; about 11.7 miles south of the Arizona-Utah state line and 17 miles east of the Arizona-Nevada state line; about 1,400 feet south and 500 feet east of the northwest corner of section 31, T.40 N., R.13 W.; Mohave County, Arizona.

A—0 to 2 inches; dark reddish gray (5YR 4/2) very cobbly loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular and irregular pores; 20 percent gravel, 30 percent cobbles, and 5 percent stones; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt1—2 to 10 inches; dark reddish gray (5YR 4/2) very cobbly clay loam, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores: 5 percent gravel and 40 percent cobbles; noneffervescent; slightly alkaline (pH 7.4); clear smooth boundary.

Bt2—10 to 30 inches; reddish brown (5YR 4/3) very cobbly clay, dark reddish brown (5YR 3/3) moist; strong medium angular structure; extremely hard, extremely firm, very sticky and very plastic; common fine and very fine roots; few fine and very fine tubular and interstitial pores; many pressure faces; common faint clay films on faces of peds and lining pores; few faint distinct organic coats on faces of peds; 5 percent gravel and 40 percent cobbles; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bt3—30 to 36 inches; reddish brown (5YR 5/4) gravelly clay, reddish brown (5YR 4/4) moist, strong fine angular blocky structure; very hard, very firm, very sticky and very plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; many pressure faces; common faint clay films on faces of peds and lining pores; 20 percent gravel; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

2Bt4—36 to 52 inches; reddish yellow and reddish brown (5YR 6/6 and 5/4) very cobbly clay loam, yellowish red and reddish brown (5YR 5/6 and 4/4) moist; strong fine angular blocky structure; very hard, very firm, sticky and plastic; common fine and very fine roots; few fine tubular and interstitial pores; few faint clay films on faces of peds and rock fragments; 20 percent cinders and 20 percent cobbles; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

2Bt5—52 to 60 inches; yellowish red (5YR 5/6) very cobbly clay loam, yellowish red (5YR 4/6) moist; strong fine angular blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and rock fragments; 20 percent cobbles and 20 percent cinders; noneffervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Thickness of mollic epipedon: 10 to 20 inches
Organic matter: 1 to 2 percent in the upper horizons

A horizon:
Color—reddish brown and dark reddish brown
Hue—2.5YR, 5YR
Value—3 through 5 dry, 2 or 3 moist

Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—10 to 20 percent gravel, 20 to 30 percent cobbles, 0 to 10 percent stones

Bt horizon:
Texture—very cobbly clay loam and clay
Color—dark reddish brown, reddish brown, and yellowish red
Hue—2.5YR, 5YR
Value—3 through 5 dry, 3 or 4 moist
Chroma—2 through 6, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—5 to 20 percent gravel, 20 to 40 percent cobbles, 0 to 10 percent stones

2Bt horizon:
Texture—very gravelly or very cobbly clay loam
Color—reddish brown, reddish yellow, and yellowish red
Hue—2.5YR, 5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to very slight
Rock fragments—15 to 40 percent cinders, 15 to 40 percent cobbles

Dera Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 10 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: loamy-skeletal, carbonatic, mesic Typic Calciorthids

Typical Pedon

Dera very gravelly fine sandy loam in an area of Dera very gravelly fine sandy loam, 1 to 10 percent slopes; about 16 miles south of the Arizona-Utah state line and 7.5 miles west of Hurricane Cliffs; about 2,400 feet south and 500 feet west of the northeast corner of section 19, T.39 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak fine platy structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine vesicular and tubular pores; 35 percent gravel; slightly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bw—2 to 9 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 25 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk1—9 to 17 inches; light brown and pinkish white (7.5YR 6/4 and 8/2) very gravelly loam, strong brown and pink (7.5YR 5/6 and 8/3) moist; moderate fine subangular blocky structure; hard, friable, sticky and slightly plastic; common fine and very fine roots; fine and very fine tubular and interstitial pores; 40 percent calcium carbonate coated gravel; violently effervescent, calcium carbonate segregated in common fine seams and soft masses and coatings on rock fragments, 43 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk2—17 to 42 inches; pinkish white (7.5YR 8/2) very gravelly loam, pink (7.5YR 8/4) moist; massive, weakly cemented; hard, firm, sticky and slightly plastic; common very fine and few fine roots; few fine and very fine tubular pores; 40 percent gravel; violently effervescent, 48 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bky—42 to 60 inches; light brown and pink (7.5YR 6/4 and 8/4) very gravelly sandy loam, strong brown and reddish yellow (7.5YR 5/6 and 7/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; many fine irregular and few fine tubular pores; 50 percent gravel; strongly effervescent, calcium carbonate segregated in common fine seams and slightly hard masses, 19 percent calcium carbonate equivalent; 15 percent crystalline gypsum as pendants on rock fragments and sand size crystals; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to calcic horizon: 5 to 10 inches
Rock fragments: average more than 35 percent

A horizon:
Texture—fine sandy loam, sandy loam, or loam
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 2 to 15 percent calcium carbonate equivalent

Rock fragments—25 to 50 percent

Bk horizon:
Texture—loam, fine sandy loam, or sandy loam
Color—pink, light brown, or brown
Value—5 through 8 dry, 4 through 8 moist
Chroma—2 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, greater than 40 percent calcium carbonate equivalent
Rock fragments—35 to 60 percent gravel

Bky horizon:
Texture—sandy loam, coarse sandy loam, or loamy sand
Color—light brown, pink, or reddish yellow
Value—5 through 8 dry, 4 through 8 moist
Chroma—2 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 10 to 25 percent calcium carbonate equivalent
Gypsum—5 to 20 percent
Rock fragments—35 to 60 percent gravel

Dermala Family

Depth class: moderately deep to very deep
Drainage class: well drained
Permeability: moderate to moderately slow
Landform: mesas
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 4,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: fine-loamy, mixed, mesic Aridic Haplustalfs

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Dermala family in an area of Dermala family-Guy family-Rock outcrop complex, 10 to 40 percent slopes; about 19 miles south of St. George, Utah on the side of Wolfhole Mountain; about 900 feet north and 2,200 feet east of the southwest corner of section 33, T.40 N., R.12 W., Mohave County, Arizona.

A—0 to 2 inches; reddish brown (5YR 5/4) very cobbly loam, dark reddish brown (5YR 3/4) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine vesicular and few fine tubular pores; 20 percent gravel, 30 percent cobbles, and 5 percent stones; noneffervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

AB—2 to 8 inches; reddish brown (5YR 5/4) very cobbly clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel, 30 percent cobbles, and 5 percent stones; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bt—8 to 24 inches; reddish brown (5YR 5/4) cobbly clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 5 percent gravel and 10 percent cobbles; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Btk—24 to 38 inches; light reddish brown (5YR 6/4) cobbly clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 5 percent gravel and 10 percent cobbles; strongly effervescent with disseminated and segregated calcium carbonate as few fine masses and seams; moderately alkaline (pH 8.2); clear smooth boundary.

Bk—38 to 60 inches; pink (5YR 7/4) cobbly loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel and 10 percent cobbles; violently effervescent with disseminated and segregated calcium carbonate as common fine masses and seams; moderately alkaline (pH 8.2).

Range in Characteristics

Depth to calcic horizon: 15 to 25 inches
Depth to bedrock: 20 to 60 inches

A horizon:
Texture—loam or clay loam
Color—reddish brown or light reddish brown
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline

Effervescence—slight to none
Rock fragments—15 to 30 percent gravel; 15 to 30 percent cobbles; 0 to 10 percent stones

Bt horizon:
Texture—clay loam or loam
Color—reddish brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to none
Rock fragments—5 to 15 percent gravel; 5 to 15 percent cobbles

Bk horizon:
Texture—clay loam or loam
Color—pink, light reddish brown, or light brown
Hue—5YR, 7.5YR
Value—5 through 8 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent
Rock fragments—5 to 15 percent gravel; 5 to 15 percent cobbles

Disterheff Series

Depth class: very deep
Drainage class: well drained
Permeability: very slow
Landform: plateaus
Parent material: alluvium from sedimentary formations
Slope range: 2 to 10 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: fine, montmorillonitic, mesic Vertic Haplustalfs

Typical Pedon

Disterheff very gravelly loam in an area of Disterheff-Natank-Yumtheska complex, 2 to 15 percent slopes; about 7 miles southwest of Poverty Mountain; about 2,530 feet north and 2,600 feet west of the southeast corner of section 11, T.34 N., R.13 W., Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 4/4) very gravelly loam, dark brown (7.5YR 4/3) moist; weak fine granular structure; soft, friable, nonsticky and nonplastic; many fine and very fine, and few medium roots; common fine and very fine irregular pores; 45 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

AB—2 to 5 inches; dark brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, firm, sticky and plastic; many fine and very fine, and common medium roots; many fine and very fine irregular pores; 10 percent gravel; noneffervescent; neutral (pH 7.2); abrupt wavy boundary.

Bt1—5 to 14 inches; brown (7.5YR 4/4) gravelly clay, dark brown (7.5YR 4/3) moist; moderate medium prismatic structure parting to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; common fine and very fine, and few medium roots; common fine and very fine tubular pores; common faint clay films on faces of peds and lining pores; many pressure faces; 15 percent gravel; noneffervescent; neutral (pH 7.2); clear wavy boundary.

Bt2—14 to 32 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate coarse prismatic structure parting to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; common fine and very fine roots; common fine and very fine tubular pores; many faint clay films on faces of peds and lining pores; many pressure faces; few manganese coatings; 10 percent gravel; noneffervescent; slightly alkaline (pH 7.4); clear wavy boundary.

2Btk1—32 to 41 inches; yellowish red (5YR 5/6) gravelly clay, yellowish red (5YR 4/6) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and very plastic; common fine and very fine roots; few fine and very fine tubular pores; common faint clay films on faces of peds and lining pores; few pressure faces; few manganese coatings; 20 percent gravel; slightly effervescent, few fine soft calcium carbonate masses and coatings on ped faces; slightly alkaline (pH 7.8); clear wavy boundary.

2Btk2—41 to 60 inches; yellowish red (5YR 4/6) gravelly clay loam, yellowish red (5YR 4/6) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine tubular pores; common faint clay films on faces of peds and lining pores; 25 percent gravel; strongly effervescent, common medium soft calcium carbonate masses and coatings on ped faces; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to calcic horizon: 20 to 40 inches
Rock fragments: average 0 to 20 percent gravel
Soil cracks: linear extensibility of 6.0 cm or more to 40 inches

A horizon:
- Texture—gravelly loam, very gravelly loam, gravelly clay loam, or clay loam
- Color—brown or dark brown
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—2 through 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Rock fragments—15 to 50 percent gravel

Bt horizon:
- Texture—clay or gravelly clay
- Color—dark brown, brown, or reddish brown
- Hue—5YR, 7.5YR
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—2 through 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Effervescence—none to very slight
- Rock fragments—0 to 20 percent gravel

Btk horizon:
- Texture—clay, gravelly clay, clay loam, or gravelly clay loam
- Color—yellowish red or light reddish brown
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 15 to 25 percent calcium carbonate equivalent
- Rock fragments—5 to 30 percent gravel

Dutchman Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: alluvium from sedimentary formations high in gypsum
Slope range: 1 to 10 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: coarse-loamy, gypsic, mesic Typic Gypsiorthids

Typical Pedon

Dutchman fine sandy loam in an area of Dutchman-McCullan complex, 1 to 10 percent slopes; about 22.5 miles south of the Arizona-Utah state line; just west of the Hurricane Cliffs; about 700 feet south and 125 feet west of the northeast corner of section 29, T.38 N., R.9 W.; Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine, and few medium roots; many very fine vesicular and common fine and very fine tubular pores; 10 percent gravel; violently effervescent, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—2 to 7 inches; reddish yellow (7.5YR 6/6) fine sandy loam, strong brown (7.5YR 5/6) moist; moderate fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent with few fine irregular soft calcium carbonate masses, 23 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk2—7 to 11 inches; pink (7.5YR 7/4) sandy loam, reddish yellow (7.5YR 6/6) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent with common fine irregular soft calcium carbonate masses, 32 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk3—11 to 20 inches; pinkish white (7.5YR 8/2) sandy loam, pink (7.5YR 8/4) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and nonplastic; few fine and very fine roots; common fine interstitial and few fine and very fine tubular pores; 10 percent gravel; violently effervescent, peds engulfed with calcium carbonate, 40 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); abrupt smooth boundary.

2By1—20 to 33 inches; white (N 8/) sandy loam, pinkish white (7.5YR 8/2) moist; massive; very hard, firm, nonsticky and nonplastic; few very fine roots; few fine irregular pores; 5 percent gravel; slightly effervescent; 70 percent weakly cemented gypsum; slightly alkaline (pH 7.8); clear wavy boundary.

2By2—33 to 60 inches; pink (7.5YR 8/4) sandy loam, pink (7.5YR 7/4) moist; massive; hard, friable, nonsticky and nonplastic; few very fine roots; common fine irregular pores; 5 percent gravel; slightly effervescent; 35 percent crystalline gypsum; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to calcic horizon: 2 to 8 inches
Depth to gypsic horizon: 15 to 25 inches

Rock fragments: average less than 15 percent

A horizon:
- Texture—very fine sandy loam, fine sandy loam, and sandy loam
- Color—light brown, pink, and reddish yellow
- Hue—5YR, 7.5YR
- Value—6 or 7 dry, 4 or 5 moist
- Chroma—2 through 6, dry or moist
- Effervescence—strong to violent, 5 to 30 percent calcium carbonate equivalent
- Rock fragments—less than 35 percent gravel

Bk horizon:
- Texture—fine sandy loam, sandy loam, and loam
- Color—pink, pinkish white, and reddish yellow
- Hue—5YR, 7.5YR
- Value—6 through 8 dry, 4 or 5 moist
- Chroma—2 through 6, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—strong to violent, 10 to 40 percent calcium carbonate equivalent
- Rock fragments—less than 15 percent gravel

By horizon:
- Texture—fine sandy loam and sandy loam
- Color—white, pinkish white, pink, and reddish yellow
- Hue—5YR, 7.5YR
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—0 through 6, dry or moist
- Effervescence—slight, 5 to 25 percent calcium carbonate equivalent
- Gypsum—20 to 90 percent (can be weakly cemented)
- Rock fragments—less than 15 percent gravel

Goblin Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: hills, escarpments, and structural benches
Parent material: colluvium and alluvium from gypsiferous shale, limestone, and sandstone
Slope range: 5 to 50 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: loamy, gypsic, mesic, shallow Typic Torriorthents

Typical Pedon

Goblin gravelly fine sandy loam, 15 to 50 percent slopes; about 14 miles south of St. George, Utah and 7 miles south of the Arizona-Utah state line; about 1,400 feet north and 1,100 feet east of the southwest corner of section 6, T.40 N., R.11 W., Mohave County, Arizona.

A—0 to 1 inch; pink (5YR 7/4) gypsiferous, gravelly fine sandy loam, reddish yellow (5YR 6/6) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; common fine and very fine vesicular pores; 30 percent gravel, 10 percent fine and medium gypsum crystals; slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Cy—1 to 10 inches; very pale brown (10YR 7/4) gypsiferous fine sandy loam, yellow (10YR 8/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; 50 percent interbedded gypsum crystals; very slightly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

2Cr—10 inches; interbedded gypsite and gypsiferous shale.

Range in Characteristics

Depth to gypsum: 1 to 5 inches
Depth to bedrock: 4 to 20 inches

A horizon:
- Texture—fine sandy loam or gravelly fine sandy loam
- Color—pink or light brown
- Hue—5YR, 7.5YR
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—4 through 6, dry or moist
- Effervescence—very slight to slight
- Rock fragments—less than 35 percent gravel or channers

Cy horizon:
- Texture—fine sandy loam, loam, or gypsum
- Color—very pale brown, pale brown, or light brown
- Hue—5YR, 7.5YR, 10YR
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—0 through 6, dry or moist
- Effervescence—none to slight, less than 10 percent calcium carbonate equivalent
- Rock fragments—less than 5 percent
- Gypsum—30 to 80 percent

Cr horizon:
- Rippable gypsite interbedded with variegated gypsiferous shale (mudstone or siltstone)

Goesling Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed alluvium from sedimentary formations
Slope range: 1 to 5 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: fine-loamy, mixed, mesic Aridic Haplustalfs

Typical Pedon

Goesling loam, 1 to 5 percent slopes; about 24 miles south of St. George, Utah, between Wolfhole Mountain and Mustang Knoll; about 600 feet north and 1,100 feet east of the southwest corner of section 30, T.39 N., R.12 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate medium platy and very fine granular structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine vesicular and few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

AB—2 to 9 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine tubular and interstitial pores; 2 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bt—9 to 19 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine roots; many fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 2 percent gravel; strongly effervescent, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Btk1—19 to 33 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic parting to strong medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; many fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 2 percent gravel; strongly effervescent, few fine and very fine rounded calcium carbonate masses, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Btk2—33 to 52 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; strong medium prismatic parting to strong medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; many fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 2 percent gravel; strongly effervescent, common fine and very fine rounded calcium carbonate masses, 22 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—52 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and very fine roots; many fine and very fine tubular and interstitial pores; 2 percent gravel; strongly effervescent, many fine calcium carbonate seams and common very fine rounded masses, 22 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Range in Characteristics

Depth to calcic horizon: 15 to 30 inches
Rock fragments: average less than 10 percent

A horizon:
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction(pH)—slightly or moderately alkaline
Effervescence—slight to none

Bt horizon:
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong

Bk or Btk horizon:
Texture—clay loam or loam
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 30 percent calcium carbonate equivalent

Grapevine Series

Depth class: very deep
Drainage class: well drained

Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium from sedimentary and igneous formations
Slope range: 0 to 15 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: coarse-loamy, mixed, thermic Typic Calciorthids

Typical Pedon

Grapevine gravelly fine sandy loam in an area of Grapevine-Hobcan complex, 1 to 5 percent slopes; about 10 miles south of St. George, Utah, just 3 miles south of the Arizona-Utah state line; about 2,100 feet north and 1,100 feet east of the southwest corner of section 17, T.41 N., R.12 W., Mohave County, Arizona.

A—0 to 4 inches; light reddish brown (5YR 6/4) gravelly fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many fine and very fine vesicular pores; 15 percent gravel and 5 percent cobbles, occurring dominantly on the surface; strongly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk1—4 to 13 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular pores; few gravel; violently effervescent, very few very fine calcium carbonate masses and seams, 25 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk2—13 to 22 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; few gravel; violently effervescent, many fine irregularly-shaped calcium carbonate masses and seams, 16 percent calcium carbonate equivalent; few fine gypsum crystals; moderately alkaline (pH 8.0); clear smooth boundary.

Bk3—22 to 60 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; hard, friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; few gravel; violently effervescent, many fine irregularly-shaped calcium carbonate masses and seams, 15 percent calcium carbonate equivalent; few fine gypsum crystals; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to calcic horizon: 3 to 10 inches
Rock fragments: average 0 to 15 percent

A horizon:
Texture—gravelly fine sandy loam, fine sandy loam, and sandy loam
Color—pink, light reddish brown, or light brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong
Rock fragments—5 to 35 percent gravel

Bk horizon:
Texture—fine sandy loam, sandy loam, or gravelly fine sandy loam
Color—light reddish brown, light brown, or reddish yellow
Hue—5YR, 7.5YR
Value—6 or 7 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 15 to 30 percent calcium carbonate equivalent
Rock fragments—0 to 15 percent gravel

Guy Family

Depth class: moderately deep to very deep
Drainage class: well drained
Permeability: moderate to moderately slow
Landform: mesa
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: coarse-loamy, mixed, mesic Aridic Calciustolls

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Guy family in an area of Dermala family-Guy family-Rock outcrop complex, 10 to 40 percent slopes; about 19 miles southwest of St. George, Utah, on the side of Low Mountain; about 1,400 feet south and 350 feet east of the northwest corner of section 21, T.40 N., R.13 W., Mohave County, Arizona.

A—0 to 4 inches; reddish brown (5YR 4/3) very cobbly

loam, dark reddish brown (5YR 3/3) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine vesicular and common fine tubular pores; 25 percent gravel, 15 percent cobbles, and 2 percent stones; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—4 to 8 inches; reddish brown (5YR 4/3) cobbly loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 5 percent gravel and 10 percent cobbles; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk1—8 to 18 inches; reddish brown (5YR 5/4) gravelly loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; 15 percent gravel and 5 percent cobbles; violently effervescent with disseminated and segregated calcium carbonate as few fine masses and pendants on rock fragments; moderately alkaline (pH 8.4); clear smooth boundary.

Bk2—18 to 28 inches; reddish brown (5YR 5/4) gravelly loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; 15 percent gravel and 5 percent cobbles; violently effervescent with disseminated and segregated calcium carbonate as common fine and medium masses and pendants on rock fragments, 18 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

2Cr—28 inches; reddish brown (5YR 5/4) weathered, interbedded mudstone, sandstone and gypsite.

Range in Characteristics

Depth to calcic horizon: 5 to 15 inches
Depth to bedrock: 20 to 60 inches

A horizon:
Texture—fine sandy loam or loam
Color—light reddish brown or reddish brown
Value—4 through 6 dry, 3 through 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 2 to 10 percent calcium carbonate equivalent
Rock fragments—10 to 30 percent gravel,10 to 30 percent cobbles, 0 to 5 percent stones

B horizon:
Texture—loam or sandy loam
Color—light reddish brown or reddish brown
Value—4 through 6 dry, 3 through 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 25 percent calcium carbonate equivalent
Gypsum—0 to 10 percent in lower part
Rock fragments—5 to 15 percent gravel; 5 to 15 percent cobbles

Gypill Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: hills, mountains and escarpments
Parent material: alluvium and colluvium from gypsiferous sedimentary formations
Slope range: 6 to 50 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy, gypsic, thermic, shallow Typic Torriorthents

Typical Pedon

Gypill fine sandy loam in an area of Gypill fine sandy loam, 15 to 40 percent slopes; about 0.7 mile south of the Arizona-Utah state line on the Sunshine Trail just southeast of St. George, Utah; about 100 feet south and 2,800 feet east of the northwest corner of section 3, T.41 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; pink (7.5YR 7/4) gypsiferous fine sandy loam, brown (7.5YR 5/4) moist; moderate medium platy structure; soft, very friable, nonsticky and nonplastic; very few very fine roots; many fine and very fine vesicular pores; 2 percent gypsum; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cy—2 to 6 inches; pale yellow (5Y 7/3) fine and medium sand-sized dispersed crystalline gypsum with white (N 8/) 1- to 2-centimeter bands of harder more consolidated crystalline gypsum and 10 to 20 percent loamy materials, pale olive and white (5Y 6/3 and N8/) moist; slightly hard and hard, friable and firm, nonsticky and nonplastic;

many fine and very fine irregular pores; 32 percent gypsum; slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Cr1—6 to 10 inches; white, pink and light brownish gray (N 8/, 5YR 8/4, 2.5YR 6/2) weathered gypsite (crystalline gypsum, siltstone, and mudstone); very hard, very firm; 40 percent gypsum; noneffervescent; abrupt boundary.

Cr2—10 to 60 inches; hard gypsite.

Range in Characteristics

Depth to bedrock: 4 to 15 inches
Rock fragments: average less than 15 percent gravel

A horizon:
- Texture—nongravelly to very cobbly fine sandy loam or loam
- Color—pink, light brown, and reddish yellow
- Hue—5YR, 7.5YR, 10YR
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to violent, 5 to 35 percent disseminated calcium carbonate equivalent
- Gypsum—1 to 20 percent
- Rock fragments—0 to 25 percent gravel; 0 to 25 percent cobbles

Cy horizon:
- Texture—nongravelly to gravelly sandy loam, very fine sandy loam, or loam with or without strata of loamy sand
- Color—pink, light brown, pale yellow, or white
- Hue—5Y, 5YR
- Value—5 through 8 dry, 4 through 8 moist
- Chroma—2 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—none to slight, 5 to 35 percent calcium carbonate equivalent
- Gypsum—30 to 90 percent
- Rock fragments—0 to 25 percent

Cr horizons:

Variegated, rippable, gypsiferous shale (mudstone or siltstone) interbedded with thin to very thick (0.5 inch to 10 feet) layers of gypsite.

