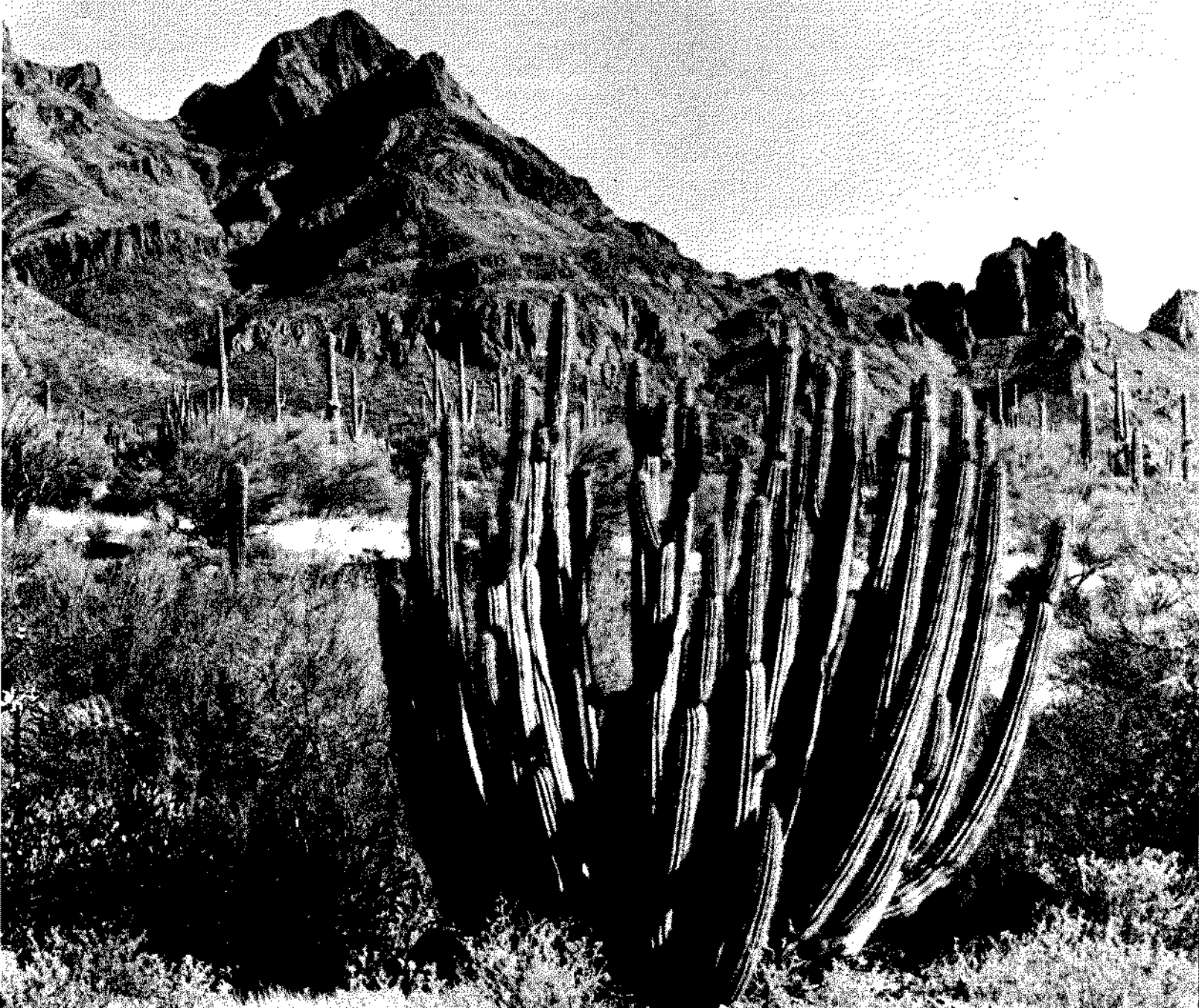


SOIL SURVEY

a special report

Organ Pipe Cactus National Monument
Pima County, Arizona



U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

DECEMBER 1972

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Cover picture - Organ Pipe Cactus.

ORGAN PIPE CACTUS NATIONAL MONUMENT PHOTO

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by
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PHOENIX, ARIZONA

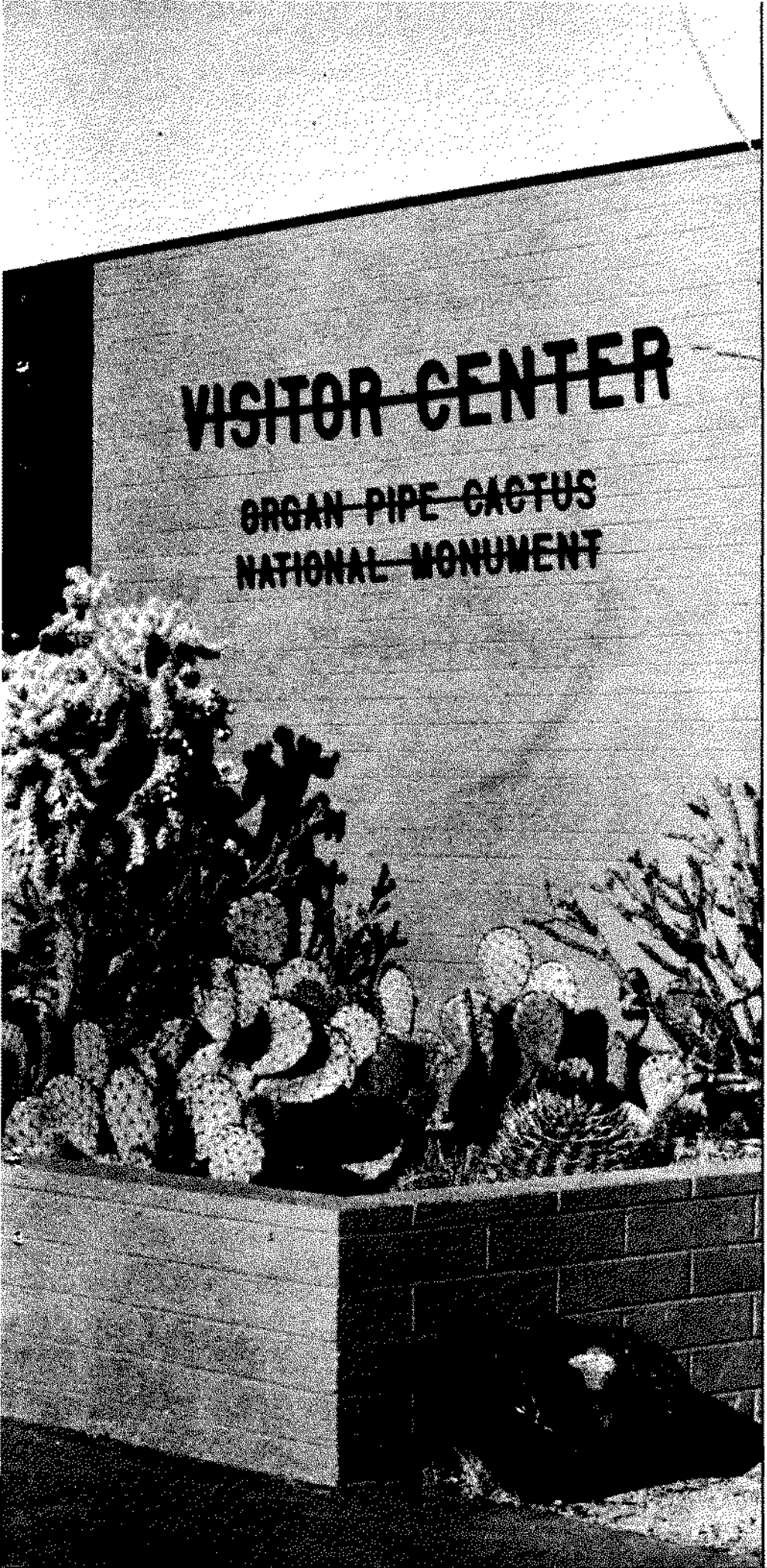
in cooperation with
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
and
ARIZONA AGRICULTURAL EXPERIMENT STATION

December 1972

Major fieldwork for this survey was done by Earl Chamberlin, Ken Dunstan, George Hartman, Kenneth Vagt and George Wendt of the Soil Conservation Service. This soil survey and interim report was made under a cooperative agreement between the Soil Conservation Service and the National Park Service for use in the general development of the Monument.

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Introduction

Organ Pipe Cactus National
Monument

Climate

Physiography and Water
Supply

How This Survey Was Made

Visitor Center.