Gyppocket Series

Depth class: very deep
Drainage class: excessively drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: colluvium and alluvium
Slope range: 2 to 20 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: sandy-skeletal, gypsic, mesic Typic Gypsiorthids

Typical Pedon

Gyppocket very cobbly sandy loam in an area of Nutter-Gyppocket complex, 2 to 20 percent slopes; about 12 miles south of the Arizona-Utah state line and just west of Hurricane Cliffs; about 400 feet north and 1,900 feet east of the southwest corner of section 36, T.40 N., R.10 W.; Mohave County, Arizona.

A—0 to 2 inches; pink (7.5YR 7/4) very gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine vesicular and few fine and very fine tubular pores; 50 percent gravel and few cobbles; strongly effervescent as disseminated calcium carbonate, 29 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk—2 to 14 inches; pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 50 percent gravel and few cobbles; strongly effervescent with calcium carbonate segregated as common fine pendants on rock fragments, 36 percent calcium carbonate equivalent; 5 percent crystalline gypsum; moderately alkaline (pH 8.4); clear smooth boundary.

By1—14 to 32 inches; very pale brown and white (10YR 8/3 and N8/) extremely gravelly gypsiferous loamy coarse sand, yellow and white (10YR 7/6 and N8/) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; many fine and very fine, and few medium roots; many fine and very fine irregular pores; 70 percent gravel; strongly effervescent as disseminated calcium carbonate, 29 percent calcium carbonate equivalent; 80 percent crystalline gypsum as pendants on rock fragments and sand grains; slightly alkaline (pH 7.6); abrupt smooth boundary.

By2—32 to 36 inches; very pale brown (10YR 8/3) extremely gravelly gypsiferous loamy sand, yellow (10YR 7/6) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine irregular pores; 60 percent gravel and 10 percent cobbles; strongly effervescent as disseminated

calcium carbonate, 19 percent calcium carbonate equivalent; 55 percent crystalline gypsum as pendants on rock fragments and sand grains; slightly alkaline (pH 7.6); abrupt smooth boundary.

By3—36 to 49 inches; very pale brown (10YR 8/3) extremely gravelly gypsiferous loamy coarse sand, brownish yellow (10YR 6/6) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; few fine and very fine roots; many fine and very fine irregular pores; 65 percent gravel; strongly effervescent, 26 percent calcium carbonate equivalent; 50 percent crystalline gypsum as pendants on rock fragments and sand grains; slightly alkaline (pH 7.6); abrupt smooth boundary.

By4—49 to 59 inches; very pale brown (10YR 8/4) extremely cobbly gypsiferous loamy coarse sand, very pale brown (10YR 7/4) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; few fine and very fine roots; many fine and very fine irregular pores; 50 percent gravel and 30 percent cobbles; strongly effervescent, 28 percent calcium carbonate equivalent; 40 percent crystalline gypsum as pendants on rock fragments and sand grains; slightly alkaline (pH 7.6); abrupt smooth boundary.

By5—59 to 60 inches; very pale brown (10YR 8/4) very gravelly gypsiferous coarse sand, yellow (10YR 7/6) moist; single grained; slightly hard, very friable, nonsticky and nonplastic; no roots; many fine and very fine irregular pores; 40 percent gravel; strongly effervescent, 28 percent calcium carbonate equivalent; 15 percent crystalline gypsum as pendants on rock fragments and sand grains; slightly alkaline (pH 7.6).

Range in Characteristics

Depth to calcic horizon: 1 to 3 inches
Depth to gypsic horizon: 10 to 25 inches
Rock fragments: average 35 to 85 percent

A horizon:
- Texture—loam, sandy loam, or loamy sand
- Color—pink, reddish yellow, light brown, or very pale brown
- Hue—7.5YR, 10YR
- Value—6 through 8 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 5 to 35 percent calcium carbonate equivalent

Bk horizon:
- Texture—loam, sandy loam, or loamy sand
- Color—light brown, reddish yellow, pink, or very pale brown
- Hue—7.5YR, 10YR
- Value—6 through 8 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent
- Gypsum—0 to 15 percent

By horizon:
- Texture—gypsum, coarse sand, or loamy sand
- Color—white, yellow, very pale brown, pale brown, pink, or light brown
- Hue—7.5YR, 10YR
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—0 through 6, dry or moist
- Effervescence—none to strong, 5 to 35 percent calcium carbonate equivalent
- Gypsum—15 to 95 percent

Gypsiorthids

Depth class: very shallow to very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces and hills
Parent material: alluvium and colluvium
Slope range: 1 to 50 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: Gypsiorthids

Reference Pedon

Note: Profile described is a reference pedon for the soils with this great group Soil Taxonomic Name. Textures and depths may vary greatly from those described.

Gypsiorthids in an area of Gypsiorthids-Gypsiorthids, shallow complex, 1 to 50 percent slopes; on the Hurricane Cliffs near the Navajo Trail; about 2,400 feet north and 2,200 feet east of the southwest corner of section 20, T.39 N., R.9 W., Mohave County, Arizona.

A—0 to 2 inches; brown (10YR 5/4) silt loam, dark brown (7.5YR 4/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few very fine tubular pores; few 1/16- to 1/4-inch strata of horizontally oriented white crystalline gypsum material; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

By—2 to 13 inches; very pale brown (7.5YR 7/4) coarse sandy loam, pale brown (10YR 6/3) moist; strong coarse granular structure; slightly hard, very friable, nonsticky and nonplastic; common medium roots; few very fine tubular pores; 30 percent visible gypsum as vertical gypsum crystals; slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

C1—13 to 31 inches; light brownish gray (2.5Y 6/3) loamy coarse sand, grayish brown (2.5Y 5/3) moist; strong medium granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few fine tubular pores; slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

C2—31 to 60 inches; light brownish gray (2.5Y 6/2) coarse sandy loam, grayish brown (2.5Y 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; cemented extremely hard flagstone size hardpan fragments, 2 to 8 inches apart; few areas of honeycombed gypsum crystals under flagstones; slightly effervescent; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to gypsic horizon: 0 to 10 inches
Depth to bedrock: 4 to greater than 60 inches
Rock fragments: average 0 to 15 percent channers, 0 to 15 percent flagstones

A horizon:
- Color—brown or strong brown
- Hue—7.5YR, 10YR
- Value—4 or 5, dry or moist
- Chroma—3 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 5 to 10 percent calcium carbonate equivalent
- Gypsum—35 to 65 percent

By and C horizons:
- Texture—coarse sandy loam or loamy coarse sand
- Color—very pale brown, light brownish gray, or light brown
- Hue—7.5YR, 10YR, 2Y
- Value—6 or 7 dry, 5 or 6 moist
- Chroma—2 through 4, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 5 to 10 percent calcium carbonate equivalent
- Gypsum—35 to 65 percent

Harrisburg Series

Depth class: moderately deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 15 percent
Elevation: 1,600 to 4,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: coarse-loamy, mixed, thermic Typic Paleorthids

Typical Pedon

Harrisburg gravelly fine sandy loam in an area of Cave-Harrisburg-Grapevine complex, 1 to 15 percent slopes; about 7.25 miles south of St. George, Utah, 0.25 mile south of the Arizona-Utah state line; about 2,100 feet north and 1,200 feet west of the southeast corner of section 33, T.42 N., R.12 W., Mohave County, Arizona (fig. 12).

A—0 to 2 inches; light reddish brown (5YR 6/4) gravelly fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine vesicular and common very fine tubular pores; 15 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—2 to 18 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and few fine roots; common very fine tubular pores; 10 percent gravel; violently effervescent, calcium carbonate segregated in few fine irregularly-shaped masses; moderately alkaline (pH 8.4); clear smooth boundary.

Bk2—18 to 26 inches; reddish yellow (5YR 6/6) gravelly fine sandy loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; 25 percent gravel; violently effervescent, calcium carbonate segregated in common fine irregularly-shaped masses; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bkm—26 to 60 inches; pinkish white indurated calcium

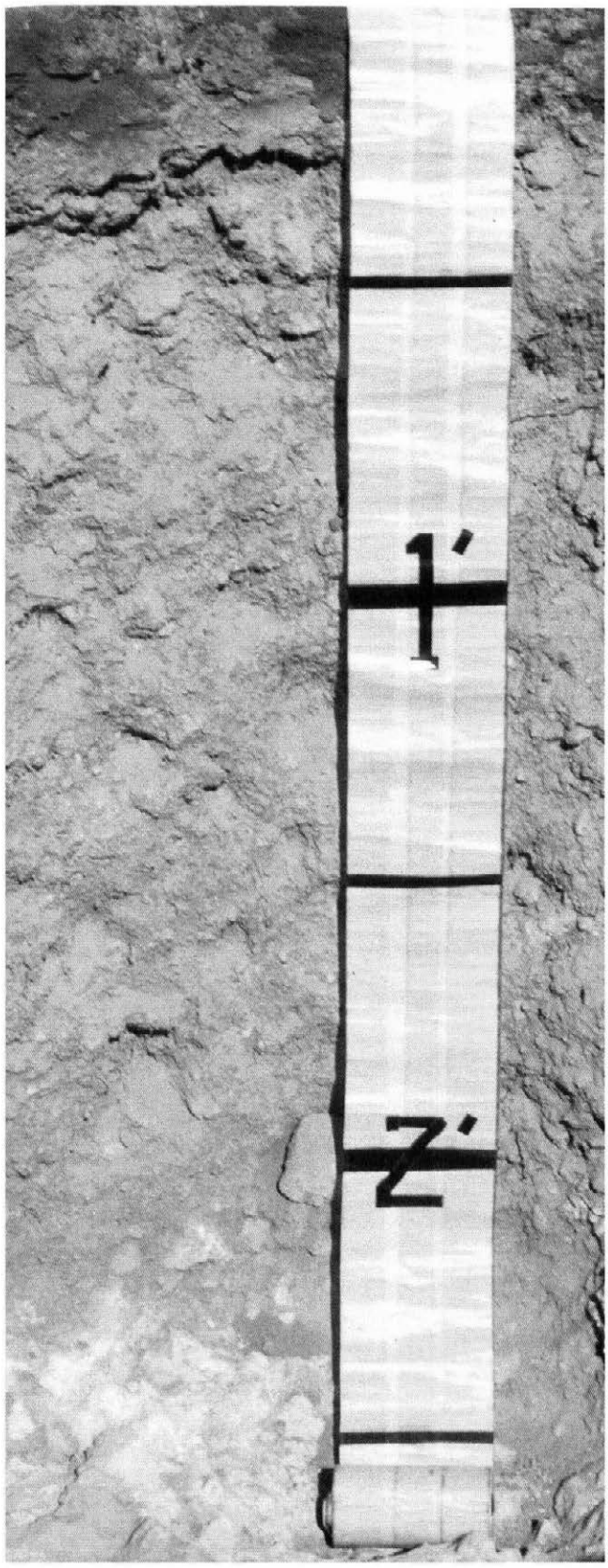


Figure 12.—Profile of Harrisburg soils, which have a high content of calcium carbonate and an indurated pan.

carbonate-cemented hardpan with a thin laminar cap on upper boundary, extremely hard; laminar indurated layer (0.5 to 2 inches thick) repeats every foot or two in the weakly to strongly cemented materials.

Range in Characteristics

Depth to petrocalcic horizon: 20 to 40 inches

A horizon:
Color—pink or light reddish brown
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong
Rock fragments—5 to 35 percent gravel

Bk horizons:
Texture—gravelly or nongravelly fine sandy loam or loam
Color—reddish yellow or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—strongly to violent, 1 to 15 percent calcium carbonate equivalent
Rock fragments—5 to 35 percent gravel

Bkm horizon:
Indurated, calcium carbonate-cemented hardpan with laminar cap. This indurated laminar cap repeats every foot or two in the weakly to strongly cemented materials to a depth of 60 inches or more.

Havasupai Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 5 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed, mesic, shallow Ustollic Paleorthids

Typical Pedon

Havasupai very gravelly loam in an area of Havasupai very gravelly loam, 1 to 5 percent slopes; about 2 miles east of Poverty Knoll; about 30 feet south and 1,800 feet west of the northeast corner of section 8, T.35 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; moderate thin platy

structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine vesicular and common fine tubular pores; 35 percent gravel; strongly effervescent, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bw—2 to 6 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 50 percent gravel and gravel-sized hardpan fragments; violently effervescent, calcium carbonate coating rock fragments, 14 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—6 to 14 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 55 percent gravel and gravel-sized hardpan fragments; violently effervescent, calcium carbonate coating rock fragments. 38 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bkm—14 to 18 inches; pink and white (7.5YR 8/3 and N8/) very strongly cemented hardpan with a laminated, indurated upper boundary about 1 inch thick; clear wavy boundary.

2Bk1—18 to 48 inches; white (N 8/) very gravelly coarse sandy loam, pinkish white (7.5YR 8/2) moist; massive, strongly cemented; extremely hard, very firm, nonsticky and nonplastic; no roots; common fine and medium irregular pores; 55 percent gravel; violently effervescent, 41 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bk2—48 to 60 inches; reddish yellow (5YR 6/6) very gravelly loamy coarse sand, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; no roots; many fine irregular pores; 55 percent gravel; violently effervescent, many calcium carbonate pendants and bridges between sand and gravel, 47 percent calcium carbonate equivalent; strongly alkaline (pH 8.6).

Range in Characteristics

Depth to calcic horizon: 2 to 10 inches
Depth to petrocalcic horizon: 10 to 20 inches
Rock fragments: average 35 to 55 percent gravel

A horizon:
Texture—loam or fine sandy loam
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 2 to 15 percent calcium carbonate equivalent

Bw and Bk horizons:
Texture—sandy clay loam, loam, and fine sandy loam
Color—brown, dark brown, or light brown
Value—4 through 6 dry, 3 through 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 5 to 39 percent calcium carbonate equivalent

2Bk horizons:
Texture—coarse sandy loam and loamy coarse sand
Color—white, pinkish white, pink, or yellowish red
Hue—5YR, 7.5YR
Value—5 through 8 dry, 4 through 8 moist
Chroma—0 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 20 to 74 percent calcium carbonate equivalent
Rock fragments—35 to 75 percent

Hindu Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: mountains
Parent material: colluvium
Slope range: 35 to 70 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70
Classification: loamy-skeletal, mixed (calcareous), thermic Lithic Torriorthents

Typical Pedon

Hindu extremely gravelly loam in an area of Hindu-Rock outcrop-Gypill complex, 35 to 70 percent slopes; on the east side of The Cockscomb in the Pakoon Area; about 2,200 feet north and 100 feet east of the southwest corner of section 2, T.35 N., R.16 W., Mohave County, Arizona.

A—0 to 1 inch; light yellowish brown (10YR 6/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft,

very friable, slightly sticky and nonplastic; common very fine and few fine roots; common very fine vesicular and few very fine tubular pores; 60 percent gravel and 5 percent cobbles; violently effervescent, 27 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—1 to 7 inches; light yellowish brown (10YR 6/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine and few fine roots; common fine and very fine tubular and interstitial pores; 60 percent gravel; violently effervescent, 31 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2R—7 inches; limestone bedrock.

Range in Characteristics

Depth to bedrock: 5 to 20 inches

Rock fragments: average 35 to 75 percent, 35 to 65 percent gravel, 0 to 20 percent cobbles

A and B horizons:

Texture—loam or fine sandy loam

Color—light yellowish brown, very pale brown, or light brown

Hue—7.5YR, 10YR

Value—5 through 7 dry, 4 or 5 moist

Chroma—3 or 4, dry or moist

Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent

Hobcan Series

Depth class: very deep

Drainage class: well drained

Permeability: moderate

Landform: fan terraces

Parent material: mixed alluvium from sedimentary and igneous rock

Slope range: 1 to 5 percent

Elevation: 1,600 to 4,500 feet

Mean annual precipitation: 6 to 9 inches

Mean annual air temperature: 57 to 70 degrees F

Classification: coarse-loamy, mixed, thermic Calcic Gypsiorthids

Typical Pedon

Hobcan very fine sandy loam in an area of Grapevine-Hobcan complex, 1 to 5 percent slopes; about 1,000 feet south of the Arizona-Utah state line and about 9 miles west of Hurricane Cliffs, about 2,600 feet north and 1,800 feet east of the southwest corner of section



Figure 13.—Gypsic soils, like this Hobcan profile, abound in this survey area.

34, T.42 N., R.11 W.; Mohave County, Arizona (fig. 13).

A—0 to 1 inch; reddish yellow (5YR 6/6) very fine sandy loam, yellowish red (5YR 5/6) moist; weak thin platy structure; soft, very friable, slightly sticky and nonplastic; common very fine and few fine roots; many fine and very fine vesicular and common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk—1 to 8 inches; reddish yellow (5YR 6/6) very fine sandy loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine and few fine roots; common fine and very fine tubular pores; slightly effervescent, common fine rounded calcium carbonate nodules, 16 percent calcium carbonate equivalent; 5 percent crystalline gypsum; moderately alkaline (pH 8.0); clear smooth boundary.

Bky1—8 to 15 inches; reddish yellow (5YR 6/6) gypsiferous fine sandy loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine and common fine roots; common fine and very fine tubular pores; slightly effervescent, common fine rounded calcium carbonate nodules, 19 percent calcium carbonate equivalent; 10 percent crystalline gypsum; moderately alkaline (pH 8.0); clear smooth boundary.

Bky2—15 to 33 inches; reddish yellow (5YR 6/6) gypsiferous loam, yellowish red (5YR 5/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; slightly effervescent, common fine rounded calcium carbonate nodules, 15 percent calcium carbonate equivalent; 15 percent crystalline gypsum; moderately alkaline (pH 8.0); clear smooth boundary.

Bky3—33 to 42 inches; reddish yellow (5YR 6/6) gypsiferous loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common fine and very fine tubular pores; slightly effervescent, common fine rounded calcium carbonate nodules, 19 percent calcium carbonate equivalent; 15 percent crystalline gypsum; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bky4—42 to 51 inches; reddish yellow (5YR 6/6) gypsiferous loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular pores; slightly effervescent, few fine rounded calcium carbonate nodules, 13 percent calcium carbonate equivalent; 5 percent crystalline gypsum; moderately alkaline (pH 8.0); clear smooth boundary.

Bky5—51 to 60 inches; reddish yellow (5YR 6/6) gypsiferous very fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine and fine roots; common fine and very fine tubular pores; slightly effervescent, few fine rounded calcium carbonate nodules, 19 percent calcium carbonate equivalent; 5 percent crystalline gypsum; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to calcic horizon: 1 to 4 inches
Depth to gypsic horizon: 8 to 16 inches
Rock fragments: average less than 15 percent gravel

A horizon:
- Texture—fine sandy loam or very fine sandy loam
- Color—yellowish red, reddish yellow, reddish brown, or light reddish brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—slight to strong
- Rock fragments—0 to 35 percent gravel

Bk horizon:
- Texture—fine sandy loam or very fine sandy loam
- Color—yellowish red, reddish yellow, reddish brown, or light reddish brown
- Hue—5YR, 7.5YR
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 15 to 25 percent calcium carbonate equivalent

By horizon:
- Texture—fine sandy loam, very fine sandy loam, or loam
- Color—yellowish red, reddish yellow, reddish brown, or light reddish brown
- Hue—5YR, 7.5YR
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—strong to violent, 15 to 25 percent disseminated calcium carbonate equivalent
- Gypsum—5 to 20 percent

Hobog Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus, ridges, and mesas
Parent material: local alluvium and eolian deposits from sedimentary and igneous formations
Slope range: 2 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, mixed, thermic Lithic Calciorthids

Typical Pedon

Hobog very gravelly sandy loam in an area of Hobog-Tidwell family complex, 8 to 35 percent slopes; about 13 miles southwest of St. George, Utah, just 5.5 miles south of the Arizona-Utah state line; about 1,950 feet north and 1,100 feet west of the southeast corner of section 26, T.41 N., R.13 W.; Mohave County, Arizona.

A—0 to 4 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; weak fine platy structure; soft, very friable, nonsticky and nonplastic; many fine and very fine and few medium roots; common fine and very fine vesicular pores; 50 percent gravel and 5 percent flagstones; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—4 to 12 inches; pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 25 percent gravel and 10 percent cobbles; violently effervescent, calcium carbonate segregated in common fine and medium masses and seams, 22 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk2—12 to 19 inches; pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine roots; few fine and very fine tubular and interstitial pores; 35 percent gravel and 10 percent cobbles; violently effervescent, calcium carbonate segregated in common fine masses and seams, 32 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2R—19 inches; limestone bedrock.

Range in Characteristics

Depth to calcic horizon: 1 to 5 inches
Depth to bedrock: 6 to 20 inches
Rock fragments: average 35 to 60 percent

A horizon:
Texture—very gravelly or very cobbly sandy loam or fine sandy loam
Color—pink or light brown
Value—6 through 8 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong
Rock fragments—35 to 50 percent gravel, 0 to 20 percent cobbles

Bk horizon:
Texture—very gravelly or very cobbly sandy loam or loam
Color—pink, light brown, or brown
Value—6 through 8 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 25 percent calcium carbonate equivalent
Rock fragments—35 to 60 percent gravel, 0 to 25 percent cobbles

R horizon:
Extremely hard limestone or calcareous sandstone bedrock

Huevi Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed alluvium and colluvium from sedimentary formations
Slope range: 5 to 15 percent
Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 4 to 8 inches
Mean annual air temperature: 72 to 78 degrees F
Classification: loamy-skeletal, mixed, hyperthermic Duric Calciorthids

Typical Pedon

Huevi very gravelly sandy loam in an area of Pompeii family-Huevi complex, 2 to 15 percent slopes; about 40 miles south of Littlefield, Arizona, and 3 miles east of the Arizona-Nevada state line; about 130 feet north and 2,485 feet west of the southeast corner of section 27, T.34 N., R.16 W., Mohave County, Arizona.

A—0 to 2 inches; reddish yellow (7.5YR 6/6) very gravelly sandy loam, brown (7.5YR 4/4) moist;

weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine irregular and few very fine tubular pores; 40 percent gravel and 10 percent cobbles; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—2 to 8 inches; reddish yellow (7.5YR 7/6) very gravelly sandy loam, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 30 percent gravel and 5 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

2Bqk1—8 to 19 inches; pink (7.5YR 8/3) extremely gravelly coarse sandy loam, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; hard, firm, nonsticky and nonplastic; common fine and very fine roots; few fine irregular pores; 60 percent gravel and 5 percent cobbles; strongly effervescent, very weakly silica and calcium carbonate cemented, 12 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt wavy boundary.