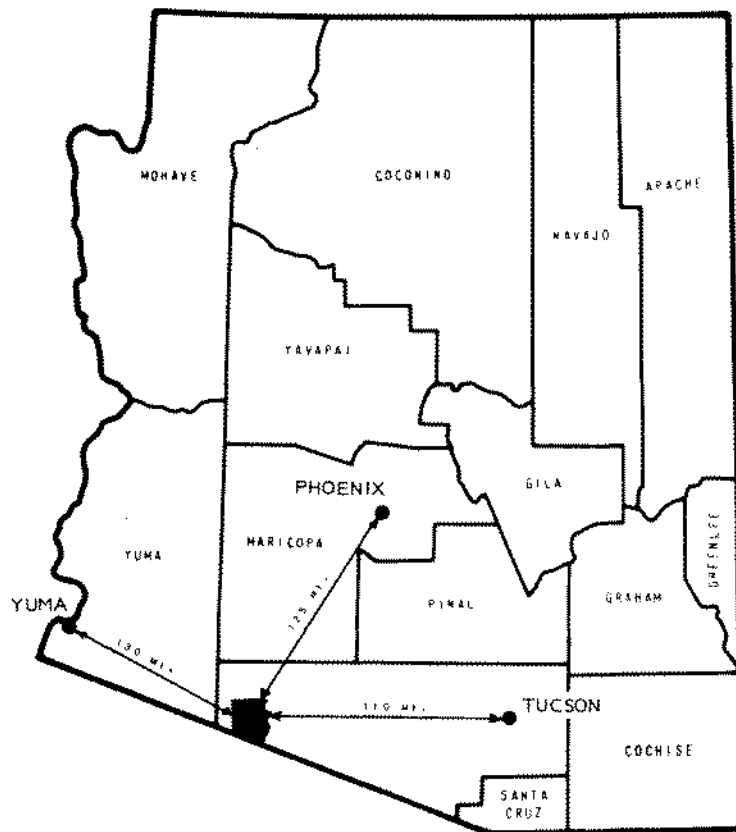
ORGAN PIPE CACTUS NATIONAL MONUMENT PHOTO

Organ Pipe Cactus National Monument

by Earl Chamberlin

Organ Pipe Cactus National Monument is in the south central part of Arizona (Figure 1). It was established by Presidential proclamation on April 13, 1937, and covers 330,779 acres or about 517 square miles. All of the land within the boundary of the Monument is federally owned except for about 800 acres of patented land and about 1280 acres of state-owned land. The National Park Service headquarters and Visitor Center is located about 5 miles north of Lukeville and adjacent to State Highway 85.

The Monument preserves a portion of the Sonoran Desert fauna and flora, and provides a place for it to be viewed and studied. The Park Service maintains a visitor's center and campground at the headquarters and supervises recreation on the Monument. Livestock grazing is usage continued from days before the Monument was established and is being phased out. Several old abandoned copper and gold mines are in the area, and in recent years there has been a renewal of interest and extensive exploration in the northern portion of the Monument.



LOCATION MAP

Figure 1.- Location of Organ Pipe Cactus National Monument in Ariz.

Climate 1/

Almost one-half of the normal yearly precipitation in this section of the State falls in the three-month period July to September. This precipitation is usually of the thunderstorm type and is associated with deep currents of moisture moving over southern Arizona from the Gulf of Mexico. A secondary precipitation maximum occurs during the winter, when storms from the Pacific Ocean sweep across Arizona via southern California. The mean number of days with 0.10 inch or more of precipitation per year is 18. The heaviest precipitation over a short period of time (an hour or less) usually occurs during summer thunderstorms. Two and one-half inches of precipitation falls in one hour about once in fifty years, in the long run. Hail may occur in any month, but is most frequent in the summer season. Snow flurries sometimes occur, usually during January or February, but they are rare and the flakes usually melt as soon as they reach the ground.

Temperatures during the coldest part of the year normally rise into the middle or high sixties in the afternoon and usually stay above freezing at night. Spring and fall temperatures are normally within the comfort zone, but summer temperatures usually reach values above 100 degrees in the afternoon hours; however, the mean estimated relative humidity during the hottest month (July) is only about 30 percent near the time of maximum temperature. There are normally 160 days per year with a maximum temperature of 90 degrees or higher. Also, there are an average of 20 days per year when the minimum temperature falls to 32 degrees or lower.

Evaporation is relatively high in this section of the State, with an average annual evaporation of 72 inches.

Sunshine is abundant, and although official sunshine records are not kept at Organ Pipe Cactus National Monument, an estimate of the mean yearly percentage of possible sunshine, based on other Arizona stations, yields a value of about 88 percent.

Physiography and Water Supply

The Monument is in the desert regions of the Basin and Range physiographic province. It is bound on the east by the crest of the Ajo Mountain Range and on the north, west and south by broad alluvium filled basins separated by isolated mountain blocks. Alluvial fans merge into broad accumulations of gravel, sand and silt which slope gently from the mountains to the center of the valleys. A series of mountains and hills that roughly form a cross divide the Monument. The Sonoita Valley and La Abra Plain that are south of the divide drain to the Sonoita River in Mexico. Several large drainageways from the northeastern part of the Monument join at Growler Canyon to form Growler Wash. This system along with San Cristobol Wash that drains the western part of the Monument flows northwest to the Gila River.

1/ Prepared by Paul C. Kangieser, National Weather Service, Phoenix, Az.

Ground water level varies greatly in the Monument. Depth to water near Lukeville is about 65 feet and at the Monument headquarters is over 300 feet. At places near the mountains and along the channel system of Growler Wash there are perched water tables within 10 to 40 feet of the surface. Ground water rises to the surface along a block fault line by Burrow, William, Quitobaquito, and Aquajito Springs. In the mountains there are some small springs, seeps and tinajas that provide water for wildlife.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Organ Pipe Cactus National Monument, where they are located, what plants grow on them and how they can be used. As the soil scientists traveled over the country they observed the steepness, length, and shape of slopes, size and gradient of drainages, kinds of native plants, kinds of rocks and many facts about the soils. They dug many holes to expose soil profiles.