2Bqk2—19 to 28 inches; pink (7.5YR 8/3) very gravelly loamy coarse sand, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; hard, firm, nonsticky and nonplastic; few very fine roots; few fine irregular pores; 40 percent gravel and 15 percent cobbles; violently effervescent, weakly silica and calcium carbonate cemented, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

2Bqk3—28 to 44 inches; pink (7.5YR 7/4) extremely gravelly sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, firm, nonsticky and nonplastic; very few very fine roots; common fine irregular pores; 60 percent gravel and 5 percent cobbles; violently effervescent, weakly silica and calcium carbonate cemented, 23 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

3Bqk—44 to 60 inches; pink (7.5YR 8/3) extremely gravelly loamy coarse sand, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; very hard, very firm, nonsticky and nonplastic; no roots; common fine irregular pores; 60 percent gravel and 5 percent cobbles; violently effervescent, weakly to strongly silica and calcium carbonate cemented, 25 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Range in Characteristics

Depth to calcic horizon: 8 to 20 inches
Rock fragments: average 35 to 65 percent gravel, 0 to 15 percent cobbles

A horizon:
- Texture—very gravelly sandy loam or loamy coarse sand
- Color—reddish yellow, pink, or light brown
- Value—6 through 8 dry, 4 through 6 moist
- Chroma—3 through 6, dry or moist
- Effervescence—slight to strong, 2 to 10 percent calcium carbonate equivalent
- Rock fragments—35 to 50 percent gravel, 5 to 10 percent cobbles

Bqk horizon:
- Texture—very to extremely gravelly sandy loam, coarse sandy loam, or loamy coarse sand
- Color—pink, reddish yellow, or light brown
- Value—6 through 8 dry, 4 through 6 moist
- Chroma—3 through 6, dry or moist
- Effervescence—strong to violent, 10 to 30 percent calcium carbonate equivalent
- Rock fragments—35 to 65 percent gravel, 5 to 20 percent cobbles

Ivanpatch Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terrace
Parent material: alluvium from sedimentary formations high in gypsum and calcium carbonate
Slope range: 1 to 5 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Classification: coarse-loamy, mixed, mesic Cambic Gypsiorthids

Typical Pedon

Ivanpatch fine sandy loam in an area of Ivanpatch fine sandy loam, 1 to 5 percent slopes; about 3 miles north of Mt. Trumbull settlement; about 700 feet north and 800 feet east of the southeast corner of section 1, T.35 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate thin platy structure; slightly hard, very friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine vesicular and

common fine tubular pores; strongly effervescent, 24 percent calcium carbonate equivalent; 2 to 3 percent crystalline gypsum as sand grains; moderately alkaline (pH 8.0); abrupt smooth boundary.

By1—2 to 11 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine and very fine roots; common fine and very fine tubular pores; strongly effervescent, 22 percent calcium carbonate equivalent; 5 percent crystalline gypsum as sand grains; moderately alkaline (pH 8.0); clear smooth boundary.

By2—11 to 25 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; strongly effervescent, 23 percent calcium carbonate equivalent; 10 percent crystalline gypsum as sand grains and small clusters of crystals; slightly alkaline (pH 7.8); clear smooth boundary.

By3—25 to 46 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; strongly effervescent, 21 percent calcium carbonate equivalent; 20 percent crystalline gypsum as sand grains and small clusters of crystals; slightly alkaline (pH 7.8); clear smooth boundary.

By4—46 to 60 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular pores; strongly effervescent, 15 percent calcium carbonate equivalent; 15 percent crystalline gypsum as sand grains and small clusters of crystals; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to gypsic horizon: 1 to 10 inches
Rock fragments: average 0 to 15 percent gravel

A horizon:
- Color—light reddish brown, reddish yellow, or light brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 1 to 25 percent calcium carbonate equivalent

By horizons:
- Texture—fine sandy loam or loam
- Color—light reddish brown, reddish yellow, or light brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 5 to 25 percent calcium carbonate equivalent
- Gypsum—5 to 25 percent

Ives Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: flood plain
Parent material: mixed alluvium
Slope range: 1 to 3 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 59 degrees F
Classification: coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents

Typical Pedon

Ives loam in an area of Ives loam, 1 to 3 percent slopes; about 12 miles south of the Arizona-Utah state line and 7.5 miles west of Hurricane Cliffs; about 2,500 feet south and 650 feet west of the northeast corner of section 35, T.40 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 5/4) stratified loam, brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and common fine roots; many very fine vesicular and common fine tubular pores; slightly effervescent, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1—2 to 9 inches; brown (7.5YR 5/4) stratified fine sandy loam, brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and common fine roots; many very fine and common fine tubular and interstitial pores; strongly effervescent, 29 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

C2—9 to 22 inches; light brown (7.5YR 6/4) stratified

loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many very fine and fine tubular pores; strongly effervescent, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

C3—22 to 60 inches; brown (7.5YR 5/4) stratified fine sandy loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few fine and very fine roots; many very fine and fine tubular pores; strongly effervescent, 13 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: average less than 5 percent

A horizon:
- Texture—fine sandy loam or loam
- Color—brown or light brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Effervescence—slight to strong, 5 to 20 percent calcium carbonate equivalent

C horizon:
- Texture—fine sandy loam and loam (stratified with coarser and finer materials)
- Color—brown or light brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Effervescence—slight to strong, 10 to 30 percent calcium carbonate equivalent, disseminated

Katzine Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: hills and mountains
Parent material: alluvium and colluvium
Slope range: 5 to 50 percent
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 56 degrees F
Classification: loamy-skeletal, mixed, mesic Calciorthidic Ustochrepts

Typical Pedon

Katzine very gravelly loam in an area of Yumtheska-Katzine-Rock outcrop Complex, 2 to 30 percent slopes; about 3 miles north by northwest of Poverty Mountain; about 1,900 feet north and 2,500 feet west of the southeast corner of section 17, T.35 N., R.12 W., Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 5/3) very gravelly loam, dark brown (7.5YR 4/3) moist; weak thin platy structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; many fine and very fine vesicular pores; 40 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—2 to 8 inches; brown (7.5YR 5/3) very gravelly loam, dark brown (7.5YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine tubular and interstitial pores; 40 percent gravel; strongly effervescent, few fine seams and coatings on rock fragments, 5 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk1—8 to 20 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; 35 percent gravel; violently effervescent, common fine calcium carbonate seams and coatings on rock fragments, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk2—20 to 31 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; common fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; 30 percent gravel; violently effervescent, common fine calcium carbonate seams and coatings on rock fragments, 21 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk3—31 to 60 inches; pink (7.5YR 7/4) very gravelly loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; common fine and very fine tubular and interstitial pores; 55 percent gravel; violently effervescent, engulfed in calcium carbonate, 28 percent calcium carbonate equivalent; moderately alkaline (pH 8.2).

Range in Characteristics

Depth to calcic horizon: 8 to 15 inches
Rock fragments: average 35 to 55 percent

A horizon:
- Texture—loam or fine sandy loam

Color—brown or light brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 1 to 10 percent calcium carbonate equivalent
Rock fragments—20 to 55 percent gravel, 5 to 35 percent cobbles

Bw horizon:
Texture—loam or fine sandy loam
Color—brown or light brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 1 to 10 percent calcium carbonate equivalent
Rock fragments—35 to 55 percent gravel; 0 to 15 percent cobbles

Bk horizons:
Texture—loam or sandy loam
Color—brown, light brown, or pink
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent
Rock fragments—20 to 55 percent gravel, 0 to 15 percent cobbles

Lozinta Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: cinder cones
Parent material: alluvium
Slope range: 15 to 50 percent
Elevation: 6,000 to 7,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Classification: ashy-skeletal over fragmental or cindery, mixed, mesic Vitrandic Ustochrepts

Typical Pedon

Lozinta very gravelly loam in an area of Wutoma-Lozinta complex, 15 to 50 percent slopes; about 1.5 miles southwest of Mt. Logan; about 2,540 feet north and 1,400 feet west of the southeast corner of section 18, T.34 N., R.8 W., Mohave County, Arizona.

A—0 to 2 inches; brown (10YR 4/3) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine interstitial pores; 50 percent cinders; neutral (pH 7.0); clear smooth boundary.

Bw1—2 to 17 inches; dark grayish brown (10YR 4/2) very gravelly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine interstitial pores; 40 percent cinders; slightly alkaline (pH 7.5); clear smooth boundary.

Bw2—17 to 28 inches; brown (10YR 4/3) very gravelly loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few fine roots; many fine interstitial pores; 40 percent cinders; slightly alkaline (pH 7.5); abrupt smooth boundary.

2C—28 to 60 inches; gray and very dark grayish brown (10YR 5/1 and 3/2) cinders, dark gray and light yellowish brown (10YR 4/1 and 6/4) moist.

Range in Characteristics

Depth to cinders: 20 to 40 inches
Rock fragments: average 35 to 60 percent gravel-sized cinders

A and B horizons:
Texture—loam or fine sandy loam
Color—dark grayish brown, grayish brown, or brown
Hue—7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline

Luzena Family

Depth class: shallow
Drainage class: well drained
Permeability: slow
Landform: mesas
Parent material: alluvium and colluvium from volcanic rocks
Slope range: 1 to 10 percent
Elevation: 6,600 to 7,200 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Classification: clayey, montmorillonitic, mesic Lithic Argiustolls

Typical Pedon

Luzena family very cobbly loam in an area of Yellowhorse-Luzena family complex, 1 to 10 percent slopes; about 13.5 miles south of the Arizona-Utah state line and 16.6 miles east of the Arizona-Nevada state line; about 500 feet south and 1,600 feet west of the northeast corner of section 12, T.39 N., R.14 W., Mohave County, Arizona.

A—0 to 2 inches; reddish brown (5YR 5/4) very cobbly

loam, dark reddish brown (5YR 3/3) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine vesicular and common fine and very fine tubular pores; 5 percent gravel, 25 percent cobbles, and 5 percent stones; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt1—2 to 16 inches; dark reddish brown (5YR 3/4) clay, dark reddish brown (5YR 3/2) moist; strong coarse angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine and very fine roots; common fine interstitial pores; many pressure faces on ped faces; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.6); abrupt irregular boundary.

Bt2—16 to 19 inches; dark reddish brown (5YR 3/4) gravelly clay, dark reddish brown (5YR 3/2) moist; strong medium angular blocky structure; very hard, very firm, very sticky and very plastic; few fine and very fine roots; common fine interstitial pores; many pressure faces on ped faces; 20 percent gravel; noneffervescent; slightly alkaline (pH 7.6); abrupt irregular boundary.

2R—19 inches; basalt.

Range in Characteristics

Depth to argillic: 1 to 2 inches
Depth to bedrock: 10 to 20 inches
Rock fragments: average less than 15 percent gravel, 0 to 5 percent cobbles

A horizon:
- Texture—very cobbly loam or clay loam
- Color—reddish brown or dark reddish brown
- Value—3 through 5 dry, 3 or 4 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Rock fragments—5 to 15 percent gravel, 15 to 35 percent cobbles, few stones

Bt horizon:
- Texture—clay loam or clay
- Color—reddish brown or dark reddish brown
- Value—3 through 5 dry, 3 or 4 moist
- Chroma—3 or 4, dry or moist
- Rock fragments—less than 15 percent gravel, less than 5 percent cobbles

R horizon:
- Basalt bedrock

McCullan Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: alluvium and colluvium from sedimentary formations high in content of gypsum
Slope range: 1 to 10 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 54 to 57 degrees F
Classification: coarse-loamy, gypsic, mesic Typic Gypsiorthids

Typical Pedon

McCullan gravelly loam in an area of Dutchman-McCullan complex, 1 to 10 percent slopes; about 20 miles south of the Arizona-Utah state line; just west of the Hurricane Cliffs; about 2,500 feet south and 400 feet west of the northeast corner of section 7, T.38 N., R.9 W.; Mohave County, Arizona.

A—0 to 1 inch; light brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine roots; many very fine vesicular and common fine and very fine tubular pores; 20 percent gravel; strongly effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—1 to 6 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; strongly effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

2By1—6 to 25 inches; white (N 8/) sandy loam, pinkish white (7.5YR 8/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and common very fine irregular pores; 10 percent gravel; slightly effervescent, 6 percent calcium carbonate equivalent; 70 percent powdery gypsum; slightly alkaline (pH 7.8); abrupt smooth boundary.

2By2—25 to 41 inches; pink (7.5YR 7/4) sandy loam, brown (7.5YR 5/4) moist; crystalline gypsum rock structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine irregular pores; 10 percent gravel; slightly effervescent, 8 percent

calcium carbonate equivalent; 50 percent crystalline gypsum; slightly alkaline (pH 7.8); clear smooth boundary.

3Bkyb—41 to 60 inches; reddish yellow (5YR 7/6) sandy loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent, common medium irregular soft calcium carbonate masses, 17 percent calcium carbonate equivalent; 35 percent crystalline gypsum; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to gypsic horizon: less than 10 inches
Rock fragments: average less than 15 percent gravel

A horizon:
- Texture—loam, fine sandy loam, and sandy loam
- Color—light brown, pink, and reddish yellow
- Hue—5YR, 7.5YR
- Value—6 or 7 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 5 to 25 percent calcium carbonate equivalent
- Rock fragments—15 to 35 percent gravel

Bw horizon:
- Texture—fine sandy loam, sandy loam, and loam
- Color—light brown, pink, and reddish yellow
- Hue—5YR, 7.5YR
- Value—6 or 7 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 5 to 25 percent calcium carbonate equivalent
- Rock fragments—less than 15 percent gravel

By horizon:
- Texture—fine sandy loam or sandy loam
- Color—white, pinkish white, pink, and reddish yellow
- Hue—5YR, 7.5YR
- Value—6 through 8 dry, 4 through 8 moist
- Chroma—0 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Calcium carbonate equivalent—5 to 30 percent
- Gypsum—20 to 90 percent (can be weakly cemented)
- Rock fragments—less than 15 percent gravel

Meadview Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces and mesas
Parent material: mixed alluvium and colluvium from sedimentary and igneous formations
Slope range: 2 to 40 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: sandy-skeletal, mixed, thermic Duric Calciorthids

Typical Pedon

Note: These soils are a taxadjunct to the Meadview series. The Meadview series has sand at 20 to 30 inches and averages sandy-skeletal. These soils have sand at 50 inches and average loamy-skeletal.

Meadview very gravelly sandy loam, 2 to 18 percent slopes; about 10 miles southwest of Littlefield, Arizona; about 1,800 feet south and 1,500 feet east of the northwest corner of section 22, T.39 N., R.16 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine vesicular and few fine tubular pores; 40 percent gravel; strongly effervescent, 8 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bw—2 to 6 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel; strongly effervescent, 8 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk1—6 to 17 inches; pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel; violently effervescent, common faint calcium carbonate coatings on rock fragments, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—17 to 35 inches; pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 50

percent calcium carbonate coated gravel; violently effervescent, weakly cemented, 21 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk3—35 to 50 inches; pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; hard, friable, slightly sticky and nonplastic; few very fine roots; common fine and very fine tubular pores; 45 percent calcium carbonate coated gravel; violently effervescent, weakly cemented, 21 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

2Bk—50 to 62 inches; reddish yellow (7.5YR 7/6) very gravelly loamy sand, reddish yellow (7.5YR 6/6) moist; single grained; loose; few very fine roots; many fine and very fine irregular pores; 50 percent gravel; slightly effervescent, 5 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Range in Characteristics

Depth to calcic horizon: 5 to 15 inches
Rock fragments: average 35 to 70 percent

A horizon:
- Texture—very gravelly or very stony sandy loam
- Color—brown, light brown, or pale brown
- Hue—7.5YR, 10YR
- Value—5 through 7 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Effervescence—slight to strong, less than 15 percent calcium carbonate equivalent
- Rock fragments—15 to 45 percent gravel, 0 to 35 percent cobbles, 0 to 35 percent stones

Bw horizon:
- Texture—very or extremely gravelly, cobbly, or stony sandy loam or loam
- Color—brown, light brown, or pale brown
- Hue—7.5YR, 10YR
- Value—5 through 7 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Effervescence—strong to violent, 1 to 10 percent calcium carbonate equivalent
- Rock fragments—20 to 65 percent gravel, 0 to 35 percent cobbles, 0 to 20 percent stones

Bk horizon:
- Texture—very or extremely gravelly, cobbly, or stony sandy loam or loam
- Color—pink, light brown, or reddish yellow
- Value—6 or 7 dry, 5 or 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 15 to 40 percent calcium carbonate equivalent
- Rock fragments—20 to 65 percent gravel, 0 to 35 percent cobbles, 0 to 20 percent stones

Mellenthin Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus, mesas, and hills
Parent material: alluvium, colluvium, and eolian deposits from limestone and sandstone
Slope range: 4 to 35 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids

Typical Pedon

Mellenthin very gravelly loam in an area of Mellenthin-Tanbark complex, 5 to 50 percent slopes, cool; about 51 miles south of St. George, Utah, just southwest of Poverty Mountain; about 1,500 feet north and 1,200 feet west of the southeast corner of section 10, T.34 N., R.12 W., Mohave County, Arizona.

A—0 to 2 inches; dark brown (7.5YR 4/3) very gravelly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; few very fine tubular pores; 50 percent gravel, 5 percent cobbles; slightly effervescent, 12 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); abrupt smooth boundary.

AB—2 to 6 inches; dark brown (7.5YR 4/3) very gravelly loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; many very fine roots; few very fine tubular pores; 40 percent gravel, 5 percent cobbles; violently effervescent, common calcium carbonate pendants on rock fragments, 16 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); clear wavy boundary.

Bk1—6 to 12 inches; brown (7.5YR 5/4) very gravelly loam, dark brown (7.5YR 4/2) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; few very fine tubular pores; 50 percent gravel, 5 percent cobbles; fragments have 1/8- to 1/2-inch thick calcium carbonate pendants on the underside, violently

effervescent, 30 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bk2—12 to 17 inches; brown (7.5YR 5/3) very gravelly loam, dark brown (7.5YR 4/2) moist; weak fine blocky structure; slightly hard, very friable; few fine roots; few very fine tubular pores; 50 percent gravel, 5 percent cobbles; fragments have 1/8- to 1/2-inch thick calcium carbonate pendants on the underside, violently effervescent, 45 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
2R—17 inches; limestone.

Range in Characteristics

Depth to calcic horizon: 1 to 6 inches
Depth to bedrock: 8 to 20 inches
Rock fragments: average 35 to 60 percent

A horizon:
Texture—very gravelly or very channery loam or fine sandy loam
Color—dark brown or brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 through 4, dry or moist
Rock fragments—25 to 50 percent gravel or channers, 5 to 25 percent cobbles or flagstones

Bk horizon:
Texture—very gravelly or very channery loam or fine sandy loam
Color—dark brown, brown, or reddish brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 through 4, dry or moist
Effervescence—strong to violent, 5 to 25 percent calcium carbonate equivalent
Rock fragments—25 to 50 percent gravel or channers, 5 to 25 percent cobbles or flagstones

R horizon:
Limestone or sandstone

Meriwhitica Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: escarpments; cliffs, and canyon walls
Parent material: colluvium
Slope range: 35 to 70 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed (calcareous), mesic Lithic Ustic Torriorthents

Typical Pedon

Meriwhitica very gravelly loam in an area of Meriwhitica-Rock outcrop-Strych complex, 35 to 70 percent slopes; on Upper Grand Wash Cliffs about 4 miles north of Pigeon Canyon; about 1,100 feet north and 700 feet east of the southwest corner of section 9, T.34 N., R.13 W., Mohave County, Arizona.

A—0 to 1 inch; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine vesicular pores; 40 percent gravel and 5 percent cobbles; strongly effervescent, 21 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bk—1 to 6 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel and 5 percent cobbles; violently effervescent, 27 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.
2R—6 inches; limestone.

Range in Characteristics

Depth to bedrock: 4 to 10 inches
Rock fragments: average 35 to 60 percent—35 to 50 percent gravel, 0 to 10 percent cobbles

A and Bk horizons:
Texture—loam and fine sandy loam
Color—light brown, brown, or pale brown
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 10 to 30 percent calcium carbonate equivalent

Mespun Series

Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Landform: fan terrace
Parent material: eolian and eolian over mixed alluvium
Slope range: 2 to 10 percent

Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: mixed, mesic Ustic Torripsamments

Typical Pedon

Mespun fine sand in an area of Mespun complex, 2 to 10 percent slopes; about 17 miles south of Littlefield, Arizona; about 75 feet south and 2,300 feet west of the northeast corner of section 36, T.38 N., R.15 W., Mohave County, Arizona.

C1—0 to 6 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; single grained; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; many very fine irregular and tubular pores; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

C2—6 to 60 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine irregular and tubular pores; noneffervescent; slightly alkaline (pH 7.8).

Range in Characteristics

C horizon:
Texture—fine sand or loamy fine sand
Color—light reddish brown and reddish yellow
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to very slight

Moenkopie Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: mesas, plateaus, and structural benches
Parent material: alluvium and eolian materials from sedimentary formations
Slope range: 5 to 30 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: loamy, mixed (calcareous), mesic Lithic Torriorthents

Typical Pedon

Moenkopie gravelly fine sandy loam in an area of Moenkopie-Pennell-Rock outcrop complex, 10 to 50 percent slopes; about 11 miles south of the Arizona-Utah state line and 3.5 miles west of the Hurricane Cliffs; about 1,200 feet north and 1,500 feet west of the southeast corner of section 31, T.40 N., R.10 W., Mohave County, Arizona.

A—0 to 1 inch; brown (7.5YR 5/4) channery fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine vesicular and few fine and very fine tubular pores; 15 percent small limestone channers; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bw—1 to 8 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 13 percent small limestone channers; strongly effervescent, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—8 to 12 inches; pink (7.5YR 8/4) channery loam, pink (7.5YR 7/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 15 percent small limestone channers; violently effervescent, common fine calcium carbonate seams and thin coatings on rock fragments, 31 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2R—12 inches; limestone.

Range in Characteristics

Depth to bedrock: 5 to 20 inches
Rock fragments: average less than 35 percent

A horizon:
Texture—channery or very channery fine sandy loam or sandy loam
Color—brown, light brown, reddish brown, or light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, less than 15 percent calcium carbonate equivalent
Rock fragments—15 to 40 percent gravel or channers, 0 to 5 percent cobbles or flagstones

Bw horizon:
Texture—channery; loam, fine sandy loam, or sandy loam (less than 18 percent clay)
Color—brown, light brown, reddish brown, or light reddish brown

Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, less than 15 percent calcium carbonate equivalent
Rock fragments—15 to 35 percent gravel or channers, 0 to 5 percent cobbles or flagstones

Bk horizon:
Texture—channery loam, fine sandy loam, or sandy loam (less than 18 percent clay)
Color—brown, light brown, pink, reddish brown, or light reddish brown
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent
Rock fragments—15 to 35 percent gravel or channers, 0 to 5 percent cobbles or flagstones

R horizon:
Extremely hard limestone or calcareous sandstone

Mokaac Series

Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Landform: fan terraces
Parent material: alluvium and colluvium from sedimentary formations high in gypsum and calcium carbonate
Slope range: 2 to 20 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: sandy-skeletal, gypsic, thermic Calcic Gypsiorthids

Typical Pedon

Mokaac very cobbly loamy fine sand in an area of Akinville-Mokaac association, 2 to 20 percent slopes; about 3.5 miles south of the Arizona-Utah state line and 1 mile west of the Hurricane Cliffs; about 1,500 feet north and 1,800 feet east of southwest corner of section 14, T.41 N., R.10 W.; Mohave County, Arizona

A—0 to 3 inches; light brown (7.5YR 6/4) very cobbly loamy fine sand, strong brown (7.5YR 5/6) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine vesicular and few fine tubular pores; 15 percent gravel, 15 percent cobbles, and 5 percent stones; violently effervescent, 8 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bky—3 to 10 inches; light brown (7.5YR 6/4) gravelly loamy fine sand, strong brown (7.5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; common fine and very fine tubular pores; 20 percent gravel and 10 percent cobbles; violently effervescent with calcium carbonate segregated as common fine seams and pendants on rock fragments, 25 percent calcium carbonate equivalent; 5 percent crystalline gypsum; moderately alkaline (pH 8.4); abrupt smooth boundary.

By1—10 to 26 inches; light brown (7.5YR 6/4) extremely gravelly sand, strong brown (7.5YR 5/6) moist; single grained; loose; many very fine, common fine, and few medium roots; many fine and very fine irregular pores; 55 percent gravel and 5 percent cobbles; violently effervescent, 30 percent calcium carbonate equivalent; 30 percent crystalline gypsum, common gypsum pendants on rock fragments; slightly alkaline (pH 7.8); abrupt smooth boundary.

By2—26 to 32 inches; light brown (7.5YR 6/4) loamy fine sand, strong brown (7.5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 10 percent gravel; violently effervescent, 15 percent calcium carbonate equivalent; 10 percent crystalline gypsum, common gypsum pendants on rock fragments; slightly alkaline (pH 7.8); abrupt smooth boundary.

By3—32 to 41 inches; light brown (7.5YR 6/4) very gravelly loamy coarse sand, brown (7.5YR 4/4) moist; single grained; loose; common fine and very fine roots; many fine and very fine irregular pores; 50 percent gravel; violently effervescent, 24 percent calcium carbonate equivalent; 30 percent crystalline gypsum, common gypsum pendants on rock fragments; slightly alkaline (pH 7.8); abrupt smooth boundary.

2Bkb1—41 to 52 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; 5 percent gravel; violently

effervescent with calcium carbonate segregated as common fine seams, 20 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

2Bkb2—52 to 60 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; no roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent with calcium carbonate segregated as common medium seams and soft masses, 20 percent calcium carbonate equivalent; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to calcic horizon: 1 to 3 inches
Depth to gypsic horizon: 15 to 35 inches
Rock fragments: average 35 to 60 percent gravel, cobbles, few stones

A horizon:
Texture—very cobbly, loamy fine sand, fine sandy loam, fine sand, or sandy loam
Color—light reddish brown, reddish yellow, or yellowish red
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to strong
Rock fragments—15 to 60 percent gravel, cobbles, few stones

Bk or Bky horizons:
Texture—gravelly; loamy fine sand, fine sandy loam, or sandy loam
Color—light reddish brown, reddish yellow, or yellowish red
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 10 to 35 percent calcium carbonate equivalent
Gypsum—less than 10 percent
Rock fragments—5 to 50 percent gravel, cobbles, few stones

By horizon:
Texture—very gravelly; sand, loamy sand, loamy coarse sand, or coarse sand
Color—pink, reddish yellow, or yellowish red
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Calcium carbonate equivalent—10 to 35 percent
Gypsum—15 to 50 percent
Rock fragments—5 to 75 percent, averages more than 35 percent gravel, cobbles, and few stones

2Bkb horizons:
May or may not occur in all pedons

Natank Series

Depth class: moderately deep
Drainage class: well drained
Permeability: slow
Landform: plateaus and mesas
Parent material: alluvium from sedimentary formations
Slope range: 2 to 20 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Classification: fine, montmorillonitic, mesic Aridic Haplustalfs

Typical Pedon

Natank very gravelly loam in an area of Disterheff-Natank-Yumtheska complex, 2 to 15 percent slopes; about 51 miles south of St. George, Utah, 9 miles west of Poverty Mountain; about 2,390 feet north and 2,625 feet west of the southeast corner of section 11, T.34 N., R.13 W., Mohave County, Arizona.

A—0 to 1 inch; brown (7.5YR 4/3) very gravelly loam, dark brown (7.5YR 4/2) moist; weak fine granular structure; soft, friable, nonsticky and slightly plastic; common fine roots; few fine interstitial pores; 40 percent gravel; neutral (pH 7.2); abrupt smooth boundary.

AB—1 to 3 inches; dark brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, firm, slightly sticky and slightly plastic; many medium roots; common very fine tubular pores; 10 percent gravel; neutral (pH 7.2); abrupt wavy boundary.

Bt1—3 to 9 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong medium angular blocky structure; very hard, very firm, very sticky and very plastic; many fine roots; common very fine tubular pores; 10 percent gravel; common distinct clay films on faces of peds and lining pores; many pressure faces; slightly alkaline (pH 7.4); clear wavy boundary.

Bt2—9 to 16 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; strong medium angular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; common very fine tubular pores; 5 percent gravel; many distinct clay films on faces of peds and

lining pores; many pressure faces; slightly effervescent; slightly alkaline (pH 7.6); abrupt wavy boundary.

2Btk1—16 to 25 inches; pink and reddish brown (5YR 8/3 and 5/4) cobbly clay loam, light reddish brown and reddish brown (5YR 6/3 and 4/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; common very fine tubular pores; 15 percent gravel and 10 percent cobbles; many faint clay films on faces of peds and lining pores; strongly effervescent, many large soft calcium carbonate masses and pendants on rock fragments; moderately alkaline (pH 8.0); gradual wavy boundary.

2Btk2—25 to 37 inches; pink (5YR 8/4) cobbly loam, reddish yellow (5YR 7/6) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; few faint clay films on faces of peds and lining pores; 15 percent gravel and 15 percent cobbles; strongly effervescent, many large soft calcium carbonate masses and pendants on rock fragments; moderately alkaline (pH 8.0); abrupt irregular boundary.

3R—37 inches; limestone with discontinuous 1/4-inch thick laminar cap.

Range in Characteristics

Depth to calcic horizon: 20 to 30 inches
Depth to bedrock: 20 to 40 inches
Rock fragments: average less than 15 percent

A horizon:
Color—brown or dark brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—35 to 50 percent gravel

t horizon:
Color—reddish brown and yellowish red
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—neutral to slightly alkaline
Effervescence—none to slight
Rock fragments—0 to 5 percent gravel

Btk horizon:
Texture—cobbly clay loam or loam
Color—pink and reddish brown
Value—5 through 8 dry, 4 through 7 moist
Chroma—3 or 4, dry or moist
Rock fragments—5 to 30 percent gravel; 5 to 15 percent cobbles

R horizon:
Hard limestone bedrock

Nickel Family

Depth class: moderately deep to very deep
Drainage class: well drained
Permeability: moderate to moderately rapid
Landform: mountains
Parent material: colluvium
Slope range: 10 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, mixed, thermic Typic Calciorthids

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Nickel family in an area of Nipton-Rock outcrop-Nickel family complex, 10 to 50 percent slopes; about 8 miles south of Littlefield, Arizona, along an east-facing slope of Elbow Canyon in the Virgin Mountains; about 400 feet north and 400 feet west of the southeast corner of section 17, T.39 N., R.15 W., Mohave County, Arizona.

A—0 to 1 inch; light yellowish brown (10YR 6/4) very cobbly loam, yellowish brown (10YR 5/4) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine and very fine vesicular pores; 20 percent gravel and 20 percent cobbles; slightly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—1 to 8 inches; light yellowish brown (10YR 6/4) very gravelly loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 30 percent gravel and 10 percent cobbles; strongly effervescent with few fine calcium carbonate pendants on rock fragments, 9 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk2—8 to 49 inches; very pale brown (10YR 7/4) very stony loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine and very fine, and few medium roots; common fine and very fine

tubular pores; 15 percent gravel, 20 percent cobbles, and 20 percent stones; strongly effervescent with common fine calcium carbonate pendants on rock fragments, 15 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.
2Cr—49 inches; weathered gneiss.

Range in Characteristics

Depth to calcic horizon: 1 to 10 inches
Depth to bedrock: 20 to 60 inches or more
Rock fragments: average 15 to 35 percent gravel, 5 to 25 percent cobbles, 0 to 25 percent stones

A horizon:
Texture—loam or fine sandy loam
Color—very pale brown, light yellowish brown, yellowish brown, or light brown
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 1 to 10 percent calcium carbonate equivalent

B horizon:
Texture—loam, fine sandy loam, sandy loam, or loamy sand
Color—very pale brown, light yellowish brown, yellowish brown, or light brown
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 5 to 20 percent calcium carbonate equivalent

Nikey Family

Depth class: moderately deep and deep
Drainage class: well drained
Permeability: moderate to moderately rapid
Landform: mesa
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: coarse-loamy, mixed, thermic Typic Calciorthids

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Nikey family in an area of Nikey family-Ruesh family-Rock outcrop complex, 10 to 40 percent slopes; about 3.5 miles south of the Arizona-Utah state line and 6 miles west of the Hurricane Cliffs; about 200 feet east and 400 feet north of the southwest corner of section 13, T.41 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; reddish brown (5YR 5/4) very cobbly fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine vesicular pores; 15 percent gravel, 25 percent cobbles, and 10 percent stones; slightly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bw—2 to 12 inches; reddish brown (5YR 5/4) very cobbly loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 15 percent gravel, 25 percent cobbles, and 10 percent stones; strongly effervescent with few fine calcium carbonate flakes, 5 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.
Bk1—12 to 26 inches; yellowish red (5YR 5/6) gravelly loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 5 percent cobbles; violently effervescent with common fine calcium carbonate masses and seams, 21 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.
Bk2—26 to 42 inches; yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 5 percent cobbles; violently effervescent with common fine calcium carbonate masses and seams, 22 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.
2Cr—42 inches; mudstone and shale.

Range in Characteristics

Depth to calcic horizon: 8 to 15 inches
Depth to bedrock: 30 to 60 inches

A and Bw horizons:
Texture—fine sandy loam, loam, or sandy clay loam

Color—light reddish brown, reddish brown, light brown, or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 2 to 15 percent calcium carbonate equivalent
Rock fragments—10 to 25 percent gravel, 5 to 30 percent cobbles, 10 to 15 percent stones

Bk horizon:
Texture—loam, sandy loam, and fine sandy loam
Color—light reddish brown, reddish brown, yellowish red, or pink
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 40 percent calcium carbonate equivalent
Gypsum—0 to 10 percent
Rock fragments—5 to 25 percent gravel, 0 to 10 percent cobbles

Nipton Series

Depth class: shallow to very shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: mountains
Parent material: colluvium
Slope range: 25 to 50 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, mixed, nonacid, thermic Lithic Torriorthents

Typical Pedon

Nipton very gravelly coarse sandy loam in an area of Nipton-Rock outcrop-Nickel family complex, 10 to 50 percent slopes; about 13 miles south of Littlefield, Arizona on western slopes of the Virgin Mountains; about 700 feet south and 2,200 feet east of the northwest corner of section 11, T.38 N., R.16 W., Mohave County, Arizona.

A—0 to 2 inches; brown (10YR 5/3) very gravelly coarse sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; 40 percent gravel and 5 percent cobbles; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.
Bw—2 to 9 inches; brown (7.5YR 5/4) very gravelly coarse sandy loam, brown (7.5YR 4/4) moist; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine, fine and medium roots; many very fine tubular pores; 40 percent gravel and 5 percent cobbles; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.
2R—9 inches; gneiss.

Range in Characteristics

Depth to bedrock: 4 to 14 inches
Rock fragments: average 30 to 50 percent gravel, 0 to 10 percent cobbles, 0 to 5 percent stones

A and B horizons:
Texture—coarse sandy loam, sandy loam, or loamy sand
Color—light brown, brown, or yellowish brown
Hue—7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline

Nutter Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: colluvium and alluvium
Slope range: 2 to 20 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: loamy-skeletal, gypsic, mesic Typic Gypsiorthids.

Typical Pedon

Nutter very gravelly loam in an area of Nutter-Gyppocket complex, 2 to 20 percent slopes; about 10 miles south of the Arizona-Utah state line and 0.5 mile west of Hurricane Cliffs; about 300 feet south and 700 feet west of the northeast corner of section 22, T.40 N., R.10 W.; Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine vesicular and common fine tubular pores; 40 percent gravel; slightly effervescent, 15 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.
Bk—2 to 13 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak fine

subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel; violently effervescent, few fine irregular calcium carbonate masses, seams and coatings on rock fragments, 27 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bky—13 to 23 inches; light brown (7.5YR 6/4) gypsiferous, gravelly fine sandy loam, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; common fine and very fine tubular and interstitial pores; 30 percent gravel; violently effervescent, few fine irregular calcium carbonate masses, seams and coatings on rock fragments, 29 percent calcium carbonate equivalent; 20 percent crystalline gypsum occurring as sand grains and pendants on rock fragments; moderately alkaline (pH 8.2); clear smooth boundary.

By1—23 to 38 inches; pink (7.5YR 7/4) gypsiferous, very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; common fine and very fine tubular pores; 50 percent gravel; strongly effervescent, 31 percent calcium carbonate equivalent; 55 percent crystalline gypsum occurring as sand grains and pendants and bridges on rock fragments; slightly alkaline (pH 7.8); clear smooth boundary.

By2—38 to 47 inches; reddish yellow (7.5YR 8/6) gypsiferous, very gravelly coarse sandy loam, reddish yellow (7.5YR 6/6) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few fine and very fine tubular pores; 45 percent gravel; strongly effervescent, 30 percent calcium carbonate equivalent; 35 percent crystalline gypsum occurring as sand grains and pendants on rock fragments; slightly alkaline (pH 7.6); abrupt smooth boundary.

By3—47 to 60 inches; pink (7.5YR 7/4) gypsiferous, very gravelly loamy coarse sand, light brown (7.5YR 6/4) moist; single grained; loose; no roots; many very fine irregular pores; 50 percent gravel; slightly effervescent, 31 percent calcium carbonate equivalent; 50 percent crystalline gypsum occurring as sand grains and pendants on rock fragments; slightly alkaline (pH 7.6).

Range in Characteristics

Depth to calcic horizon: 1 to 3 inches
Depth to gypsic horizon: 10 to 25 inches
Rock fragments: average 35 to 80 percent

A horizon:
- Texture—fine sandy loam or sandy loam
- Color—light reddish brown, pink, reddish yellow, or light brown
- Hue—5YR, 7.5YR
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 5 to 25 percent calcium carbonate equivalent

Bk horizon:
- Texture—fine sandy loam, sandy loam, or loam
- Color—light reddish brown, pinkish white, pink, reddish yellow, or light brown
- Hue—5YR, 7.5YR
- Value—5 through 8 dry, 4 through 8 moist
- Chroma—2 through 6, dry or moist
- Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent
- Gypsum—0 to 25 percent

By horizon:
- Texture—gypsum, fine sandy loam, sandy loam, or coarse sand
- Color—pink, white, pinkish white, light reddish yellow, reddish yellow, or light brown
- Hue—7.5YR, 10YR
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—0 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—none to strong, 0 to 35 percent calcium carbonate equivalent
- Gypsum—20 to 90 percent

Padilla Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: fan terraces
Parent material: mixed alluvium from sedimentary formations
Slope range: 1 to 5 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: fine, mixed, mesic Ustollic Haplargids

Typical Pedon

Padilla silt loam, 1 to 5 percent slopes, in an area of Padilla silt loam, 1 to 5 percent slopes; about 11 miles south of Poverty Mountain; about 500 feet south and 2,200 feet east of the northwest corner

of section 28, T.33 N., R.12 W., Mohave County, Arizona.

A—0 to 1 inch; reddish brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; weak thin platy structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many fine and very fine vesicular pores; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

AB—1 to 5 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many fine irregular pores; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bt1—5 to 13 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; slightly effervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Bt2—13 to 40 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong fine prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky and very plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; strongly effervescent, disseminated, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Btk—40 to 60 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate fine prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; very few very fine roots; few fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 5 percent gravel; strongly effervescent, few small rounded calcium carbonate masses, 12 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: average 0 to 10 percent gravel

A horizon:
- Texture—clay loam, silt clay loam, or silt loam
- Value—4 or 5 dry or moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—none to slight

Bt horizon:
- Texture—clay or silty clay
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 1 to 15 percent calcium carbonate equivalent

Btk horizon:
- Texture—clay or clay loam
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—3 or 4, dry or moist
- Effervescence—5 to 15 percent calcium carbonate equivalent

Pennell Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus and mesas
Parent material: mixed alluvium and eolian materials from sedimentary formations
Slope range: 10 to 30 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Classification: loamy, mixed, mesic Lithic Calciorthids

Typical Pedon

Pennell gravelly fine sandy loam in an area of Moenkopie-Pennell-Rock outcrop complex, 10 to 50 percent slopes; about 9.5 miles south of the Arizona-Utah state line, 3 miles west of the Hurricane Cliffs; about 700 feet south and 2,550 feet west of the northeast corner of section 20, T.40 N., R.10 W., Mohave County, Arizona.

A—0 to 1 inch; yellowish red (5YR 5/6) gravelly fine sandy loam, yellowish red (5YR 4/6) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common fine vesicular pores; 30 percent limestone fragments; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—1 to 5 inches; yellowish red (5YR 5/6) gravelly fine sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many fine and very fine roots; common fine interstitial and tubular pores; 20 percent limestone fragments; violently effervescent, few fine soft calcium carbonate masses, seams and pendants on rock

fragments, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk2—5 to 12 inches; light reddish brown (5YR 6/4) gravelly loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine tubular and interstitial pores; 25 percent limestone fragments; violently effervescent, common fine soft calcium carbonate masses, seams, and pendants on rock fragments, 32 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2R—12 inches; limestone.

Range in Characteristics

Depth to calcic horizon: 1 to 3 inches
Depth to bedrock: 10 to 20 inches
Rock fragments: average 15 to 35 percent

A horizon:
Texture—gravelly or channery fine sandy loam
Color—yellowish red, reddish yellow, or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to strong

Bk horizon:
Texture—gravelly or channery fine sandy loam, sandy loam, or loam
Color—light reddish brown, reddish yellow, or yellowish red
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 15 to 30 percent calcium carbonate equivalent

R horizon:
Extremely hard limestone or calcareous sandstone bedrock

Pocum Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: mesas and fan terraces
Parent material: mixed alluvium and colluvium derived from volcanic rocks
Slope range: 1 to 10 percent
Elevation: 4,800 to 6,500 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy, mixed, mesic, shallow Ustochreptic Paleorthids

Typical Pedon

Pocum gravelly fine sandy loam in an area of Pocum-Spenlo complex, 1 to 10 percent slopes; about 7.6 miles south of the Arizona-Utah state line and 16.8 miles east of the Arizona-Nevada state line; about 400 feet south and 1,000 feet west of the northeast corner of section 12, T.40 N., R.14 W., Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 4/4) gravelly fine sandy loam, dark brown (7.5YR 3/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; common very fine vesicular and common fine and very fine tubular pores; 10 percent gravel and 5 percent cobbles; strongly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk—2 to 14 inches; brown (7.5YR 5/4) gravelly loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 25 percent gravel and hardpan fragments; violently effervescent, common fine irregular calcium carbonate nodules, 7 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bkm—14 to 18 inches; indurated, calcium carbonate-cemented hardpan.

B'k—18 to 22 inches; pinkish white and pinkish gray (7.5YR 8/2 and 7/2) gravelly loam, pink (7.5YR 8/4 and 7/4) moist; weak fine subangular structure; slightly hard, friable, slightly sticky and slightly plastic; very few fine and very fine roots; common fine interstitial pores; 20 percent gravel and hardpan fragments, violently effervescent, weakly calcium carbonate cemented, 39 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

B'km—22 to 24 inches; indurated, calcium carbonate-cemented hardpan; abrupt smooth boundary.

B"k—24 to 48 inches; pinkish white and pinkish gray (7.5YR 8/2 and 7/2) gravelly loam, pink (7.5YR 8/4 and 7/4) moist; massive; hard, firm, slightly sticky and slightly plastic; no roots; common fine tubular pores; 20 percent gravel and hardpan fragments, violently effervescent, weakly calcium carbonate cemented, 32 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

2R—48 inches; basalt bedrock.

Range in Characteristics

Depth to calcic horizon: 1 to 5 inches
Depth to petrocalcic: 10 to 20 inches
Depth to bedrock: 40 to 60 inches
Rock fragments: average 15 to 35 percent gravel

A horizon:
Texture—gravelly loam or fine sandy loam
Color—brown or light brown
Value—4 through 6 dry, 3 through 5 moist
Chroma—2 through 4, dry or moist
Effervescence—1 to 10 percent calcium carbonate equivalent
Rock fragments—0 to 5 percent cobbles, 15 to 30 percent gravel

Bk horizon:
Texture—gravelly loam or fine sandy loam
Color—pinkish white, pink, and light brown
Value—5 through 8 dry, 4 through 7 moist
Chroma—2 through 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—5 to 40 percent calcium carbonate equivalent
Rock fragments—15 to 35 percent gravel

Bkm horizon:
Indurated, calcium carbonate-cemented hardpan repeats every foot or two with weakly to strongly cemented materials; extending to a maximum depth of 59 inches

R horizon:
Hard basalt rock.

Pompeii Family

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed alluvium from sedimentary formations
Slope range: 2 to 7 percent
Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 72 to 78 degrees F
Classification: loamy-skeletal, mixed, hyperthermic, shallow Typic Paleorthids

Typical Pedon

Pompeii family very gravelly loam in an area of Pompeii family-Huevi complex, 2 to 15 percent slopes; about 13 miles southwest of Olaf Knolls; about 40 feet north and 2,560 feet west of the southeast corner of section 27, T.34 N., R.16 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4 moist); moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine and very fine vesicular and few very fine tubular pores; 50 percent gravel and 5 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—2 to 6 inches; light brown (7.5YR 6/4) very gravelly sandy clay loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel and 5 percent cobbles; strongly effervescent, common fine soft calcium carbonate masses; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk2—6 to 9 inches; pink (7.5YR 8/4) very gravelly clay loam, reddish yellow (7.5YR 7/6) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel and hardpan fragments, 5 percent cobbles; violently effervescent, many fine soft calcium carbonate masses; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bkm—9 to 60 inches; indurated calcium carbonate-cemented hardpan with laminar cap; alternating thin indurated layers (0.5 to 2 inches thick) with weakly to strongly cemented materials every foot or two.

Range in Characteristics

Depth to petrocalcic horizon: 4 to 20 inches
Rock fragments: average 35 to 50 percent gravel, 0 to 5 percent cobbles

A horizon:
Texture—very gravelly loam or fine sandy loam
Color—light brown or pink
Value—6 through 8 dry, 4 through 6 moist
Chroma—3 through 6 dry or moist
Effervescence—slight to strong, 2 to 10 percent calcium carbonate equivalent

Bk horizon:
Texture—very gravelly sandy clay loam or clay loam
Color—light brown or pink
Value—6 through 8 dry, 4 through 6 moist

Chroma—3 through 6 dry or moist
Effervescence—strong to violent, 10 to 25 percent calcium carbonate equivalent

Radnik Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: floodplains
Parent material: mixed alluvium
Slope range: 1 to 5 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Classification: coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents

Typical Pedon

Radnik loam in an area of Radnik loam, 1 to 5 percent slopes; about 14.9 miles south of the Arizona-Utah state line and 23.5 miles east of the Arizona-Nevada state line; about 2,400 feet south and 2,100 feet east of the northwest corner of section 17, T.39 N., R.11 W., Mohave County, Arizona.

A—0 to 3 inches; reddish yellow (7.5YR 6/6) loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine vesicular and common fine tubular pores; strongly effervescent, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1—3 to 47 inches; reddish yellow (7.5YR 6/6) stratified loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; strongly effervescent, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

C2—47 to 60 inches; light brown (7.5YR 6/4) stratified loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine tubular pores; strongly effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.0).

Range in Characteristics

Rock fragments: average less than 15 percent

A horizon:
Color—reddish yellow or light brown
Value—5 or 6 dry, 3 or 4 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 5 to 20 percent calcium carbonate equivalent

C horizon:
Color—reddish yellow or light brown
Value—5 or 6 dry, 3 or 4 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 5 to 20 percent calcium carbonate equivalent

Rizno Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: plateaus and structural benches
Parent material: mixed alluvium and eolian deposits from sedimentary formations
Slope range: 4 to 35 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents

Typical Pedon

Rizno very channery sandy loam in an area of Rizno-Bond-Rock outcrop complex, 4 to 25 percent slopes; about 15 miles southeast of Olaf Knolls; about 900 feet south and 500 feet east of the northwest corner of section 11, T.33 N., R.14 W., Mohave County, Arizona.

A—0 to 1 inch; reddish brown (5YR 5/4) very channery sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; few fine tubular pores; 40 percent channers; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw1—1 to 4 inches; reddish brown (5YR 5/4) channery sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent channers; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bw2—4 to 6 inches; light reddish brown (5YR 6/4) channery loam, reddish brown (5YR 5/4) moist; weak fine subangular blocky structure; slightly

hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent channers; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
2R—6 inches; sandstone bedrock.