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

Soils of one series can differ in texture of the surface soil and in slope and stoniness. On the basis of such differences a soil series is divided into phases. The name of a soil phase indicates a feature that affects management of vegetation. For example, Gilman very fine sandy loam, saline is one of two phases with the Gilman series.

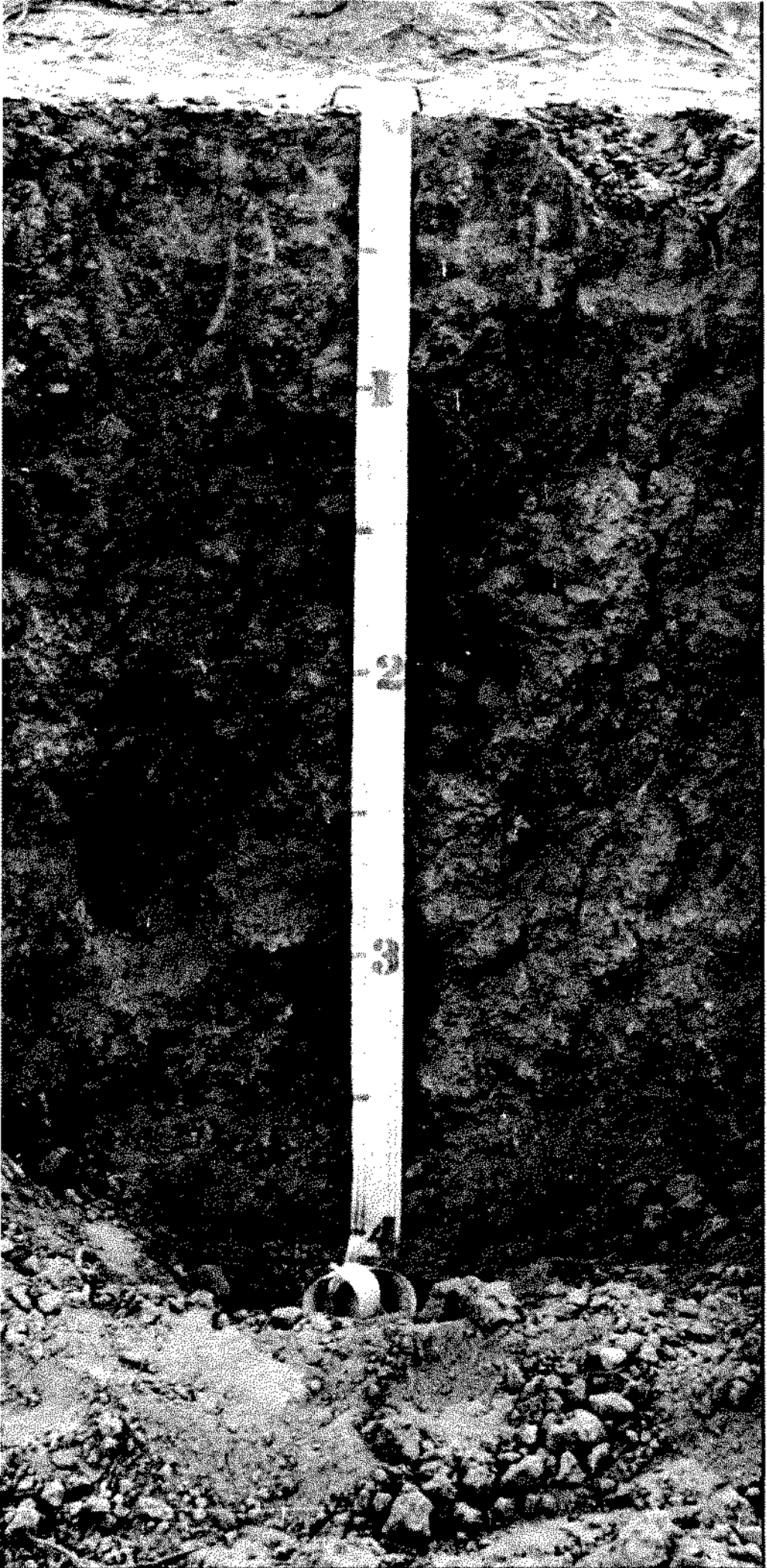
After a guide for classifying and naming the soils was worked out, the soil scientists drew boundaries of the individual soils on aerial photographs. These photographs show roads, drainages, buildings, and other details that help in drawing boundaries accurately. The soil map at the back of this survey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

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soil are so intricately mixed or occur in such small individual tracts that it is not practical

to show them separately on the map. They show such a mixture of soils as one mapping unit and call it a soil complex. Ordinarily a soil complex is named for the major kinds of soil in it, for example, Harqua-Gunsight complex.