Range in Characteristics

Depth to bedrock: 4 to 20 inches
Rock fragments: average 5 to 15 percent channers, 5 to 15 percent flagstones

A horizon.
Texture—flaggy, channery, or very channery fine sandy loam or sandy loam
Color—reddish brown or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong
Rock fragments—10 to 40 percent channers, 0 to 10 percent flagstones

Bw horizons:
Texture—channery or flaggy fine sandy loam, sandy loam, or loam
Color—reddish brown or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong
Rock fragments—5 to 15 percent channers, 0 to 10 percent flagstones

R horizon:
Sandstone or limestone

Robroost Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium from sedimentary formations
Slope range: 1 to 3 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 54 to 57 degrees F
Classification: coarse-loamy, mixed, mesic Cambic Gypsiorthids

Typical Pedon

Robroost fine sandy loam in an area of Robroost fine sandy loam, 1 to 3 percent slopes; about 9 miles south of the Arizona-Utah state line and 1.5 miles west of Hurricane Cliffs; about 3,700 feet north and 2,200 feet west of the southeast corner of section 16, T.40 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak thin platy and weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine vesicular and common fine tubular pores; 5 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bw—2 to 8 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 5 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.
By1—8 to 20 inches; pink (5YR 7/4) loam, light reddish brown (5YR 6/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 5 percent gravel; 5 percent gypsum crystals; strongly effervescent, 12 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); clear smooth boundary.
By2—20 to 32 inches; reddish yellow (5YR 7/6) sandy loam, yellowish red (5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 5 percent gravel; 10 percent gypsum crystals; strongly effervescent, 10 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); clear smooth boundary.
By3—32 to 44 inches; reddish yellow (5YR 7/6) loam, yellowish red (5YR 5/6) moist; massive; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 10 percent gravel; 5 percent gypsum crystals; strongly effervescent, 10 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); clear smooth boundary.
By4—44 to 55 inches; pink (5YR 7/4) sandy loam, reddish yellow (5YR 6/6) moist; massive; soft, very friable, nonsticky and nonplastic; few fine and very fine roots; common fine and very fine tubular pores; 10 percent gravel; 10 percent gypsum crystals; strongly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.
By5—55 to 60 inches; pink (5YR 7/4) gravelly loamy sand, reddish yellow (5YR 6/6) moist; single grained; loose; few fine and very fine roots; common fine and very fine tubular pores; 15

percent gravel; 10 percent gypsum crystals; strongly effervescent; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to gypsic horizon: 8 to 20 inches
Rock fragments: average 2 to 15 percent

A horizon:
Texture—fine sandy loam or sandy loam
Color—reddish yellow, light reddish brown or yellowish red
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to strong

Bw horizon:
Texture—fine sandy loam or loam
Color—reddish yellow, light reddish brown, or reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to strong, less than 5 percent calcium carbonate equivalent
Gypsum—0 to 5 percent

By horizon:
Texture—loam, fine sandy loam, or sandy loam
Color—pink, light reddish brown, reddish yellow, or yellowish red
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 10 to 20 percent calcium carbonate equivalent
Gypsum—10 to 20 percent

Ruesh Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed alluvium and colluvium derived from sedimentary formations high in gypsum
Slope range: 3 to 20 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: coarse-loamy, gypsic, thermic Typic Gypsiorthids

Typical Pedon

Ruesh very gravelly fine sandy loam, 3 to 20 percent slopes; about 0.5 miles south of the Arizona-Utah state line and 3 miles east of the Hurricane Cliffs; about 2,000 feet west of the southeast corner of section 35, T.42 N., R.10 W.; Mohave County, Arizona.

A—0 to 2 inches; reddish yellow (5YR 6/6) very gravelly fine sandy loam, yellowish red (5YR 5/6) moist; weak thin platy structure; slightly hard, friable, nonsticky and nonplastic; many very fine and common fine roots; many very fine vesicular and common fine tubular pores; 35 percent gravel and 5 percent cobbles; violently effervescent, 18 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk—2 to 12 inches; reddish yellow (5YR 7/6) loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and common fine roots; common fine and very fine tubular and interstitial pores; 10 percent gravel; violently effervescent, segregated as common fine calcium carbonate seams and few fine soft masses, 23 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt wavy boundary.

2By1—12 to 22 inches; white and pink (N 8/ and 5YR 7/4) sandy loam, white and reddish yellow (N 8/ and 5YR 6/6) moist; massive with crystalline gypsum structure; slightly hard, friable, nonsticky and nonplastic; few very fine and fine roots; many fine and very fine irregular pores; 5 percent gravel; strongly effervescent, 11 percent calcium carbonate equivalent; 80 percent crystalline gypsum; slightly alkaline (pH 7.6); abrupt smooth boundary.

2By2—22 to 29 inches; pink (5YR 7/4) sandy loam, yellowish red (5YR 7/4) moist; massive; hard, firm, nonsticky and nonplastic; few very fine and fine roots; many fine and very fine irregular pores; 5 percent gravel; strongly effervescent, 6 percent calcium carbonate equivalent; 50 percent crystalline gypsum; slightly alkaline (pH 7.6); abrupt smooth boundary.

2By3—29 to 32 inches; white (N 8/) gypsum, white (N 8/) moist; crystalline gypsum structure; hard, firm, slightly sticky and slightly plastic; very few very fine roots; many very fine and fine irregular pores; 5 percent gravel; noneffervescent; 98 percent crystalline gypsum; slightly alkaline (pH 7.6); abrupt smooth boundary.

2By4—32 to 40 inches; pink (5YR 7/4) sandy loam, yellowish red (5YR 5/6) moist; massive; hard, firm, nonsticky and nonplastic; very few very fine roots; many fine and very fine irregular pores; 5 percent gravel; strongly effervescent, 8 percent calcium

carbonate equivalent; 50 percent crystalline gypsum; slightly alkaline (pH 7.6); abrupt smooth boundary.

3By5—40 to 60 inches; white and pink (N 8/ and 5YR 7/4) very cobbly sandy loam, white and yellowish red (N 8/ and 5YR 5/6) moist; crystalline gypsum structure; very hard, very firm, nonsticky and nonplastic; no roots; many fine and very fine irregular pores; 20 percent gravel and 30 percent cobbles; strongly effervescent, 7 percent calcium carbonate equivalent; 80 percent crystalline gypsum; slightly alkaline (pH 7.6).

Range in Characteristics

Depth to calcic horizon: 1 to 4 inches
Depth to gypsic horizon: 8 to 20 inches
Rock fragments: average less than 15 percent

A horizon:
- Texture—fine sandy loam or sandy loam
- Color—pink, light reddish brown, and reddish yellow
- Value—6 or 7 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 5 to 25 percent disseminated calcium carbonate equivalent
- Gypsum—0 to 5 percent
- Rock fragments—5 to 50 percent gravel; 0 to 5 percent cobbles

Bk horizon:
- Texture—fine sandy loam, sandy loam, and loam
- Color—pink, light reddish brown, and reddish yellow
- Value—4 through 7 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent, 10 to 25 percent calcium carbonate equivalent
- Gypsum—0 to 5 percent
- Rock fragments—less than 15 percent gravel

By horizon:
- Texture—fine sandy loam, sandy loam, and loam
- Color—white, pinkish white, pink, and reddish yellow
- Hue—5YR, N/
- Value—5 through 8 dry, 4 through 8 moist
- Chroma—0 through 6, dry or moist
- Effervescence—none to slight, 2 to 15 percent disseminated calcium carbonate equivalent
- Gypsum—40 to 90 percent
- Rock fragments—less than 15 percent gravel

Ruesh Family

Depth class: moderately deep and deep
Drainage class: well drained
Permeability: moderately rapid to moderately slow
Landform: mesa
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: coarse-loamy, gypsic, thermic Typic Gypsiorthids

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Ruesh family in an area of Nikey family-Ruesh family-Rock outcrop complex, 10 to 40 percent slopes; about 3.5 miles south of the Arizona-Utah state line and 6 miles west of the Hurricane Cliffs; about 150 feet east and 300 feet north of the southwest corner of section 13, T.41 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; yellowish red (5YR 5/6) very cobbly fine sandy loam, yellowish red (5YR 4/6) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common very fine vesicular pores; 15 percent gravel, 25 percent cobbles, and 10 percent stones; slightly effervescent, 2 percent calcium carbonate equivalent; 5 percent crystalline gypsum; slightly alkaline (pH 7.8); abrupt smooth boundary.

By1—2 to 10 inches; yellowish red (5YR 5/6) cobbly fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 10 percent gravel and 15 percent cobbles; slightly effervescent, 5 percent calcium carbonate equivalent; 10 percent crystalline gypsum; slightly alkaline (pH 7.8); clear smooth boundary.

By2—10 to 19 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; 10 percent gravel; slightly effervescent, 5 percent calcium carbonate equivalent; 25 percent crystalline gypsum; slightly alkaline (pH 7.6); clear smooth boundary.

By3—19 to 28 inches; pink (5YR 7/4) loamy sand, light reddish brown (5YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; few fine tubular and common very fine irregular pores; 5 percent gravel; noneffervescent; 80 percent crystalline gypsum; slightly alkaline (pH 7.6); abrupt smooth boundary.
2Cr—28 inches; weathered gypsiferous mudstone.

Range in Characteristics

Depth to gypsic horizon: 1 to 10 inches
Depth to bedrock: 20 to 60 inches

A horizon:
- Texture—fine sandy loam, loam, or sandy loam
- Color—yellowish red, light reddish brown, or reddish brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—none to strong, 0 to 10 percent calcium carbonate equivalent
- Rock fragments—10 to 20 percent gravel, 10 to 30 percent cobbles, 0 to 15 percent stones

By horizon:
- Texture—fine sandy loam, sandy loam, or loam
- Color—yellowish red, reddish yellow, or pink
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—none to slight, 0 to 15 percent calcium carbonate equivalent
- Gypsum—10 to 80 percent
- Rock fragments—0 to 20 percent gravel, 0 to 5 percent cobbles

Sedillo Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 8 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed, mesic Ustollic Haplargids

Typical Pedon

Sedillo very cobbly loam in an area of Sedillo very cobbly loam, 1 to 8 percent slopes; in Whitmore Canyon about 9 miles southeast of the settlement of Mt. Trumbull; about 2,300 feet south and 200 feet west of the northeast corner of section 34, T.34 N., R.9 W., Mohave County, Arizona.

A—0 to 2 inches; light reddish brown (5YR 6/3) very cobbly loam, reddish brown (5YR 4/3) moist; moderate medium platy and moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many very fine vesicular and few fine tubular pores; 30 percent gravel, 20 percent cobbles, and 5 percent stones; noneffervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bt—2 to 8 inches; light reddish brown (5YR 6/3) very cobbly clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 30 percent gravel, 20 percent cobbles, and 5 percent stones; slightly effervescent, 7 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.
Btk1—8 to 18 inches; reddish brown (5YR 5/3) very cobbly clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine and few medium roots; many fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 30 percent gravel, 20 percent cobbles, and 5 percent stones; strongly effervescent, few fine soft calcium carbonate masses, seams, and pendants on rock fragments, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.
Btk2—18 to 32 inches; reddish brown (5YR 5/4) very cobbly clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine, and few medium roots; many fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 30 percent gravel, 20 percent cobbles, and 5 percent stones; violently effervescent, many medium calcium carbonate masses, seams, and pendants on rock fragments, 25 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.
Btk3—32 to 55 inches; reddish yellow (5YR 6/6) very cobbly clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and very fine, and very few medium roots; few fine and very

fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 30 percent gravel, 20 percent cobbles, and 5 percent stones; violently effervescent, many medium calcium carbonate masses, seams, and pendants on rock fragments, 28 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); abrupt smooth boundary.

2Bky—55 to 60 inches; pink (5YR 7/4) cobbly loam, yellowish red (5YR 5/6) moist; massive; hard, friable, slightly sticky and slightly plastic; no roots; common fine and very fine tubular pores; 10 percent gravel and 10 percent cobbles; violently effervescent, common medium calcium carbonate masses, seams and pendants on rock fragments, 21 percent calcium carbonate equivalent; 5 to 10 percent fine gypsum crystals; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to base of argillic horizon: 30 to 55 inches
Depth to calcic horizon: 10 to 20 inches
Depth to gypsum: usually below 50 inches, ranges from 40 to 60 inches
Rock fragments: average 15 to 35 percent gravel, 5 to 30 percent cobbles, 0 to 10 percent stones

A horizon:
Texture—loam or clay loam
Color—brown or light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to slight, 0 to 5 percent calcium carbonate equivalent

Bt and upper Btk horizons:
Color—light reddish brown or reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 5 to 15 percent calcium carbonate equivalent

Lower Btk horizons:
Texture—loam or clay loam
Color—pink, light reddish brown, reddish yellow, or light brown
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 30 percent calcium carbonate equivalent

Bky horizon:
Texture—loam, clay loam, or sandy loam
Color—pink, light reddish brown, reddish yellow, or light brown
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—strong to violent, 10 to 30 percent calcium carbonate equivalent
Gypsum—5 to 15 percent
Rock fragments—10 to 20 percent gravel, 5 to 10 percent cobbles

Shelley Series

Depth class: very deep
Drainage class: somewhat excessively to excessively drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed alluvium and colluvium from granite and gneiss
Slope range: 1 to 15 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: sandy-skeletal, mixed, thermic Typic Calciorthids

Typical Pedon

Shelley very gravelly sandy loam in an area of Blind family-Shelley complex, 5 to 15 percent slopes, stony; about 2.5 miles south of Littlefield, Arizona; about 1,000 feet south and 800 feet east of the northwest corner of section 21, T.40 N., R.15 W.; Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; moderate fine and medium platy structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; many very fine vesicular and common fine tubular pores; 20 percent gravel, 10 percent cobbles, and 10 percent stones; noneffervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—2 to 8 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 5 percent cobbles; slightly effervescent, calcium carbonate pendants on sand grains and rock fragments, 7

percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—8 to 30 inches; light yellowish brown (10YR 6/4) extremely cobbly loamy coarse sand, dark yellowish brown (10YR 4/4) moist; single grained; loose; many very fine, common fine and few medium roots; many fine and very fine irregular pores; 35 percent gravel, 25 percent cobbles, and 10 percent stones; strongly effervescent, calcium carbonate pendants on sand grains and rock fragments, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bk—30 to 60 inches; light yellowish brown (10YR 6/4) very gravelly coarse sand, dark yellowish brown (10YR 4/4) moist; single grained; loose; common very fine and fine roots; many fine and very fine irregular pores; 50 percent gravel and 5 percent cobbles; strongly effervescent, calcium carbonate pendants on sand grains and rock fragments, 7 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Range in Characteristics

Depth to calcic horizon: 1 to 10 inches, 6 to 25 percent calcium carbonate equivalent

Rock fragments: average more than 35 percent throughout—20 to 50 percent gravel, 0 to 30 percent cobbles, 0 to 20 percent stones

A horizon:

Texture—sandy loam or loamy sand
Color—light brown or light yellowish brown
Hue—7.5YR, 10YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Effervescence—none to slight, 0 to 10 percent calcium carbonate equivalent

Bk horizon:

Texture—sandy loam, coarse sandy loam, loamy sand, and loamy coarse sand
Color—brown, light brown, light yellowish brown, and yellowish brown
Hue—7.5YR, 10YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 6 to 25 percent calcium carbonate equivalent

Showlow Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: hills and mesas
Parent material: alluvium and colluvium from volcanic rocks
Slope range: 1 to 50 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Classification: fine, montmorillonitic, mesic Aridic Argiustolls

Typical Pedon

Showlow very cobbly clay loam in an area of Showlow-Thunderbird complex, 2 to 25 percent slopes; about 1.5 miles south of Castle Peak; about 700 feet east and 1,300 feet north of the southwest corner of section 23, T.32 N., R.12 W., Mohave County, Arizona.

A—0 to 2 inches; dark reddish gray (5YR 4/2) very cobbly clay loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; hard, firm, slightly sticky and slightly plastic; few fine roots; few very fine tubular pores; 20 percent gravel and 30 percent cobbles; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt1—2 to 5 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; strong fine granular blocky structure; very hard, very firm, very sticky and very plastic; few fine and very fine roots; few fine and very fine tubular pores; common faint clay films on faces of peds and lining pores; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.4); clear smooth boundary.

Bt2—5 to 23 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; strong fine angular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; few very fine tubular pores; many faint clay films on faces of peds and lining pores; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

2Btk1—23 to 41 inches; yellowish red (5YR 5/6) stony clay, reddish brown (2.5YR 4/4) moist; strong fine angular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; common fine and very fine tubular pores; common faint clay

films on faces of peds and lining pores; 10 percent gravel, 10 percent cobbles, and 10 percent stones; slightly effervescent, few fine soft calcium carbonate masses, 7 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); gradual wavy boundary.

2Btk2—41 to 60 inches; yellowish red (5YR 5/6) very cobbly clay, reddish brown (2.5YR 4/4) moist; moderate fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common fine and very fine tubular pores; few faint clay films on faces of peds and lining pores; 30 percent gravel, 20 percent cobbles, and 5 percent stones; slightly effervescent, few fine soft calcium carbonate masses, 7 percent calcium carbonate equivalent; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to accumulation of calcium carbonate: 20 to 30 inches

Rock fragments: average 0 to 5 percent in control section

A horizon:
- Texture—very or extremely cobbly clay loam or loam
- Color—reddish gray or dark reddish gray
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—2 or 3, dry or moist
- Rock fragments—10 to 20 percent gravel, 20 to 30 percent cobbles, 0 to 5 percent stones

Bt horizon:
- Texture—clay or silty clay
- Color—reddish gray or dark reddish gray
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—2 or 3, dry or moist
- Rock fragments—0 to 5 percent gravel

Btk horizon:
- Texture—stony, very cobbly or extremely cobbly clay or clay loam
- Color—yellowish red or reddish brown
- Hue—2.5YR, 5YR
- Value—4 or 5 dry, 3 or 4 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—slight to strong, 1 to 10 percent calcium carbonate equivalent
- Rock fragments—0 to 30 percent gravel, 10 to 30 percent cobbles, 0 to 15 percent stones

Spenlo Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: mesas
Parent material: mixed alluvium
Slope range: 1 to 3 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: fine-loamy, mixed, mesic Ustollic Haplargids

Typical Pedon

Spenlo loam in an area of Pocum-Spenlo complex, 1 to 10 percent slopes; about 17 miles south of St. George, Utah; in the saddle between Mokaac and Wolfhole mountains, about 3,300 feet north and 2,500 feet east of the southwest corner of section 19, T.40 N., R.12 W., Mohave County, Arizona.

A1—0 to 2 inches; reddish brown (5YR 5/3) loam, reddish brown (5YR 4/3) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine vesicular pores; 5 percent gravel; noneffervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

A2—2 to 6 inches; reddish brown (5YR 5/3) loam, reddish brown (5YR 4/3) moist; moderate medium platy structure; slightly hard, friable, sticky and slightly plastic; common fine and very fine roots; many very fine and common fine tubular and interstitial pores; 1 percent fine gravel; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bt—6 to 21 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic parting to moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine and few medium roots; many very fine and common fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 1 percent fine gravel; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Btk1—21 to 29 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong medium prismatic parting to strong medium subangular blocky structure; hard, friable, sticky

and plastic; common fine and very fine roots; many very fine and common fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 1 percent fine gravel; slightly effervescent, few fine calcium carbonate masses and seams, 2 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Btk2—29 to 46 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic parting to moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; many very fine and common fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 2 percent fine gravel; strongly effervescent, common fine calcium carbonate masses, seams and thin coatings on rock fragments, 2 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Btk3—46 to 60 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic parting to moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; many very fine and common fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 5 percent fine gravel; violently effervescent, common fine calcium carbonate seams and coatings on rock fragments, 5 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Range in Characteristics

Depth to base of argillic: more than 40 inches
Rock fragments: average 0 to 5 percent gravel

A horizon:
Texture—loam or clay loam
Color—reddish brown or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to slight, 0 to 5 percent calcium carbonate equivalent

Bt horizon:
Color—reddish brown or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to slight, 0 to 5 percent calcium carbonate equivalent

Btk horizon:
Texture—clay loam or sandy clay loam
Color—reddish brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 2 to 10 percent calcium carbonate equivalent

Sponiker Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 10 percent
Elevation: 5,800 to 8,000 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Classification: fine, montmorillonitic, mesic Pachic Argiustolls

Typical Pedon

Sponiker loam in an area of Sponiker loam, 1 to 10 percent slopes; about 3 miles northwest of Mount Dellenbaugh; about 2,100 feet north and 1,400 feet east of the southwest corner of section 28, T.32 N., R.12 W., Mohave County, Arizona.

Oi—1 inch to 0; pine needles.

A—0 to 3 inches; dark brown (7.5YR 4/3) loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine tubular pores; 5 percent gravel; noneffervescent; neutral (pH 7.0); abrupt smooth boundary.

Bt1—3 to 8 inches; dark brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 5 percent gravel; noneffervescent; neutral (pH 7.0); clear smooth boundary.

Bt2—8 to 42 inches; dark brown (7.5YR 4/3) clay, dark brown (7.5YR 3/2) moist; strong fine prismatic structure parting to strong fine angular blocky; very hard, firm, very sticky and very plastic; common fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; many distinct clay films on faces of peds

and lining pores; 5 percent gravel; noneffervescent; neutral (pH 7.2); clear smooth boundary.

2Bt—42 to 60 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong fine angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; few fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 5 percent gravel; noneffervescent; neutral (pH 7.2).

Range in Characteristics

Thickness of mollic epipedon: 30 to 45 inches
Rock fragments: average 0 to 5 percent gravel

O horizon:
Is absent in some pedons

A horizon:
Texture—loam or clay loam
Color—dark brown or dark reddish brown
Hue—5YR, 7.5YR
Value—3 or 4 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist

Bt horizon:
Texture—clay or clay loam (more than 35 percent clay)
Color—dark brown or dark reddish brown in the upper part and reddish brown or yellowish red in the lower part
Hue—5YR, 7.5YR
Value—3 through 5 dry, 3 or 4 moist
Chroma—2 through 4, dry or moist
Reaction (pH)—neutral to slightly alkaline
Effervescence—none to very slight

Springerville Series

Depth class: deep
Drainage class: well drained
Permeability: very slow
Landform: mesa
Parent material: alluvium and colluvium from volcanic rocks
Slope range: 3 to 10 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: fine, montmorillonitic, mesic Aridic Haplusterts

Typical Pedon

Springerville very cobbly clay loam in an area of Springerville-Delenbaw complex, 3 to 25 percent slopes; about 21 miles south by southwest of St. George, Utah, on Black Rock Mountain; about 50 feet north and 1,300 feet east of the southwest corner of section 30, T.40 N., R.13 W., Mohave County, Arizona.

A—0 to 1 inch; dark reddish brown (5YR 3/2) very cobbly clay loam, dark reddish brown (5YR 2.5/2) moist; strong medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and common fine roots; many very fine vesicular and common fine tubular pores; 30 percent gravel and 20 percent cobbles; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

Bt—1 to 9 inches; dark reddish gray (5YR 4/2) clay loam, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine and common fine tubular pores; few faint clay films lining pores; common pressure faces; few faint organic coats lining pores; 10 percent gravel; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bsst—9 to 27 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky and very plastic; common fine and very fine, and few medium roots; common fine interstitial pores; common faint clay films on faces of peds and lining pores; common intersecting slickensides and many pressure faces; few faint organic coats on faces of peds and lining pores; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Bk1—27 to 32 inches; reddish brown (5YR 4/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; common pressure faces; 15 percent gravel and 5 percent cobbles; violently effervescent, common medium soft calcium carbonate masses and seams, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk2—32 to 42 inches; yellowish red (5YR 5/6) gravelly clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; 15 percent gravel and 5 percent cobbles; violently effervescent, many medium soft calcium carbonate masses and coatings on rock fragments, 14 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
2R—42 inches; basalt bedrock.