In some places the soil material is so rocky, so shallow or so severely eroded that it cannot be classified to soil series. These areas are shown on the soil map and are described in the survey, but are called land types and given descriptive names. Rock land and Rock outcrop are examples of land types.



Description of Soils

SOIL SERIES

Ajo
Antho
Cherioni
Cipriano
Gachado
Gilman
Growler
Gunsight
Harqua
Laveen
Lomitas
Perryville
Rillito
Rockland
Rock outcrop
Stonyland-Rock outcrop Assn.
Torrifluents

APPROX. ACREAGE and EXTENT

Profile of Gilman Soil.

Series Descriptions

In this section the soils of Organ Pipe Cactus National Monument are described briefly. Soil series are described first and then followed by brief descriptions of mapping units in that series. The description of each soil series is representative of all the soils in that series. If a profile of a mapping unit differs from the typical profile the differences are stated in the mapping unit description. To get full information on any one mapping unit it is necessary to read both the description of the unit and the description of the soil series to which the unit belongs.

A symbol in parentheses precedes the name of each mapping unit. This symbol identifies the mapping unit on the detailed soil map.

The approximated acreage and proportionate extent of each mapping unit are shown in Table 1. Many terms used in describing soils are defined in the glossary and some are defined in the section "How This Survey Was Made". More detailed information about the terminology and methods of soil sampling can be obtained from the Soil Survey Manual (1).
1/

AJO SERIES

The Ajo series consists of moderately deep, nearly level to gently sloping very gravelly soils that have an indurated lime pan. They formed in local alluvium on the upper parts of alluvial fans at the base of the Ajo Range.

Typically, the surface layer is brown very gravelly loam, about 2 inches thick. The subsoil is reddish brown and yellowish red very gravelly clay loam, with segregated lime in the lower part and extends to an indurated lime pan at about 24 inches.

Ajo soils are well drained, and have low available water capacity. Runoff is slow to medium depending on slope and permeability is moderately slow above the pan. Effective rooting depth is limited by the pan and erosion hazard is slight.

1/ Number in parentheses refers to literature cited in the Appendix.

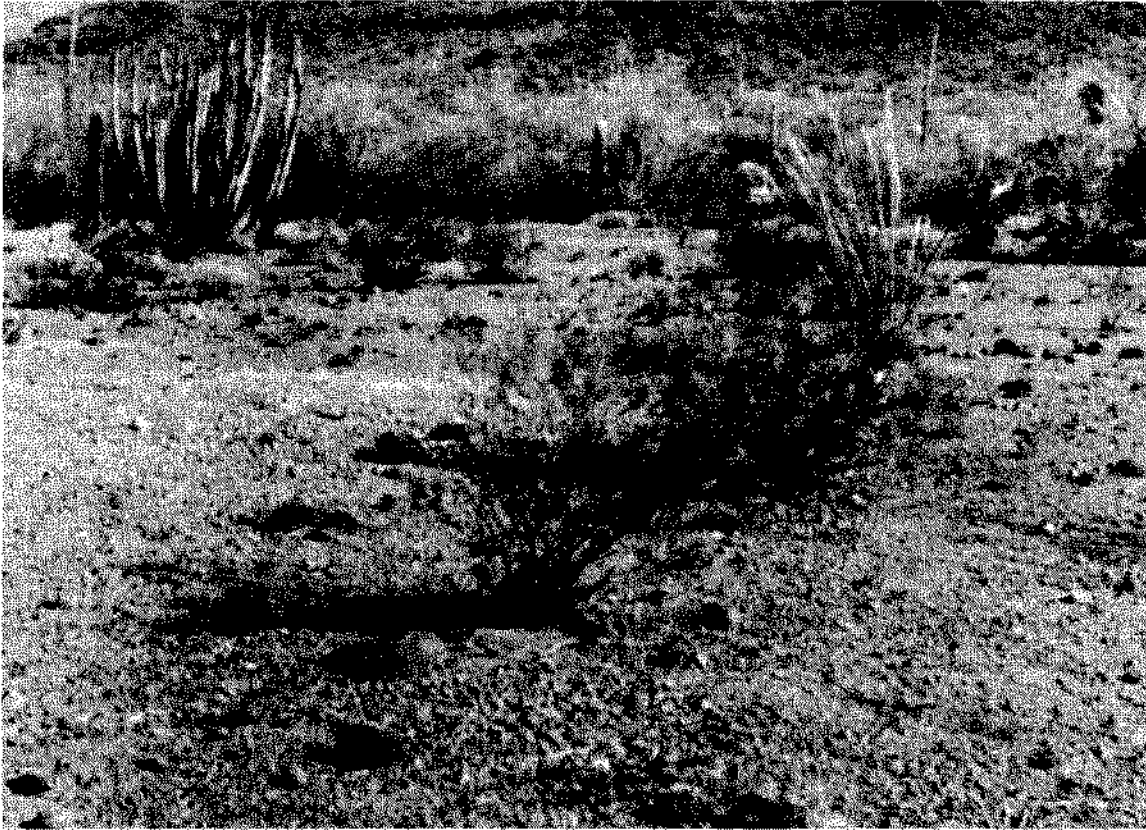


Figure 2.- Sparse creosote bush and a variety of cactus growing on Ajo very gravelly loam