Range in Characteristics

Depth to calcium carbonate accumulation: 25 to 40 inches
Depth to bedrock: 40 to 59 inches
Cracks 1 to 2 centimeters wide from surface to 20 inches or more

A horizon:
Texture—cobbly to very cobbly loam, clay loam, or silty clay loam
Color—dark brown or dark reddish brown
Hue—5YR, 7.5YR
Value—3 or 4 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—10 to 35 percent gravel, 5 to 25 percent cobbles, 0 to 5 percent stones

Bss horizon:
Texture—dominantly clay with clay loam horizons above and below
Color—dark reddish gray or reddish brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline

Bk horizon:
Texture—gravelly or cobbly clay or clay loam
Color—reddish brown or yellowish red
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 through 6, dry or moist
Effervescence—strong to violent, 5 to 15 percent calcium carbonate equivalent
Rock fragments—5 to 20 percent gravel, 5 to 20 percent cobbles, 0 to 5 percent stones

2R horizon:
Basalt bedrock

Strych Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces, plateaus, mesas, and escarpments
Parent material: alluvium and colluvium from sedimentary formations
Slope range: 1 to 70 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed, mesic Ustollic Calciorthids

Typical Pedon

Strych very gravelly loam, in an area of Strych very gravelly loam, 2 to 10 percent slopes; about 6 miles south of Seegmiller Mountain; about 800 feet north and 2,300 feet west of the southeast corner of section 10, T.38 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine vesicular and common fine tubular pores; 40 percent gravel; slightly effervescent, 8 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bk1—2 to 9 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel; strongly effervescent, few fine calcium carbonate filaments and thin coatings on rock fragments, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.
Bk2—9 to 24 inches; pink (7.5YR 7/4) very gravelly loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine, common fine, and few medium roots; common fine and very fine tubular and interstitial pores; 40 percent gravel; violently effervescent, common fine calcium carbonate seams and coatings on rock fragments, 28 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear wavy boundary.
2Bk3—24 to 33 inches; pink (7.5YR 7/4) extremely gravelly loam, brown (7.5YR 5/4) moist; massive; hard, friable, sticky and slightly plastic; many very

fine, common fine, and few medium roots; common fine and very fine tubular and interstitial pores; 60 percent gravel; violently effervescent, many medium calcium carbonate seams and coatings on rock fragments, 35 percent calcium carbonate equivalent; moderately alkaline (pH 8.4) abrupt wavy boundary.

2Bk4—33 to 48 inches; reddish yellow and pink (7.5YR 7/6 and 7/4) extremely gravelly loam, brown (7.5YR 5/4) moist; massive; hard, friable, sticky and slightly plastic; many very fine and common fine roots; common fine and very fine tubular and interstitial pores; 65 percent gravel; violently effervescent, many fine calcium carbonate seams and coatings on rock fragments, 38 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt wavy boundary.

3Btkb—48 to 60 inches; light brown (7.5YR 6/4) very gravelly clay loam, strong brown (7.5YR 5/6) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; no roots; common fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 40 percent gravel; violently effervescent, common fine calcium carbonate seams and coatings on rock fragments and ped faces, 29 percent calcium carbonate equivalent; strongly alkaline (pH 8.6).

Range in Characteristics

Depth to calcic horizon: 6 to 12 inches
Rock fragments: average 35 to 65 percent gravel, 0 to 5 percent cobbles

A horizon:
Texture—very gravelly loam or fine sandy loam
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 5 to 10 percent calcium carbonate equivalent
Rock fragments—35 to 65 percent gravel, 0 to 5 percent cobbles

Bk horizon:
Texture—very gravelly or extremely gravelly loam or sandy loam
Color—light brown, brown or pink
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 15 to 40 percent calcium carbonate equivalent
Rock fragments—35 to 65 percent gravel, 0 to 5 percent cobbles

3Btkb horizon:
May not occur in all pedons.

Strych Family

Depth class: moderately deep and deep
Drainage class: well drained
Permeability: moderately slow to moderately rapid
Landform: mesas and escarpments
Parent material: colluvium
Slope range: 10 to 40 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Classification: loamy-skeletal, mixed, mesic Ustollic Calciorthids

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Strych family in an area of Tanbark family-Strych family-Rock outcrop complex, 10 to 40 percent slopes; about 9 miles south of the Arizona-Utah state line and 4.5 miles west of the Hurricane Cliffs; about 1,200 feet north and 50 feet east of the southwest corner of section 17, T.40 N., R.10 W., Mohave County, Arizona.

A—0 to 3 inches; light reddish brown (5YR 6/4) extremely cobbly fine sandy loam, reddish brown (5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine vesicular pores; 30 percent gravel, 30 percent cobbles, and 5 percent stones; strongly effervescent, 10 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); abrupt smooth boundary.

Bw—3 to 13 inches; yellowish red (5YR 5/6) very cobbly loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 15 percent cobbles; strongly effervescent, 10 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bk1—13 to 26 inches; light reddish brown (5YR 6/4) very cobbly loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 20 percent cobbles; violently

effervescent, calcium carbonate segregated as common fine masses and seams, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk2—26 to 46 inches; light reddish brown (5YR 6/4) very cobbly clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 20 percent cobbles; violently effervescent, calcium carbonate segregated as many fine and medium masses and seams, 24 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Cr—46 inches; interbedded gypsite and mudstone.

Range in Characteristics

Depth to calcic horizon: 1 to 15 inches
Depth to bedrock: 20 to 60 inches

A horizon:
- Texture—sandy loam, fine sandy loam, or loam
- Color—light reddish brown, reddish brown, or reddish yellow
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—slight to strong, 5 to 20 percent calcium carbonate equivalent
- Rock fragments—15 to 30 percent gravel, 15 to 30 percent cobbles, 0 to 10 percent stones

B horizons:
- Texture—sandy loam, loam, and clay loam
- Color—yellowish red, reddish yellow, light reddish brown, or reddish brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—strong to violent, 10 to 25 percent calcium carbonate equivalent
- Gypsum—0 to 10 percent in lower part
- Rock fragments—10 to 30 percent gravel, 10 to 50 percent cobbles

Tanbark Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: hills, plateaus, mesas, and escarpments
Parent material: alluvium, colluvium, and eolian materials from sedimentary formations
Slope range: 15 to 75 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy, gypsic, mesic, shallow Ustic Torriorthents

Typical Pedon

Tanbark loam in an area of Tanbark loam, 15 to 75 percent slopes; about 17 miles south of St George, Utah, just 10.5 miles south of the Arizona-Utah state line; about 1,500 feet south and 800 feet east of the northwest corner of section 27, T.40 N., R.12 W., Mohave County, Arizona.

Ay—0 to 1 inch; white (N 8/) gypsiferous loam, white and pinkish white (N 8/ and 7.5YR 8/2) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine vesicular and irregular pores; 12 percent gravel; 60 percent gypsum crystals; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cy—1 to 17 inches; white and pinkish white (N 8/ and 7.5YR 8/2) gypsiferous sandy loam, white and pinkish white (N 8/ and 7.5YR 8/2) moist; massive; loose; common fine and very fine roots; many fine and very fine irregular pores; 70 percent crystalline gypsum; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

2Cr—17 inches; white and pinkish white (N 8/ and 7.5YR 8/2) gypsite.

Range in Characteristics

Depth to bedrock: 10 to 20 inches
Rock fragments: average less than 15 percent

A horizon:
- Texture—gypsiferous loam, gypsiferous sandy loam
- Color—white, pinkish white, pink, or light reddish brown
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—0 through 4, dry or moist
- Reaction (pH)—slightly to moderately alkaline
- Effervescence—none to slight
- Gypsum—20 to 70 percent

Cy horizon:
- Color—white, pinkish white, pink, or light reddish brown
- Value—6 through 8 dry, 5 through 8 moist
- Chroma—0 through 4, dry or moist
- Effervescence—none to slightly effervescent, less than 5 percent calcium carbonate equivalent
- Gypsum—50 to 80 percent

Cr horizon:
Interbedded soft to hard gypsite and gypsiferous mudstone and shale.

Tanbark Family

Depth class: shallow to moderately deep
Drainage class: well drained
Permeability: moderate to moderately rapid
Landform: mesas and escarpments
Parent material: colluvium from sedimentary and igneous formations
Slope range: 10 to 40 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 53 to 56 degrees F
Classification: loamy, gypsic, mesic, shallow Ustic Torriorthents

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Tanbark family in an area of Tanbark family-Strych family-Rock outcrop complex, 10 to 40 percent slopes; about 9 miles south of the Arizona-Utah state line and 4.5 miles west of the Hurricane Cliffs; about 1,700 feet north and 50 feet west of the southeast corner of section 18, T.40 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; light reddish brown (5YR 6/4) very cobbly fine sandy loam, reddish brown (5YR 4/4) moist; moderate thin platy structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; many very fine vesicular and common fine tubular pores; 25 percent gravel, 25 percent cobbles, and 5 percent stones; strongly effervescent; 25 percent crystalline gypsum as sand grains; moderately alkaline (pH 8.0); abrupt smooth boundary.

By—2 to 14 inches; white and reddish yellow (N 8/ and 5YR 7/6) fine sandy loam, yellowish red (5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and irregular pores; strongly effervescent; 55 percent crystalline gypsum as sand grains; slightly alkaline (pH 7.8); clear wavy boundary.

2Cr—14 inches; interbedded gypsiferous mudstone and gypsite.

Range in Characteristics

Depth to bedrock: 10 to 40 inches

Depth to crystalline gypsum: 0 to 2 inches

A horizon:
Texture—fine sandy loam, sandy loam, or loam
Color—light reddish brown, reddish yellow, or reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 2 to 15 percent calcium carbonate equivalent
Rock fragments—15 to 30 percent gravel, 15 to 30 percent cobbles, 0 to 10 percent stones

By horizon:
Texture—loam, fine sandy loam, or sandy loam
Color—white, pink, light reddish brown, reddish yellow, or reddish brown
Hue—5YR, 7.5YR
Value—5 through 8, dry or moist
Chroma—0 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 5 to 15 percent calcium carbonate equivalent
Gypsum—30 to 90 percent
Rock fragments—0 to 25 percent gravel, 0 to 25 percent cobbles

Tassi Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: structural benches
Parent material: mixed alluvium from sedimentary formations
Slope range: 5 to 15 percent
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy, mixed, mesic, shallow Ustollic Paleorthids

Typical Pedon

Tassi very gravelly loam in an area of Tassi-Rizno complex, 5 to 35 percent slopes; on the Grand Wash Bench about 12 miles southwest of Poverty Mountain; about 565 feet south and 2,240 feet west of the northeast corner of section 32, T.34 N., R.13 W., Mohave County, Arizona.

A—0 to 1 inch; light brown (7.5YR 6/3) very gravelly

loam, brown (7.5YR 4/3) moist; weak fine platy and granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine and few medium roots; many fine vesicular and common fine irregular pores; 40 percent gravel; strongly effervescent, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—1 to 5 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 15 percent gravel; violently effervescent, 30 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk2—5 to 10 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel; violently effervescent, few fine calcium carbonate flakes, 32 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bkm1—10 to 12 inches; white and pinkish white (N 8/ and 7.5YR 8/2) indurated, calcium carbonate-cemented hardpan with a 1- to 2-centimeter thick laminar cap; abrupt wavy boundary.

Bkm2—12 to 28 inches; white and pinkish white (N 8/ and 7.5YR 8/2) moderately to strongly calcium carbonate-cemented hardpan; abrupt smooth boundary.

2R—28 inches; limestone bedrock.

Range in Characteristics

Depth to petrocalcic horizon: 5 to 20 inches
Depth to bedrock: 20 to 40 inches
Rock fragments: average 15 to 35 percent; 10 to 30 percent gravel and 0 to 5 percent cobbles

A horizon:
Texture—sandy loam or loam
Color—light brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 5 to 20 percent calcium carbonate equivalent
Rock fragments—15 to 45 percent gravel, 0 to 5 percent cobbles

Bk horizon:
Texture—loam or sandy loam
Color—light brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent

2R horizon:
Limestone or sandstone bedrock.

Teesto Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderate
Landform: volcanic hills, cinder cones, and terraces
Parent material: eolian and colluvium
Slope range: 1 to 15 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: loamy-skeletal, mixed (calcareous), mesic Lithic Ustic Torriorthents

Typical Pedon

Teesto very cobbly loam in an area of Chic-Teesto-Rock outcrop complex, 1 to 30 percent slopes; about 3 miles south of Diamond Butte; about 1,100 feet south and 2,000 feet west of the northeast corner of section 17, T.36 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; many very fine vesicular and few fine tubular pores; 30 percent gravel and 25 percent cobbles; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bw—2 to 10 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 20 percent cobbles; slightly effervescent; moderately alkaline (pH 8.0); abrupt irregular boundary.

2R—10 inches; basalt bedrock.

Range in Characteristics

Depth to bedrock: 5 to 20 inches
Rock fragments: average 10 to 30 percent gravel, 10 to 30 percent cobbles

A horizon:
Texture—loam or sandy loam
Color—brown or light brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to slight

B horizon:
Texture—loam or clay loam
Color—brown or light brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 1 to 15 percent calcium carbonate equivalent

Thunderbird Series

Depth class: moderately deep
Drainage class: well drained
Permeability: very slow
Landform: mesas
Parent material: alluvium and colluvium from basalt
Slope range: 2 to 25 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Classification: fine, montmorillonitic, mesic Aridic Argiustolls

Typical Pedon

Thunderbird very cobbly clay loam in an area of Showlow-Thunderbird complex, 2 to 25 percent slopes; about 1.5 miles south of Castle Peak; about 1,300 feet north and 800 feet east of the southwest corner of section 23, T.32 N., R.12 W., Mohave County, Arizona.

A—0 to 2 inches; dark brown (7.5YR 4/2) very cobbly clay loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable, sticky and plastic; many very fine roots; few very fine tubular pores; 30 percent cobbles and 30 percent gravel; neutral (pH 7.2); abrupt wavy boundary.

Bt1—2 to 8 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to strong fine angular blocky; extremely hard, very firm, very sticky and very plastic; many very fine roots; common very fine tubular pores; many distinct clay films on faces of peds and lining pores; 10 percent gravel; neutral (pH 7.2); clear wavy boundary.

Bt2—8 to 29 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; strong medium prismatic structure parting to strong fine angular blocky; extremely hard, extremely firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; many prominent clay films on faces of peds and lining pores; common pressure faces; 10 percent gravel; slightly alkaline (pH 7.4); clear wavy boundary.

Btk—29 to 32 inches; reddish brown (5YR 4/3) gravelly clay, dark reddish brown (5YR 3/3) moist; strong medium prismatic structure parting to strong fine angular blocky; extremely hard, extremely firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; many prominent clay films on faces of peds and lining pores; slightly effervescent, few fine soft calcium carbonate masses, noneffervescent; 20 percent gravel; slightly alkaline (pH 7.6); abrupt smooth boundary.

Bk—32 to 34 inches; reddish brown (5YR 4/4) gravelly clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; strongly effervescent, few fine rounded soft calcium carbonate masses, 25 percent calcium carbonate equivalent; 20 percent gravel; slightly alkaline (pH 7.6); abrupt smooth boundary.

2R—34 inches; basalt bedrock.

Range in Characteristics

Depth to bedrock: 20 to 40 inches
Depth to calcium carbonate accumulation: 20 to 35 inches
Rock fragments: average 5 to 25 percent

A horizon:
Color—dark brown or brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—10 to 25 percent gravel, 10 to 35 percent cobbles, 0 to 5 percent stones

Bt horizon:
Texture—clay, gravelly clay or gravelly clay loam
Color—dark brown, brown or reddish brown
Hue—5YR, 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 or 3, dry or moist

Reaction (pH)—neutral to slightly alkaline
Effervescence—none to slight
Rock fragments—0 to 25 percent gravel

Bk horizon:
Texture—gravelly or cobbly, clay or clay loam
Color—brown or reddish brown
Hue—5YR, 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, less than 15 percent calcium carbonate equivalent
Rock fragments—5 to 20 percent gravel, 5 to 20 percent cobbles

Tidwell Family

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus, mesas, and ridges
Parent material: alluvium from sedimentary and igneous formations
Slope range: 8 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy, mixed (calcareous), thermic Lithic Torriorthents

Typical Pedon

Tidwell family very gravelly fine sandy loam in an area of Hobog-Tidwell family complex, 8 to 35 percent slopes; about 2 miles west of Mokaac Mountain; about 800 feet south and 300 feet east of the northwest corner of section 3, T.40 N., R.13 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common very fine vesicular and fine tubular pores; 30 percent gravel and 5 percent flagstones; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C—2 to 6 inches; reddish yellow (7.5YR 6/6) gravelly loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; 5 percent cobbles, 20 percent gravel; violently effervescent; moderately alkaline (pH 8.0); very abrupt smooth boundary.

2R—6 inches; interbedded limestone, mudstone, shale and gypsite.

Range in Characteristics

Depth to bedrock: 4 to 20 inches
Rock fragments: average 5 to 35 percent

A horizon:
Texture—gravelly or very gravelly fine sandy loam, loam, or sandy loam
Color—pink, light brown, and reddish yellow
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 1 to 15 percent calcium carbonate equivalent
Rock fragments—15 to 50 percent gravel, 0 to 10 percent flagstones

C horizon:
Texture—gravelly fine sandy loam or loam
Color—pink, light brown, or reddish yellow
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Effervescence—strong to violent, 1 to 15 percent calcium carbonate equivalent
Rock fragments—15 to 35 percent gravel, 0 to 15 percent cobbles

R horizon:
Limestone interbedded with gypsiferous mudstone, shale, and gypsite

Tonopah Series

Depth class: very deep
Drainage class: excessively drained
Permeability: very rapid
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 10 percent
Elevation: 1,500 to 3,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 60 to 70 degrees F
Classification: sandy-skeletal, mixed, thermic Typic Calciorthids

Typical Pedon

Tonopah gravelly loamy fine sand in an area of Bard family-Tonopah-Arada family association, 1 to 10 percent slopes; about 6 miles northwest of Littlefield, Arizona; about 1,300 feet west and 50 feet south of the

northeast corner of section 27, T.41 N., R.16 W., Mohave County, Arizona.

A—0 to 3 inches; light brown (7.5YR 6/4) gravelly loamy fine sand, strong brown (7.5YR 5/6) moist; moderate thin platy structure; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; many very fine vesicular and common fine tubular pores; 20 percent gravel-sized hardpan fragments; strongly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk1—3 to 8 inches; reddish yellow (7.5YR 7/6) gravelly loamy fine sand, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; common fine and very fine tubular pores; 25 percent gravel-sized hardpan fragments; violently effervescent, common fine calcium carbonate masses, pore fillings and pendants on rock fragments, 22 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bk2—8 to 29 inches; pink and reddish yellow (7.5YR 7/6 and 6/6) very gravelly loamy fine sand, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; common fine and very fine tubular pores; 40 percent gravel-sized hardpan fragments; violently effervescent, many fine calcium carbonate masses, pore fillings and pendants on rock fragments, 39 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Bk3—29 to 60 inches; reddish yellow (7.5YR 6/6) very gravelly loamy sand, strong brown (7.5YR 5/6) moist; massive; soft, very friable, nonsticky and nonplastic; very few fine and very fine roots; common fine and very fine tubular pores; 40 percent gravel-sized hardpan fragments; violently effervescent, many fine calcium carbonate masses, pore fillings and pendants on rock fragments, 22 percent calcium carbonate equivalent; strongly alkaline (pH 8.8).

Range in Characteristics

Depth to calcic horizon: 1 to 10 inches
Rock and hardpan fragments: average 35 to 50 percent

A horizon:
- Texture—gravelly or very gravelly loamy fine sand or loamy sand
- Color—pink, light brown, or reddish yellow
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Effervescence—strong to violent
- Rock and hardpan fragments—15 to 50 percent gravel

Bk horizon:
- Texture—very gravelly loamy sand, loamy fine sand, or fine sand
- Color—pink, reddish yellow, or light brown
- Value—5 through 7 dry, 4 through 6 moist
- Chroma—4 through 6, dry or moist
- Reaction (pH)—moderately to strongly alkaline
- Effervescence—strong to violent, 15 to 40 percent calcium carbonate equivalent
- Rock and hardpan fragments—35 to 50 percent gravel

Torrifluvents

Depth class: moderately deep to very deep
Drainage class: excessively to poorly drained
Permeability: rapid
Landform: flood plains
Parent material: mixed alluvium
Slope range: 1 to 3 percent
Elevation: 1,500 to 5,000 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 53 to 72 degrees F
Classification: Torrifluvents

Reference Pedon

Note: Profile described is a reference profile for the soils with this great group Soil Taxonomic Name. Textures and depths may vary greatly from those described.

Torrifluvents, in an area of Riverwash-Torrifluvents complex, 1 to 3 percent slopes; about 1,400 feet south and 1,000 feet west of the northeast corner of section 21, T.41 N., R.14 W., Mohave County, Arizona.

C—0 to 40 inches; light brown (7.5YR 6/4) stratified sand-gravel-loamy fine sand, brown (7.5YR 4/4) moist; single grained; loose, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine irregular pores; 30 percent gravel and 15 percent cobbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

2R—40 inches; hard sandstone bedrock.

Range in Characteristics

Depth to bedrock: 20 to 60 or more inches
Rock fragments: average 5 to 40 percent gravel, 2 to 35 percent cobbles, 0 to 5 percent stones

Surface and substratum:
Texture—loam, sandy loam, fine sandy loam, or loamy sand
Color—light brown, brown, or light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to violent, 1 to 25 percent calcium carbonate equivalent

Torriorthents

Depth class: shallow to very deep
Drainage class: well to somewhat excessively drained
Permeability: moderate to moderately rapid
Landform: hills, escarpments, plateaus, and mesas
Parent material: colluvium, eolian, and alluvium
Slope range: 10 to 70 percent
Elevation: 1,600 to 6,000 feet
Mean annual precipitation: 6 to 14 inches
Mean annual air temperature: 52 to 70 degrees F
Classification: Torriorthents

Reference Pedon

Note: Profile described is a reference profile for the soils with this great group Soil Taxonomic Name. Textures and depths may vary greatly from those described.

Torriorthents in an area of Mellenthin-Rock outcrop-Torriorthents complex, 10 to 70 percent slopes; in the Twist Hills area just east of Main Street Valley; about 1,200 feet west of the northeast corner of section 25, T.38 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine vesicular and common fine tubular pores; 40 percent gravel; slightly effervescent, 8 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Ck—2 to 40 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel; strongly effervescent, 10 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

R—40 inches; hard limestone bedrock.

Range in Characteristics

Depth to weathered or unweathered bedrock: 10 to 60 inches
Rock fragments: average 5 to 40 percent gravel, 0 to 35 percent cobbles, 0 to 5 percent stones

Surface horizon:
Texture—very cobbly or very gravelly loamy sand, loam, sandy loam, or fine sandy loam
Color—light brown, brown, or light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—slight to violent, 1 to 15 percent calcium carbonate equivalent

Subsurface horizon:
Texture—loamy sand, sandy loam, loam, or sandy clay loam
Color—light brown, brown, or light reddish brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 5 to 30 percent calcium carbonate equivalent
Gypsum—0 to 15 percent

R horizon:
May not be present in all pedons.
Ranges from soft mudstone to hard bedrock (basalt, sandstone, or limestone)

Tours Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: flood plains and alluvial fans
Parent material: mixed alluvium
Slope range: 1 to 3 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 54 to 57 degrees F
Classification: fine-silty, mixed (calcareous), mesic Typic Torrifluvents

Typical Pedon

Tours silt loam in an area of tours silt loam, 1 to 3 percent slopes; about 8.5 miles south of the Arizona-Utah state line, just 4 miles west of the Hurricane Cliffs; about 200 feet north and 900 feet east of the

southwest corner of section 7, T.40 N., R.10 W., Mohave County, Arizona.

A—0 to 2 inches; reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; common very fine vesicular pores; 3 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

AC—2 to 8 inches; yellowish red (5YR 5/6) stratified silt loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine tubular pores; stratified with thin layers of finer and coarser materials; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C—8 to 60 inches; yellowish red (5YR 5/6) stratified silty clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common very fine tubular pores; stratified with thin layers of finer and coarser materials; slightly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: average less than 5 percent

A horizon:
- Texture—silt loam or silty clay loam
- Color—light reddish brown or reddish brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—slight to strong, less than 15 percent calcium carbonate equivalent

C horizon:
- Texture—silt loam or silty clay loam
- Color—yellowish red, reddish brown, reddish yellow, or light reddish brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Effervescence—slight to strong, less than 15 percent calcium carbonate equivalent

Tsezhin Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: colluvium and alluvium from granite, gneiss, and limestone
Slope range: 5 to 15 percent
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 56 degrees F
Classification: loamy-skeletal, mixed, mesic Aridic Haplustalfs

Typical Pedon

Tsezhin very cobbly sandy loam in an area of Tsezhin very cobbly sandy loam, 5 to 15 percent slopes; about 24 miles south of Littlefield, Arizona, on the east side of the Virgin Mountains in Hungry Valley; about 1,000 feet south and 2,600 feet west of the northeast corner of section 32, T.37 N., R.16 W., Mohave County, Arizona.