SCS PHOTO 2-951-3

About 15 percent of the surface is covered with vegetation. The dominant plants are triangular bursage and creosotebush with scattered ocotillo, saguaro, chain fruit and buckhorn cholla cacti. Sixweeks grama, sixweeks fescue, Rothrock grama and fluff grass, occur along waterways where moisture concentrates and as scattered plants on the convex portions of the landscape. Most areas have a few paloverde trees, organ pipe and clumps of prickly pear cacti on the upper slopes. Other plants that occur at some places on the Ajo soils are jojoba, brittle-bush, annual buckwheat; and hedgehog, pencil cholla and Christmas cacti. In some areas these soils have excellent stands of saguaro and cholla cacti.

These soils are used for recreation, wildlife refuge, and grazing.

(Ahd) Ajo very cobbly sandy loam, 2 to 5 percent slopes

This unit occupies the upper portion of alluvial fans at the base of the Ajo Range. The areas are 50 to 500 acres in size. Inclusions are about 5 percent Cachado very cobbly loam and 5 percent Cipriano very gravelly loam.

Soils of this unit are in native desert shrub and cacti vegetation. They are used for recreation, wildlife refuge and grazing.

(AkB) Ajo very gravelly loam, 1 to 5 percent slopes

This soil occupies the upper portions of the bajada along the base of the Ajo Range. The areas are 100 to 1000 acres and more in size. Inclusions are about 5 percent Gachado very cobbly loam and 5 percent Cipriano very gravelly loam.

All of these soils are in native desert shrub and cacti vegetation. They are used for recreation, wildlife refuge and grazing. This area has numerous old prospect holes that mar the landscape.

ANTHO SERIES

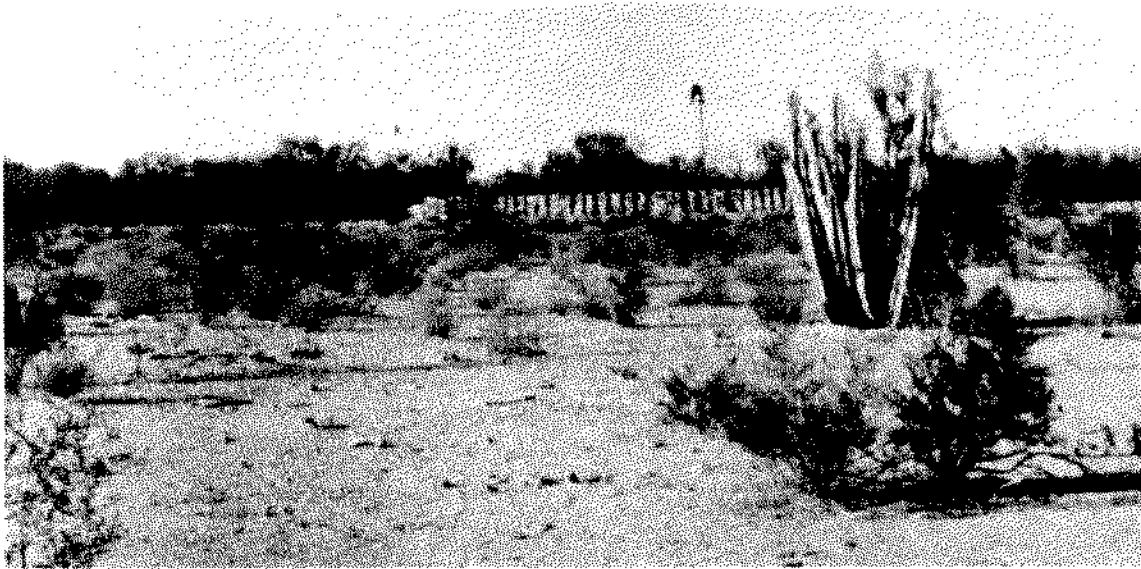


Figure 3.- *Senita cactus and creosote bush growing on Antho fine sandy loam*

SCS PHOTO 2-951-16

The Antho Series consists of deep, nearly level to gently sloping sandy loam soils. They formed in recent stratified alluvium from andesite, rhyolite, schist, granite, quartzite and tuffs on alluvial fans and flood plains.

Typically, the surface layer is light yellowish brown sandy loam, about 2 inches thick. The underlying material is very pale brown sandy loam, from 10 to 25 inches thick. The substratum is light brown gravelly sandy loam to 40 inches and more. The soil is moderately alkaline and contains lime in the substratum.

Antho soils are well drained and have fair available water capacity. Runoff is slow and permeability is moderately rapid. The effective rooting depth is 40 to 60 inches. Erosion hazard is slight.