A1—0 to 2 inches; brown (7.5YR 5/3) very cobbly sandy loam, dark brown (7.5YR 4/3) moist; moderate thin platy structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine vesicular and common fine tubular pores; 25 percent gravel, 20 percent cobbles, and 5 percent stones; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

A2—2 to 6 inches; brown (7.5YR 5/4) very cobbly loam, dark brown (7.5YR 4/4) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine vesicular and tubular pores; 25 percent gravel, 20 percent cobbles, and 5 percent stones; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bt1—6 to 11 inches; reddish yellow (5YR 6/6) very cobbly clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 25 percent gravel, 20 percent cobbles, and 5 percent stones; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Bt2—11 to 37 inches; reddish yellow (5YR 6/6) very cobbly clay loam, yellowish red (5YR 4/6) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; many faint clay films on faces of peds and lining pores; common pressure faces; 25 percent gravel, 20 percent cobbles, and 5 percent

stones; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Bt3—37 to 45 inches; yellowish red (5YR 5/6) very cobbly sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm, sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; common pressure faces; 25 percent gravel, 20 percent cobbles, and 5 percent stones; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bk—45 to 60 inches; white (N 8/) very cobbly sandy loam, pinkish white (7.5YR 8/2) moist; massive; hard, firm, slightly sticky and nonplastic; few fine and very fine roots; few very fine tubular pores; 25 percent gravel, 20 percent cobbles, and 5 percent stones; violently effervescent, weakly cemented, 58 percent calcium carbonate equivalent; strongly alkaline (pH 8.8).

Range in Characteristics

Depth to base of argillic: 30 to 50 inches
Depth to calcic horizon: 30 to 50 inches
Rock fragments: average 35 to 60 percent throughout—20 to 30 percent gravel, 15 to 25 percent cobbles, 0 to 15 percent stones

A horizon:
Texture—sandy loam or loam
Color—light brown or brown
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to slight

Bt horizon:
Texture—sandy clay loam or clay loam
Color—reddish yellow, yellowish red, reddish brown, or light reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—none to slight

Bk horizon:
Texture—sandy loam, loam, or loamy sand
Color—white, pinkish white, pink, or light brown
Value—5 through 7 dry, 4 through 6 moist
Chroma—0 through 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 60 percent calcium carbonate equivalent

Tsezhin Family

Depth class: moderately deep to deep
Drainage class: well drained
Permeability: slow to moderate
Landform: mesas
Parent material: colluvium
Slope range: 10 to 70 percent
Elevation: 5,800 to 6,500 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 47 to 56 degrees F
Classification: loamy-skeletal, mixed, mesic Aridic Haplustalfs

Reference Pedon

Note: Profile described is a reference profile for the soils with this family name. Textures and depths may vary greatly from those described.

Tsezhin family in an area of Tsezhin family-Ashfork family-Rock outcrop complex, 10 to 70 percent slopes; about 24 miles southwest of St. George, Utah, on the south side of Black Rock Mountain; about 900 feet north and 2,200 feet east of the southwest corner of section 12, T.39 N., R.14 W., Mohave County, Arizona.

A—0 to 1 inch; reddish brown (5YR 5/3) very cobbly loam, dark reddish brown (5YR 3/3) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic, common fine and very fine roots; many fine and very fine vesicular pores; 20 percent gravel, 25 percent cobbles, and 5 percent stones; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

Bw—1 to 4 inches; reddish brown (5YR 5/3) very cobbly loam, dark reddish brown (5YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic, common fine and very fine roots; common fine and very fine tubular and interstitial pores; 20 percent gravel and 15 percent cobbles; noneffervescent; neutral (pH 7.2); clear smooth boundary.

Bt—4 to 14 inches; reddish brown (5YR 5/4) very cobbly clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic, common fine and very fine, and few medium roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 35 percent gravel and 20 percent cobbles; noneffervescent; slightly alkaline (pH 7.7); clear smooth boundary.

Btk—14 to 33 inches; light reddish brown (5YR 6/4) very cobbly clay loam, reddish brown (5YR 4/4)

moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic, common fine and very fine and few medium roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 20 percent gravel and 35 percent cobbles; slightly effervescent, few fine calcium carbonate masses; slightly alkaline (pH 7.8); abrupt smooth boundary.

2Cr—33 inches; weathered gypsiferous mudstone.

Range in Characteristics

Depth to bedrock: 20 to 60 inches

A horizon:
- Texture—loam or clay loam
- Color—reddish brown or brown
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Rock fragments—10 to 30 percent gravel, 10 to 40 percent cobbles, 0 to 10 percent stones

B horizon:
- Texture—loam or clay loam
- Color—reddish brown, light reddish brown, or brown
- Hue—5YR, 7.5YR
- Value—5 or 6 dry, 4 or 5 moist
- Chroma—3 or 4, dry or moist
- Reaction (pH)—neutral to slightly alkaline
- Effervescence—none to slight
- Gypsum—0 to 5 percent in lower part only
- Rock fragments—average 35 to 60 percent; 10 to 30 percent gravel and 10 to 40 percent cobbles

Twist Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 10 percent
Elevation: 4,000 to 5,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 55 to 59 degrees F
Classification: fine-loamy, mixed, mesic Typic Haplargids

Typical Pedon

Twist loam in an area of Twist loam, 1 to 10 percent slopes; about 17 miles south of the Arizona-Utah state line and 55 miles west of Hurricane Cliffs; about 700 feet north and 1,000 feet west of the southeast corner of section 20, T. 39 N., R. 10 W., Mohave County, Arizona.

A—0 to 2 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and nonplastic; many very fine vesicular and few fine tubular pores; 5 percent fine gravel; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bt—2 to 7 inches; yellowish red (5YR 5/6) heavy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; few faint clay films on faces of peds and lining pores; 5 percent gravel; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Btk—7 to 15 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular and interstitial pores; common faint clay films on faces of peds and lining pores; 5 percent fine gravel; strongly effervescent, calcium carbonate segregated in many fine seams and soft masses, 18 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—15 to 37 inches; reddish yellow and pink (5YR 7/6 and 8/3) sandy clay loam, yellowish red and pink (5YR 5/6 and 7/3) moist; strong medium subangular blocky structure; very hard, firm, sticky and slightly plastic; many very fine and common fine roots; common fine and very fine tubular and interstitial pores; violently effervescent, engulfed in calcium carbonate, weakly cemented, 60 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); abrupt wavy boundary.

2Bky—37 to 53 inches; reddish yellow (5YR 7/6) sandy loam, reddish yellow (5YR 6/6) moist; massive; very hard, firm, nonsticky and nonplastic; common very fine and few fine roots; common fine and very fine tubular and irregular pores; strongly effervescent, calcium carbonate segregated in common soft masses and seams, 28 percent calcium carbonate equivalent; 5 percent crystalline gypsum; moderately alkaline (pH 8.0); clear wavy boundary.

2By1—53 to 58 inches; reddish yellow (5YR 7/6) sandy loam, reddish yellow (5YR 6/6) moist: massive;

hard, friable, nonsticky and nonplastic; no roots; common fine and very fine tubular and irregular pores; noneffervescent; 30 percent crystalline gypsum; slightly alkaline (pH 7.8); abrupt smooth boundary.

2By2—58 to 60 inches; white (N 8/) gypsum, white (N 8/) moist; massive; hard, firm, nonsticky and nonplastic; noneffervescent; 70 to 80 percent crystalline gypsum; slightly alkaline (pH 7.8).

Range in Characteristics

Depth to base of argillic: 15 to 20 inches
Depth to calcic horizon: 15 to 20 inches
Depth to gypsic horizon: 30 to 39 inches
Rock fragments: 0 to 15 percent gravel, 0 to 15 percent cobbles, 0 to 15 percent stones

A horizon:
Texture—loam or very cobbly loam
Color—light reddish brown, reddish brown, or yellowish red
Hue—5YR, 7.5YR
Value—5 through 7 dry, 3 through 5 moist
Chroma—3 through 6, dry or moist
Effervescence—very slight to strong, 1 to 15 percent calcium carbonate equivalent

Bt and Btk horizons:
Texture—clay loam, loam, or sandy clay loam
Color—yellowish red, light reddish brown, reddish brown, or reddish yellow
Hue—5YR, 7.5YR
Value—5 through 7 dry, 3 through 5 moist
Chroma—4 through 6, dry or moist
Effervescence—slight to violent, 1 to 20 percent calcium carbonate equivalent

Bk horizon:
Texture—loam or sandy loam
Color—reddish yellow, pink, pinkish white, or pinkish gray
Hue—5YR, 7.5YR
Value—6 through 8 dry, 5 through 8 moist
Chroma—2 through 6, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 60 percent calcium carbonate equivalent, can be weakly cemented

By horizon:
Texture—Gypsum with texture similar to sandy loam
Color—reddish yellow, white, pink, or light reddish brown
Value—6 through 8, dry or moist
Chroma—0 through 6, dry or moist
Gypsum—5 to 80 percent
Effervescence—none to strong, 1 to 30 percent calcium carbonate equivalent

Ubank Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: mesas
Parent material: mixed alluvium
Slope range: 1 to 10 percent
Elevation: 4,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Classification: coarse-loamy, carbonatic, mesic Ustollic Calciorthids

Typical Pedon

Ubank gravelly fine sandy loam in an area of Pocum-Childers-Ubank complex, 1 to 10 percent slopes; on West Mesa about 18 miles southwest of St. George, Utah; about 1,200 feet south and 1,500 feet east of the northwest corner of section 13, T.40 N., R.11 W., Mohave County, Arizona.

A—0 to 2 inches; light reddish brown (5YR 6/4) gravelly fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy and weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine vesicular and few fine tubular pores; 15 percent gravel and 10 percent calcium carbonate concretions; strongly effervescent, 20 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bw—2 to 6 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine and few medium roots; common fine and very fine tubular pores; 10 percent gravel and 2 percent cobbles; strongly effervescent, 15 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk1—6 to 16 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine and very fine and few medium roots; common fine and very fine tubular pores; 10 percent gravel and 2 percent cobbles; strongly effervescent, few fine calcium carbonate masses and common fine

seams, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk2—16 to 60 inches; mottled pinkish white and pink (5YR 8/2 and 8/3) gravelly loam, pink (5YR 7/3) moist; massive, weakly to strongly calcium carbonate cemented; very hard, firm, sticky and slightly plastic; few fine and very fine roots; few fine and very fine tubular pores; 5 percent gravel and 2 percent calcium carbonate concretions; violently effervescent, engulfed in calcium carbonate, 75 percent calcium carbonate equivalent; strongly alkaline (pH 8.6).

Range in Characteristics

Depth to calcic horizon: 6 to 20 inches
Rock fragments: average 5 to 25 percent gravel or concretions, 0 to 5 percent cobbles

A horizon:
Color—light reddish brown and reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—slightly to moderately alkaline
Effervescence—slight to strong, 5 to 20 percent calcium carbonate equivalent

Bw horizon:
Texture—loam and sandy loam
Color—light reddish brown and reddish brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 5 to 20 percent calcium carbonate equivalent

Bk horizon:
Texture—sandy loam and loam
Color—pink, pinkish white, and white
Value—6 through 8 dry, 5 through 8 moist
Chroma—1 through 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 19 to 75 percent calcium carbonate equivalent; averages more than 40 percent

Virgin Peak Series

Depth class: shallow and very shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: mountains
Parent material: colluvium from granite and gneiss
Slope range: 10 to 70 percent
Elevation: 5,000 to 8,000 feet
Mean annual precipitation: 16 to 20 inches
Mean annual air temperature: 45 to 56 degrees F
Classification: loamy-skeletal, mixed, mesic, shallow Typic Haplustolls

Typical Pedon

Virgin Peak very gravelly loam in an area of Virgin Peak-Rock outcrop complex, 10 to 70 percent slopes; about 15 miles south by southwest of Littlefield, Arizona; about 2,200 feet north and 50 feet east of the southwest corner of section 4, T.37 N., R.16 W., Mohave County, Arizona.

A—0 to 2 inches; dark brown (10YR 3/3) very gravelly loam, very dark brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine irregular pores; 40 percent gravel and 2 percent cobbles; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bw—2 to 7 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel and 2 percent cobbles; noneffervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

2Cr—7 to 17 inches; weathered gneiss; clear wavy boundary.

2R—17 inches; gneiss bedrock.

Range in Characteristics

Depth to bedrock: 4 to 20 inches
Rock fragments: average 35 to 50 percent gravel, 0 to 10 percent cobbles

A and Bw horizons:
Color—grayish brown, dark brown, or brown
Value—3 through 5, dry or moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline
Effervescence—none to very slight

Whiskey Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: stream terraces
Parent material: mixed alluvium
Slope range: 1 to 4 percent
Elevation: 5,800 to 7,000 feet
Mean annual precipitation: 14 to 18 inches

Mean annual air temperature: 48 to 52 degrees F
Classification: fine-loamy, mixed, mesic Pachic Haplustolls

Typical Pedon

Whiskey silt loam in an area of Whiskey silt loam, 1 to 4 percent slopes; about 4 miles northeast of Mount Trumbull; about 1,600 feet south and 100 feet west of the northeast corner of section 6, T.35 N., R.7 W., Mohave County, Arizona.

A—0 to 5 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 3/3) moist; moderate fine granular structure; slightly hard, very friable, slightly plastic; many very fine roots; many very fine tubular pores; 2 percent gravel; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bw—5 to 13 inches; dark brown (7.5YR 4/4) loam, dark brown (7.5YR 3/3) moist; moderate very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; 2 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk—13 to 32 inches; dark brown (7.5YR 4/4) loam, dark brown (7.5YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common medium roots; many fine tubular pores; 5 percent gravel; strongly effervescent, 9 percent calcium carbonate equivalent; lime accumulations as few fine filaments and threads; moderately alkaline; gradual wavy boundary.

C—32 to 60 inches; dark brown (7.5YR 4/4) loam, dark brown (7.5YR 3/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; 10 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of mollic epipedon: 40 to 60 inches
Depth to segregated calcium carbonate: 10 to 30 inches
Rock fragments: average 0 to 15 percent gravel

A horizon:
Hue—7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Reaction (pH)—neutral to moderately alkaline

B and C horizons:
Hue—7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Reaction (pH)—neutral to moderately alkaline
Effervescence—none to strong, 0 to 10 percent calcium carbonate equivalent
The Bw and Bk horizons are absent in some pedons

Winkel Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus and mesas
Parent material: mixed alluvium from sedimentary formations
Slope range: 2 to 25 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, mixed, thermic, shallow Typic Paleorthids

Typical Pedon

Winkel very gravelly loam in an area of Winkel very gravelly loam, 2 to 25 percent slopes; about 5 miles south of Olaf Knolls; about 1,700 feet south and 1,400 feet west of the northeast corner of section 29, T.35 N., R.15 W., Mohave County, Arizona.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots+; many fine vesicular and few fine tubular pores; 35 percent gravel and 5 percent cobbles; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—2 to 5 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel; strongly effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk1—5 to 9 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel and 20 percent cobbles; strongly effervescent, few fine calcium carbonate seams and thin coatings on rock fragments, 19 percent calcium carbonate

equivalent; moderately alkaline (pH 8.4); clear smooth boundary.
Bk2—9 to 13 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 35 percent gravel and 20 percent cobbles; violently effervescent, common fine calcium carbonate seams and coatings on rock fragments, 29 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); very abrupt smooth boundary.
2Bkm—13 to 32 inches; indurated, calcium carbonate-cemented hardpan with laminar cap.
3R—32 inches; basalt bedrock.

Range in Characteristics

Depth to petrocalcic horizon: 10 to 20 inches
Depth to bedrock: 20 to 40 inches
Rock fragments: average 35 to 50 percent gravel, 0 to 20 percent cobbles

A horizon:
Color—light brown, brown, or pink
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 5 to 15 percent calcium carbonate equivalent

Bw horizon:
Texture—gravelly, very gravelly, or very cobbly loam or sandy loam
Color—light brown or brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 or 5, dry or moist
Effervescence—slight to strong, 5 to 15 percent calcium carbonate equivalent

Bk horizon:
Texture—gravelly, very gravelly, or very cobbly loam or sandy loam
Color—light brown or pink
Value—6 or 7 dry, 5 or 6 moist
Chroma—4 or 5, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent

Wutoma Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: cinder cones
Parent material: eolian and residuum
Slope range: 15 to 50 percent
Elevation: 6,000 to 7,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 54 degrees F
Classification: ashy-skeletal over fragmental or cindery, mixed, mesic Vitrandic Ustochrepts

Typical Pedon

Wutoma extremely gravelly loam in an area of Wutoma-Lozinta complex, 15 to 50 percent slopes; about 2.5 miles southwest of Mt. Logan; about 1,100 feet south and 1,200 feet west of the northeast corner of section 20, T.34 N., R.8 W., Mohave County, Arizona.

A—0 to 2 inches; dark brown (10YR 4/3) extremely gravelly loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; many very fine tubular pores; 75 percent gravel-sized cinders; neutral (pH 7.3); abrupt smooth boundary.
Bw—2 to 12 inches; brown (10YR 4/3) extremely gravelly loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; slightly hard, very friable; many fine roots; many fine tubular pores; 70 percent gravel-sized cinders; slightly alkaline (pH 7.8); abrupt smooth boundary.
2C—12 to 60 inches; black cinders; few medium roots; few pockets and stratifications of extremely cindery loam.

Range in Characteristics

Depth to loose cinders: 1 to 20 inches
Rock fragments: average 60 to 80 percent gravel-sized cinders

A and B horizons:
Texture—loam or fine sandy loam
Color—dark brown, brown, or dark yellowish brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—1 through 3, dry or moist
Reaction (pH)—neutral to slightly alkaline

C horizon:
Texture—loose cinders

Yellowhorse Series

Depth class: moderately deep
Drainage class: well drained
Permeability: very slow

Landform: mesas
Parent material: colluvium and alluvium from volcanic rocks
Slope range: 1 to 10 percent
Elevation: 6,600 to 7,200 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Classification: fine, montmorillonitic, mesic Udic Chromusterts

Typical Pedon

Yellowhorse cobbly loam in an area of Yellowhorse-Luzena family complex, 1 to 10 percent slopes; about 13.8 miles south of the Arizona-Utah state line and 16.9 miles east of the Arizona-Nevada state line; about 1,900 feet south and 200 feet west of the northeast corner of section 12, T.39 N., R.14 W., Mohave County, Arizona.

A—0 to 2 inches; reddish brown (5YR 4/3) cobbly loam, dark reddish brown (5YR 3/3) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common very fine vesicular and tubular pores; 5 percent gravel, 20 percent cobbles, and 5 percent stones; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.
Bt—2 to 10 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; many pressure faces and few faint clay films lining pores; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.
Btss—10 to 24 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/3) moist; strong coarse angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few very fine roots; common fine interstitial pores; many pressure faces and many intersecting slickensides forming wedges; few faint clay films lining pores; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.6); abrupt irregular boundary.
2R—24 inches; basalt bedrock

Range in Characteristics

Depth to bedrock: 20 to 40 inches
Rock fragments: average 0 to 15 percent gravel, 0 to 5 percent cobbles
Organic matter: 1 to 2 percent in upper horizons

A horizon:
Texture—cobbly loam
Color—reddish brown or dark reddish brown
Hue—5YR, 7.5YR
Value—3 through 5 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—5 to 10 percent gravel, 5 to 20 percent cobbles, 0 to 5 percent stones

Bt horizon:
Texture—clay loam or clay
Color—reddish brown or dark reddish brown
Hue—5YR, 7.5YR
Value—3 through 5 dry, 3 or 4 moist
Chroma—2 through 6, dry or moist
Reaction (pH)—neutral to slightly alkaline
Rock fragments—0 to 20 percent gravel, 0 to 5 percent cobbles

R horizon:
Basalt bedrock

Yellowhorse Family

Depth class: deep and very deep
Drainage class: moderately well to somewhat poorly drained
Permeability: very slow
Landform: plateaus
Parent material: mixed alluvium from volcanic and sedimentary formations
Slope range: 0 to 3 percent
Elevation: 5,800 to 7,000 feet
Mean annual precipitation: 18 to 22 inches
Mean annual air temperature: 45 to 50 degrees F
Classification: fine, montmorillonitic, mesic, Udic Chromusterts

Typical Pedon

Yellowhorse family in an area of Yellowhorse family silty clay, 0 to 3 percent slopes; about 2 miles north of Mt. Dellenbaugh on the Shivwits Plateau; about 1,500 feet south and 2,200 feet west of the northeast corner of section 25, T.32 N., R.12 W., Mohave County, Arizona.

A—0 to 3 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 3/3) moist; strong very fine granular structure; hard, firm, very sticky and very plastic; common fine and very fine roots; many very fine irregular pores; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bss—3 to 41 inches; brown (7.5YR 4/3) silty clay, dark brown (7.5YR 3/3) moist; strong medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine and very fine roots; few very fine tubular pores; many slickensides with some intersecting, many pressure faces; noneffervescent; slightly alkaline (pH 7.8); gradual wavy boundary.

Bk—41 to 60 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/4) moist; strong fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; many pressure faces; violently effervescent, many fine and medium calcium carbonate masses, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.2).

Range in Characteristics

Cracks 5 millimeters or more wide, from surface to more than 25 centimeters in depth, 6 out of 10 years, for fewer than 150 days cumulative per year.

Depth to bedrock: 45 to 70 inches

Rock fragments on surface: 0 to 5 percent gravel; 0 to 5 percent cobbles

A and Bss horizons:

Texture—clay or silty clay
Color—brown or dark brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—neutral to slightly alkaline

Bk horizon:

Texture—clay or silty clay
Color—brown or dark brown
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 or 4, dry or moist
Effervescence—strong to violent, 15 to 30 percent calcium carbonate equivalent
Rock fragments—0 to 5 percent gravel; 0 to 5 percent cobbles

Yumtheska Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus, mesas, mountains, and hills
Parent material: alluvium and colluvium from sedimentary formations
Slope range: 2 to 50 percent
Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 56 degrees F
Classification: loamy-skeletal, mixed, mesic Lithic Calciustolls

Typical Pedon

Yumtheska very gravelly loam in an area of Disterheff-Natank-Yumtheska complex, 2 to 15 percent slopes; about 53 miles southeast of Littlefield, Arizona; about 2,590 feet north and 2,540 feet west of the southeast corner of section 11, T.34 N., R.13 W., Mohave County, Arizona.

A—0 to 2 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; moderate thick platy structure; soft, very friable, slightly sticky and slightly plastic; many fine and few medium roots; common fine vesicular pores; 50 percent gravel and 5 percent cobbles; slightly effervescent; slightly alkaline (pH 7.4); clear smooth boundary.

Bk1—2 to 8 inches; dark brown (10YR 4/3) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; common fine tubular pores; 50 percent channers with faint calcium carbonate coatings; slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

2Bk2—8 to 14 inches; light gray (10YR 7/2) very gravelly loam, grayish brown (10YR 5/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 35 percent channers; violently effervescent, faint calcium carbonate coatings and pendants on rock fragments; moderately alkaline (pH 8.0); abrupt irregular boundary.

3R—14 inches; limestone bedrock with thin laminar calcium carbonate coating on upper surface.