About 20 percent of the surface is covered with vegetation. The dominant plants are creosotebush, triangular and white bursage. There are scattered paloverde and ironwood trees, ocotillo, and saguaro, barrel, chain fruit, and buckhorn cholla cacti. Some areas of Antho

have in addition to a thin understory of annual sixweeks grama, sixweeks fescue and fluff grass an appreciable amount of perennial big galleta and bush muhly.

(An) Antho fine sandy loam

This soil occupies alluvial fans and flood plains. Slopes range from 0 to 3 percent. Local relief is 5 to 10 feet and areas are 50 to 500 acres in size. In places there are small elongated areas .1 to 1 acre in size that have a gravelly sandy loam surface and 10 to 35 percent of the areas have underlying layers containing more than 35 percent gravel. On the lower end of some bodies there are areas that are moderately saline in the underlying layers. Inclusions of Torrifluvents along the narrow drainageways make up about 5 percent of the area.

All of these soils are in native desert shrub and cacti vegetation. They are used for recreation, wildlife refuge and grazing.

ANTHO VERY GRAVELLY VARIANT

This variant consists of deep nearly level to gently sloping very gravelly sandy loam soils. They formed in recent stratified alluvium from schist and granitic rocks on alluvial fans and flood plains.

Typically, the surface layer is brown gravelly fine sandy loam, about 7 inches thick. The underlying layer is brown very gravelly sandy loam about 10 inches thick. The substratum is brown very gravelly sandy loam and has a slight lime accumulation to 60 inches and more.

This soil is well drained and has low available water capacity. Runoff is slow, permeability is moderately rapid and the effective rooting depth is 40 to 60 inches. Erosion hazard is slight.

About 20 percent of the surface is covered with vegetation. The main plants are creosotebush and triangular bursage with a scattering of organ pipe, senita, saguaro, barrel, and chain fruit cholla cacti, ironwood and paloverde trees, ocotillo and annual sixweeks grama, sixweeks fescue and fluff grass.

(Ao) Antho soils, very gravelly variant

This soil occupies alluvial fans and flood plains. Slopes range from 1 to 3 percent and mapped areas are 50 to 100 acres in size. Inclusions are about 15 percent Torrifluvents that lie in the drainageways. Some areas of this unit are subject to occasional flooding.

All of this unit is in native desert shrub and cacti vegetation and is used for recreation, wildlife refuge and grazing.

CHERIONI SERIES

The Cherioni series consists of shallow and very shallow, nearly level to moderately sloping gravelly and cobbly soils. They formed in a thin mantle of alluvium over basic igneous or tuffaceous conglomerate rock. These soils occupy low beveled hills.

Typically, the soil surface has a 60 percent cover of dark colored cobble. The surface layer is light brown, gravelly, very fine sandy loam about 3 inches thick. The upper underlying layer is light brown gravelly very fine sandy loam, with many durinodes and is about 4 inches thick. The lower underlying layer is a light brown silica-lime cemented pan extending to bedrock at about 11 inches.

Cherioni soils are well drained and have moderate permeability above the pan. Runoff is slow and erosion hazard is slight. Available water capacity is very low and the effective rooting depth is limited by the pan at about 11 inches.

About 10 to 15 percent of the surface is covered with vegetation. Creosotebush and triangular bursage are the dominant species and commonly there is a scattering of white bursage, turksbeard, range ratany, ocotillo, and hedgehog, saguaro, chain fruit cholla and barrel cacti, as well as annual sixweeks fescue, sixweeks grama, fluff grass and an occasional paloverde tree.

(ChB) Cherioni gravelly very fine sandy loam, 0 to 8 percent slopes

This soil occupies low hills in different parts of the Monument. Areas are 40 to 400 acres in size. Inclusions of Rillito and Rock outcrop make up less than 5 percent of the area.

All of these soils are in desert shrub and cacti vegetation. They are used for recreation, campgrounds, wildlife refuge and grazing.

CIPRIANO SERIES

The Cipriano series consists of shallow, nearly level and gently sloping very gravelly loam soils underlain by a duripan. They formed in old alluvium from andesite, rhyolite, tuff and schist and occupy the intermediate portions on alluvial fans.

Typically the soil surface has 65 percent cover of gravel. The surface layer is light brown gravelly loam about 2 inches thick. The underlying material is light brown very gravelly loam with many white lime coated durinodes in the lower part and is 10 to 18 inches thick. The substratum is a pink and white duripan with a thin laminar cap and is 2 inches to several feet thick.

Cipriano soils are well drained, have low available water capacity, and medium runoff. Permeability is moderate above the pan, and effective rooting depth is about 11 inches. Erosion hazard is slight.