Range in Characteristics

Depth to calcic horizon: 1 to 4 inches
Depth to bedrock: 10 to 20 inches
Rock fragments: average 35 to 50 percent

A horizon:

Color—brown, pale brown, or grayish brown
Value—5 or 6 dry, 3 moist
Chroma—2 or 3, dry or moist
Effervescence—none to slight, less than 5 percent calcium carbonate equivalent

Rock fragments—35 to 50 percent gravel or channers, 0 to 10 percent cobbles or flagstones

Bk horizon:
Texture—very gravelly loam or sandy loam
Color—dark brown, brown, pale brown, light gray, or dark grayish brown
Value—4 through 7 dry, 3 through 6 moist
Chroma—2 or 3, dry or moist
Reaction (pH)—moderately alkaline
Effervescence—slight to strong, 15 to 40 percent calcium carbonate equivalent
Rock fragments—35 to 45 percent gravel or channers, 5 to 15 percent cobbles or flagstones

R horizon:
Extremely hard limestone or calcareous sandstone

Yurm Family

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: fan terraces and mesas
Parent material: alluvium and colluvium from limestone and other sedimentary formations
Slope range: 15 to 35 percent
Elevation: 1,600 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Classification: loamy-skeletal, mixed, thermic, shallow Typic Paleorthids

Typical Pedon

Yurm family very gravelly loam in an area of Yurm very gravelly loam, 15 to 35 percent slopes; about 4 miles south of Olaf Knolls; about 1,300 feet north and 2,200 feet east of the southwest corner of section 30, T.35 N., R.14 W., Mohave County, Arizona.

A—0 to 2 inches; brown (7.5YR 5/4) very gravelly loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and very fine roots; many fine vesicular and few fine tubular pores; 30 percent gravel and 5 percent cobbles; strongly effervescent, 16 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—2 to 12 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel and 10 percent cobbles; violently effervescent, common faint calcium carbonate coatings on rock fragments, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—12 to 16 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and interstitial pores; 40 percent gravel and 10 percent cobbles; violently effervescent, common faint calcium carbonate coatings on rock fragments, 23 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); very abrupt smooth boundary.

Bkm—16 to 60 inches; indurated, calcium carbonate-cemented hardpan with laminar cap; interbedded every foot or two with weakly to strongly cemented materials.

Range in Characteristics

Depth to calcic horizon: 1 to 2 inches
Depth to petrocalcic horizon: 10 to 20 inches

A horizon:
Texture—very gravelly loam or very cobbly sandy loam
Color—brown or light brown
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Effervescence—slight to strong, 5 to 10 percent calcium carbonate equivalent
Rock fragments—15 to 50 percent gravel, 0 to 25 percent cobbles

Bk horizon:
Texture—very gravelly or very cobbly loam or fine sandy loam
Color—light brown or pink
Value—6 or 7 dry, 5 or 6 moist
Chroma—3 or 4, dry or moist
Reaction (pH)—moderately to strongly alkaline
Effervescence—strong to violent, 15 to 35 percent calcium carbonate equivalent
Rock fragments—15 to 50 percent gravel, 0 to 25 percent cobbles

Bkm horizon:
Indurated, laminated, dense layer is 0.5 inch to 6 inches thick. It repeats every foot or two with weakly to strongly cemented materials to 60 inches or more.

Formation of the Soils

Soil is a complex, natural, three-dimensional body on the earth's surface that supports plants and other life forms. It consists of inorganic and organic material and has characteristics and qualities determined by physical and chemical processes that result from the interaction of five factors: climate, living organisms, time, topography, and parent material. The influence of each varies from one location to another, but the interaction of all the factors determines the kind of soil that forms (Thompson 1975).

Soil is often seen as a thermodynamic system existing in equilibrium with certain external, soil forming factors. Changes in these factors cause the soil to move towards a new equilibrium (Wilding et al. 1983).

The soils of this area have undergone dynamic alterations. Faulting, folding, uplift and canyon cutting have altered elevation and topography; volcanic eruptions have added fresh material; streams have eroded surfaces and transported sediment to low-lying areas; winds have transported and deposited sediments; and changes have occurred in the climate and the types of organisms living on the soil. These various events have greatly influenced the soil properties. In this section the five factors that affect soil formation in the survey area are discussed and major processes are described.

Climate

Climate affects soil formation through its influence on animal and plant life. Moisture and temperature cause physical and chemical weathering. Climate also contributes to landform expression and to the development of geomorphic surfaces and local topography.

As temperature and moisture increase, so do physical, chemical, and biological processes in the soil because moisture and temperature control the rate and degree of mineral decomposition and alteration. Climate also influences the leaching of clay, humus, soluble salts, and minerals from the upper part of the solum and their accumulation in layers deeper in the soil profile. Nitrogen fixation, carbon transformation, and other microbial activity are strongly affected by soil temperature and moisture (Thompson 1957).

Climate change complicates the study of soil formation but can strongly influence the kind of soil formed. Climatic changes have been verified through geologic evidence of stream erosion and deposition and glacial activity. Theories regarding climatic changes are many and complex. Most agree that temperature and precipitation changes affected the advance and retreat of the ice sheets, which in turn affected moisture and mineral deposition in nonglaciated areas (Flint 1971). Since the last ice age, about 10,000 years ago, temperatures have warmed slightly, and available moisture has decreased greatly. Heavy rainfall was contemporaneous with glacial climates, and snowlines were lower than at present (Gulluly et al. 1968).

These changes are evident in this survey area. With higher precipitation came higher runoff, which cut canyons and stripped the surrounding areas of soil and left much of the survey area with exposed bedrock. Most of the soils in this survey are relatively young because of the past and present erosion that has occurred.

Downcutting and headcutting of canyons continues today, but has slowed tremendously as a result of the great decline in precipitation.

Evidence of different climates in soil formation can be seen in the soils of this survey on stable geomorphic surfaces just by changes in elevation. Soils at 1,500 to 3,000 feet have little to no organic matter and, generally speaking, show little evidence of mineral weathering and leaching, because of very low effective precipitation (4 to 10 inches) and hot temperatures. Soils which exhibit little to no development since being deposited because of the low effective precipitation and hot temperatures include the Arizo, Akinville, Gypill, Hindu, Nipton, and Tidwell family soil series. The exceptions to this are the very old relic areas of pliocene sediments in the Littlefield and Pakoon areas. Some of the soils in these areas were deposited and formed under a more moist climate and have since formed petrocalcic horizons of shallow to moderate depths. Soils in this climate

regime that have petrocalcic horizons include the Cave, Harrisburg, Bard family, Winkel, and Yurm soil series.

Soils at 3,000 to 5,000 feet may contain trace amounts of organic matter. Evidence of mineral weathering and leaching increases as effective precipitation increases to about 10 to 12 inches and average annual air temperature falls to about 54 to 57 degrees F. Some soils have cambic horizons, and others have formed weak argillic horizons. Soils in this climatic regime that have cambic or argillic horizons include the Robroost and Twist soil series.

Soils at 5,000 to 6,500 feet have 0.5 to 1.0 percent organic matter in the upper foot of the soil profile, and evidence of mineral weathering and leaching is shown by the segregated carbonates moderately deep to deep in the profile and the moderate to strong argillic horizons that have formed below the surface. Effective precipitation is about 12 to 18 inches. Soils in this climatic regime having these features include the Barx, Boquillas family, Showlow, Delenbaw, Disterheff, Goesling, Natank, Padilla, Sedillo, Spenlo, Thunderbird, and Tsezhin soil series.

Soils that occur above 6,500 feet usually have 1.0 percent or more organic matter in the upper twelve inches and have moderately to strongly developed argillic horizons. Carbonates are leached from the surface and usually are not found even below the argillic horizons. Average annual air temperature is about 45 to 50 degrees F, and average annual precipitation is 18 to 22 inches. Soils in this climatic regime having these features include the Luzena, Sponiker, and Yellowhorse soil series.

Living Organisms

Living organisms play an extremely important role in soil formation and in the cycling of carbon and nitrogen. These three processes are closely related. Carbon fixed by plants is decomposed by soil microbes. The nitrogen cycle is interrelated with the carbon cycle, and the rate of nitrogen cycling is closely related to productivity. Accumulation of organic matter in soils is a balance between productivity, biomass accumulation, and the rate of decomposition. Organic-matter accumulation and decomposition products have a profound influence on soil formation (Wilding et al. 1983).

Among all living organisms, the higher plants have the most significant overall influence on soil formation. Plants of all sizes intercept precipitation, reduce soil erosion, trap sediment, and help aerate soils. Decaying plant remains, especially fibrous grass roots, are the major source of organic matter.

Animals influence soil formation by contributing organic matter and synthesizing it. They also mix soil horizons by burrowing into the soil. Burrowing animals, such as prairie dogs, skunks, gophers, and ground squirrels, influence soil mainly by mechanical turning and mixing. Insects, nematodes, earthworms, and millipedes synthesize organic matter, and thus they are dependent on the soil for plants and animal remains and for moisture.

The soils below 5,000 feet in this survey area are generally dry for long periods of time. They are well to excessively drained and so do not pond water for long periods. Plants cover only a small portion of their surface. Because of their sparseness, they add little organic matter to the soil, give scant protection from wind and water erosion, and provide little shade. Therefore, the soils of this dry area have very low organic matter content.

The soils above 5,000 feet, on the other hand, are moist for longer periods, and surface horizons contain 0.5 to 1.0 percent or more organic matter. Microbial activity is high in these soils during the warm moist season of the year and low during the cold winter months.

Time

Soils acquire their properties over periods of time measured in hundreds and thousands of years. The rate of soil formation is a product of all the component individual factors taking place in the soil over time. Soil age is difficult to determine but is relative to soil development and the age of the geomorphic surface (Wilding et al. 1983).

A young soil in a relative sense is one which has a profile closely resembling its parent material. The soils of dunes, flood plains, and alluvial fans go through alternating sedimentation and erosional cycles so fast that soil forming processes haven't had time to alter the parent material. Some of the soils of this area which fall in this category are the Arizo, Berzatic family, Ives, Mespun, Radnik, and Tours soils. Also included in this category are Torrifluvents and Riverwash.

Older soils include those which have had time in place to begin alteration of the parent material. They occur on somewhat stable to stable geomorphic surfaces. Examples of these soils are the Akinville, Barx, Showlow, Delenbaw, Ivanpatch, Katzine, Padilla, Strych, and Tonopah soil series.

The old and very old soils are those with well defined, moderate to strong structured argillic, calcic, and/or cambic horizons. They occur on very stable geomorphic surfaces and have undergone horizonal

transformation in the soil profile. Soils in this group include the Cave, Childers, Harrisburg, Havasupai, Bard family, Tassi, Winkel, and Yurm soil series.

Topography and Parent Material

Since soils form a three-dimensional continuum on the landscape, any study of soil formation and distribution requires an understanding of the evolution of the landscape. Geomorphology is the interpretive description of landscapes, including an explanation of the history of those landscapes. Through the use of geomorphic terms, the relationships of parent material, topography, and soils will create a picture in the mind's eye of these relationships.

The Shivwits area assumes the position of a structural transition zone between the Colorado Plateaus and the Basin-and-Range province of the Mohave Desert (Moore 1972). This structural transition begins with the Hurricane Cliffs on the east side of the survey area and ends with the Virgin Mountains on the west side. The tectonics of faulting, folding, volcanics, and very active geologic erosion has created a very complex pattern of geomorphic surfaces and soils seen as cliffs, buttes, canyons, mesas, plateaus, and steep mountains. Almost all of the geomorphic surfaces are relatively young and are actively being changed by geologic erosion.

Several major faults cross the area from north to south (fig. 14). The largest and most pronounced is the Hurricane Fault, which formed the Hurricane Cliffs. This fault begins south of the Colorado River and extends northward 180 miles to Paragonah, Utah (Gregory 1950). Within the boundaries of the survey area, vertical displacement seen along the cliffs ranges from 1,000 to 2,000 feet.

The Grand Wash Fault forms an upper and lower escarpment with a structural bench known as the Grand Wash Bench. This fault extends north a few miles into Utah and south several miles south of the Colorado River covering some 80 miles (Moore 1972). Within the boundaries of the survey area, vertical displacement seen along the Grand Wash Cliffs south of Mud Mountain, where it is most distinctive, ranges between 800 to 1,500 feet on each of the upper and lower cliffs, giving it a total height of 1,600 to 3,000 feet (USGS topographic maps).

Several major faults contributed to the formation of the Virgin Mountains located in the northwest portion of the survey. These faults are named Piedmont, Front, Cottonwood, Sullivan's Canyon, and Grand Wash faults. The Virgin Mountain Anticline is also recognized in their formation (Moore 1972). Several smaller faults, thrusts, and folds are recognized in the Virgin Mountain area. Vertical displacement was very extensive. One can see a 5,000-foot elevation change from the west side of the mountains with the piedmont slopes extending up to about 3,000 feet elevation and Mount Bangs, visible from Littlefield, Arizona, at 8,012 feet (USGS topographic maps).

There are many other faults, named and unnamed, that crisscross the survey area but generally lie in a north-south configuration. These faults help form many of the named geographic features of the area such as Sullivan Draw, Main Street Valley, Twist Hills, Hidden Canyon, Hobble Canyon, and Hungry Valley (USGS topographic maps).

Tectonic displacement continues in this area even today. An earthquake having a magnitude between 5.5 and 5.9 occurred as late as September 2, 1992; the epicenter was near the Arizona-Utah state line near the Washington Fault just five miles southeast of St. George, Utah (Pearthree and Wallace 1992).

Along with tectonic displacement exposing a variety of sedimentary, igneous, and metamorphic rock formations, volcanic activity has added to this variety with its cinder cones, basalt lava flows, plugs and dikes. Several distinctive geographic features have been formed by volcanic activity. Black Rock, Mokaac, Grassy, Seegmuller, Yellow John, Mud, Wolfhole, and Poverty mountains are all old basalt lava flows forming mesas at 6,000 to 7,000 feet of elevation. Poverty Knoll, Diamond Butte, Twin Butte, and Mustang Knoll are old volcanic dikes and plugs topping out at just over 6,000 feet of elevation. Cinder Hill, Mount Logan, Mount Emma, and Slide Mountain are combination cinder cones and volcanic dikes and plugs ranging in elevation from 5,200 to 7,800 feet (USGS topographic maps).

The single largest geologic formation influencing soil formation in the Shivwits Area is the Kaibab Limestone. This formation is broken by faults, folds and canyons, yet it influences to some degree almost all the soils recognized in this survey area. The airborne calcium carbonate from the plateaus and escarpments affects even the soils high up on the lava flows. Many of the soils recognized here are directly related to the Kaibab Limestone by forming in alluvium and colluvium derived and often resting on the formation itself. Some of these soils include the Bisoodi, Dera, Katzine, Meriwhitica, Meadview, Strych, Tidwell family, Yumtheska, and Moenkopie soil series. These soils contain limestone rock fragments and are very calcareous throughout their profiles.

The Moenkopie Formation with its mudstone and 100-plus-foot thick layers of gypsum is believed to have the second largest effect on soil formation in the survey area. Canyon and cliff walls expose the very

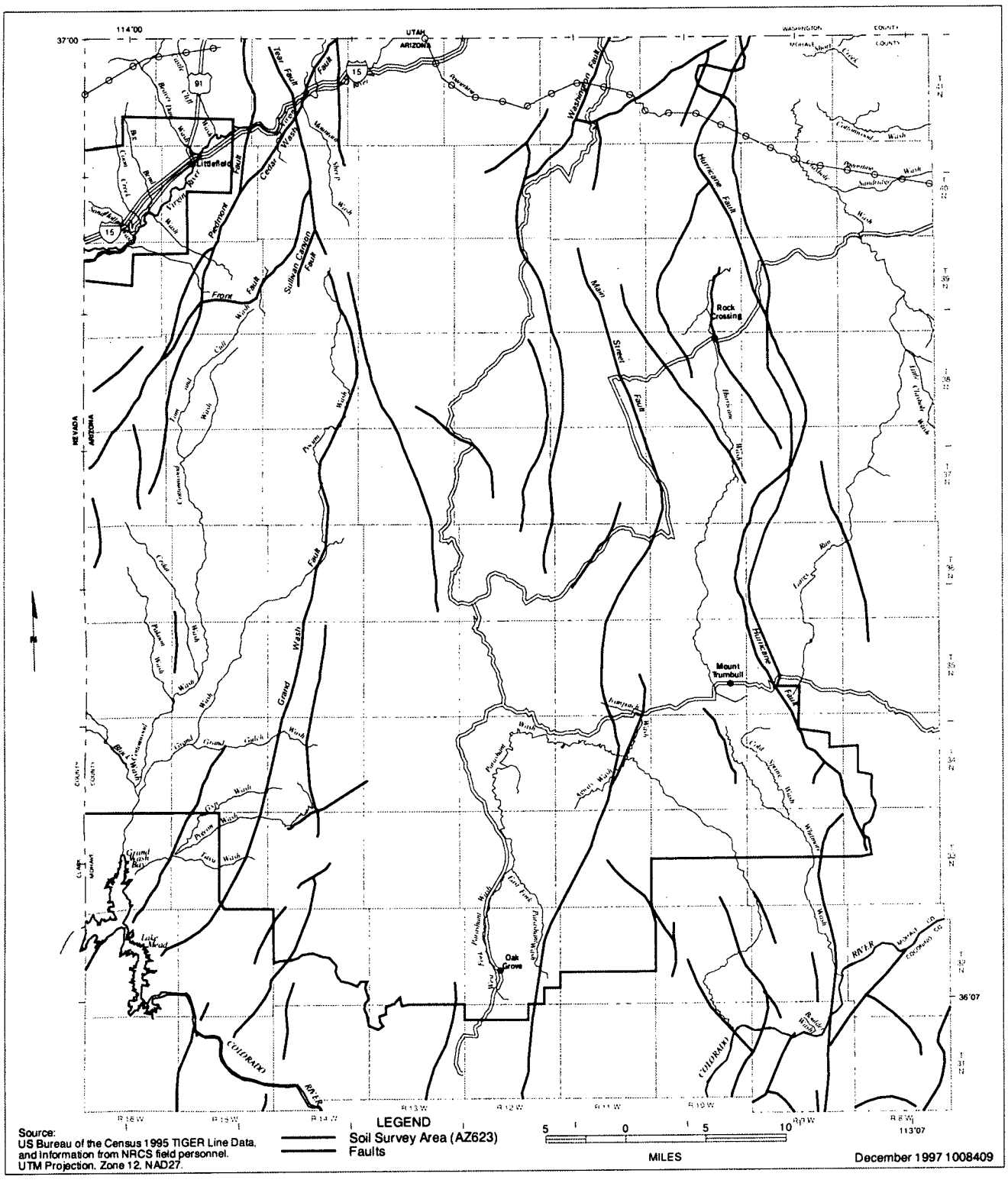


Figure 14.—Fault lines of the Shivwits area.

thick layers of gypsum, which is highly erodible and is carried by water to all the soils forming below these large deposits of gypsum. Soils containing gypsum are unique in their characteristics. They are lower in specific gravity, contain a higher percentage of pore space, are more easily eroded by wind and water, have low load-bearing capacities, and are easily leached by water; thus they are given to subsidence. Soils with these characteristics include the Dutchman, Goblin, Gypill, Gyppocket, Hobcan, Ivanpatch, McCullan, Mokaac, Nutter, Robroost, Ruesh, Sedillo, Tanbark, and Twist soil series. There are many more soils which contain gypsum but it is either in trace amounts or below the 60-inch depth of soil recognition.

The volcanic mesas have the third largest influence on the soils formed in the survey area. Not only do the basalt mesas have shallow to deep clayey soils with an overstory of trees and loamy calcareous soils at lower elevations, but these mesas have contributed basalt stone, cobble, and gravel to soils below them for miles around. Clayey soils with an overstory of trees include the Ashfork family, Boquillas family, Showlow, Delenbaw, Luzena, Sponiker, Springerville, Thunderbird, and Yellowhorse soil series. Loamy calcareous soils on basalt mesas include the Childers, Pocum, Teesto, Ubank, and Winkel soil series.

The granite and gneiss of the Virgin Mountains influence soils of the mountains themselves, the piedmont slopes of the Littlefield area, and, to a limited extent, the soils in Hungry Valley and the northern end of the Pakoon Area. Soils closest to the mountain contain many granite and gneiss boulders and stones. As the piedmont slopes away from the mountain, rock fragments become smaller until just before the dropoff to the river the soils are dominated by gravel- and sand-sized particles. The valley side alluvium on the piedmont fan derived from granite and gneiss consists of loamy to sand-producing soils that are droughty. This droughtiness combines with low precipitation to produce very little vegetation. Soils exhibiting these characteristics include the Arizo, Blind family, Meadview, Shelley, and Tsezhin soil series. Soils on the mountain slopes in the Virgin Mountains that formed from the colluvium of the granite and gneiss have some of the same droughty conditions as a result of depth to rock, steep slopes, and content of rock fragments. The Virgin Peak and Tsezhin soil series are the only two named soils mapped in the granite-gneiss area of the Virgin Mountains. The Yumtheska and Katzine soil series make up the limestone areas.

Cinder cones are of very limited extent in the Shivwits Area but the soils formed from these cindery knolls and mountains are unique. The highly porous cinders act as catcher's mitts, collecting airborne particles, predominantly clay and silt-sized particles. These cinders are combined with the volcanic glass sand-sized particles, forming even-textured loams. The large percentage of gravel- and cobble-sized cinders in these soils and the limited depth to which the eolian particles have penetrated cause droughtiness, which limits the soils' productivity. Usually, 100 percent cinders with no soil particles filling voids occur at depths of 20 to 40 inches. Soils having these characteristics include the Chic, Lozinta, and Wutoma soil series.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having 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 plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3.0
Low	3.0 to 6.0
Moderate	6.0 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high, and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may

be nearly level or have a grade toward one or both sides.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

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 oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Control section. The part of the soil on which

classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

ECe. Measured electrical conductivity of a saturated soil extract. See Salinity.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion hazard, water. Determined by the following "K factor" and percent slope:

K	Percent slope			
factor	0-3	3-15	15-30	30+
.02-.20	slight	slight	moderate	severe
.24-.37	slight	moderate	severe	severe
.43-.69	moderate	severe	severe	v. severe

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors 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 drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Fluventic. Of or pertaining to recent soil deposits left behind by running water in and along drainage channels.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsiferous. Used as a soil texture modifier to indicate presence of gypsum in the soil (ex: gypsiferous loam).

Gypsum. A naturally occurring mineral consisting of hydrous calcium sulfate ($CaSO_4$ & H_2O).

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected

by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Hydrous. Containing water usually chemically combined (as in hydrous calcium sulfate).

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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 so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are 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.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. 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 of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. The negative log of the hydrogen ion concentration. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the

desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of land surface, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief (less and greater than 300 m).

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Runoff of surface water from a soil is determined by the percent slope and the hydrologic group, as indicated by the following:

Hydrologic group	Percent slope			
	0-3	3-15	15-30	30+
A	very slow	very slow	slow	slow
B	slow	medium	rapid	rapid
C	slow	medium	rapid	v. rapid
D	medium	med./rap.	v. rapid	v. rapid

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The degree to which a soil is affected by soluble salts. The amount of total salts in the soil is ascertained by measuring the conductivity of a saturated soil extract. The conductivity is measured in decisiemens per meter (dS/m), which are the same as millimhos per centimeter (mmhos/cm). Classes of salinity are nonsaline, 0 to 2 dS/m; very slightly saline, 2 to 4 dS/m; slightly saline, 4 to 8 dS/m; moderately saline, 8 to16 dS/m; and strongly saline, more than 16 dS/m. Salinity classes and saline hazard estimates are:

Salinity class	Electrical conductivity (dS/m)	Hazard
Nonsaline	0-2	none
Very slight	2-4	low
Slight	4-8	low
Moderate	8-16	moderate
Strong	16+	high

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

SAR. Sodium adsorption ratio. See Sodicity.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na to Ca + Mg. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and 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 separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Soil textural classes. These are as follows:

USDA texture	Textural class	General
S, LS	coarse	sandy
SL, FSL	moderately coarse	loamy
VFSL, L, SIL, SI	medium	loamy
CL, SCL, SICL	moderately fine	loamy
SC, SIC, C	fine	clayey

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structural bench (or bench). A platform-type, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers with an essentially horizontal attitude.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for

program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).