About 15 to 20 percent of the surface has a cover of vegetation. The main plants are creosotebush, triangular bursage and brittlebush. Most areas have scattered range ratany, paloverde trees, ocotillo, and saguaro, hedgehog, buckhorn and chain fruit cholla cacti, sixweeks fescue, sixweeks grama, fluff grass and annual buckwheat.

This soil is used for recreation, wildlife refuge and grazing.

(Cp) Cipriano gravelly loam

This soil occupies the middle portion of the bajada. Slopes range from 0 to 5 percent and local relief is 2 to 20 feet. Areas are crossed by a few deep drainageways and are 20 to 250 acres in size. Inclusions are soils of the Rillito and Gunsight series, soil similar to the Ajo series but shallow rather than moderately deep. Torrifluvents also are included in this mapping unit.

All of these soils are in native desert shrub and cacti vegetation and are used for recreation, wildlife refuge, and grazing.

GACHADO SERIES

Gachado series consists of shallow, gently to moderately sloping cobbly soils. They formed in places on igneous rocks and occupy toe slopes of hills and mountains.

Typically, the surface layer is brown very cobbly loam, about 2 inches thick. The subsoil is yellowish red gravelly heavy clay loam about 10 inches thick. Underlying the subsoil is basic igneous rock that is lime coated.

The soil is well drained and has very low available water capacity. Runoff is medium and permeability is moderately slow. Effective rooting depth is about 13 inches and erosion hazard is slight.

About 10 to 15 percent of the surface is covered with vegetation. It consists of creosotebush, triangular bursage, brittlebush and scattered Mexican jumping bean, wolfberry, ocotillo, paloverde and ironwood trees, chain fruit and buckhorn cholla, saguaro, organ pipe, and hedgehog cacti, annual sixweeks fescue, sixweeks grama, fluff grass and annual buckwheat.

This soil is used for recreation, wildlife refuge and grazing.

(GaB) Gachado very cobbly loam, 2 to 8 percent slopes

This soil lies on pediment slopes at the base of low hills and mountains. Areas of this soil are narrow, irregularly shaped and are 20 to 200 acres in size. Included in mapping are about 15 percent of Rock outcrop and 10 percent of Rillito or Gunsight soils.

All of this soil is in native desert shrub and cacti vegetation. They are used for recreation, wildlife refuge and grazing.

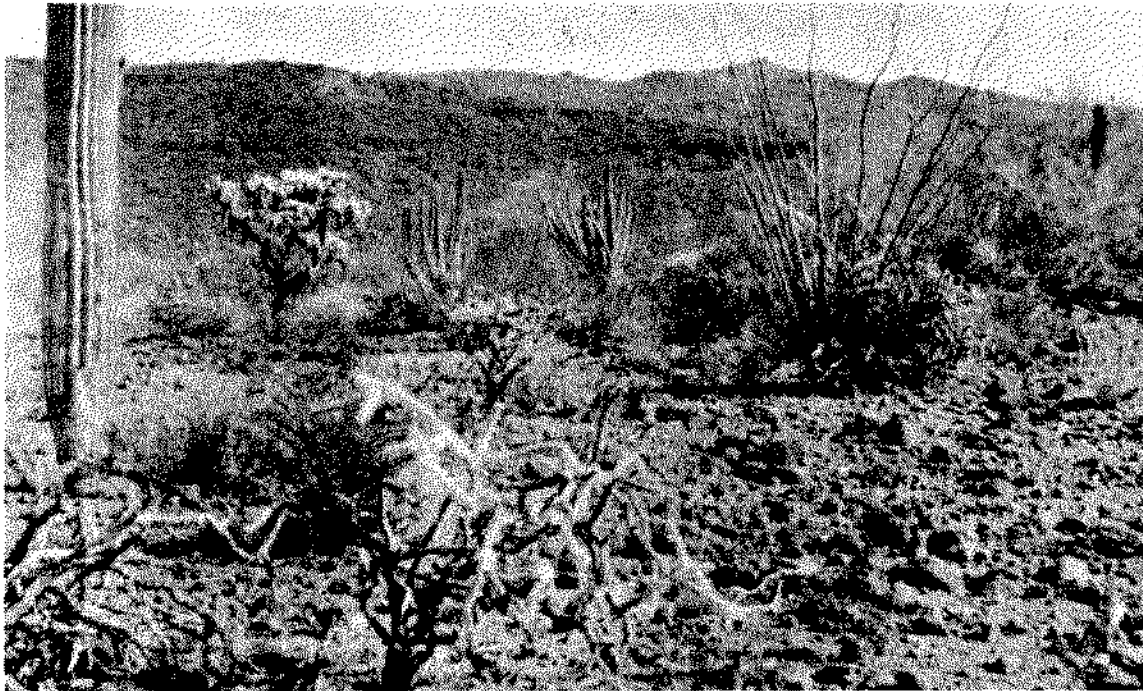


Figure 4.- Gachado very cobbly loam at the base of Tertiary age mountains.

SCS PHOTO 2-951-13

GILMAN SERIES

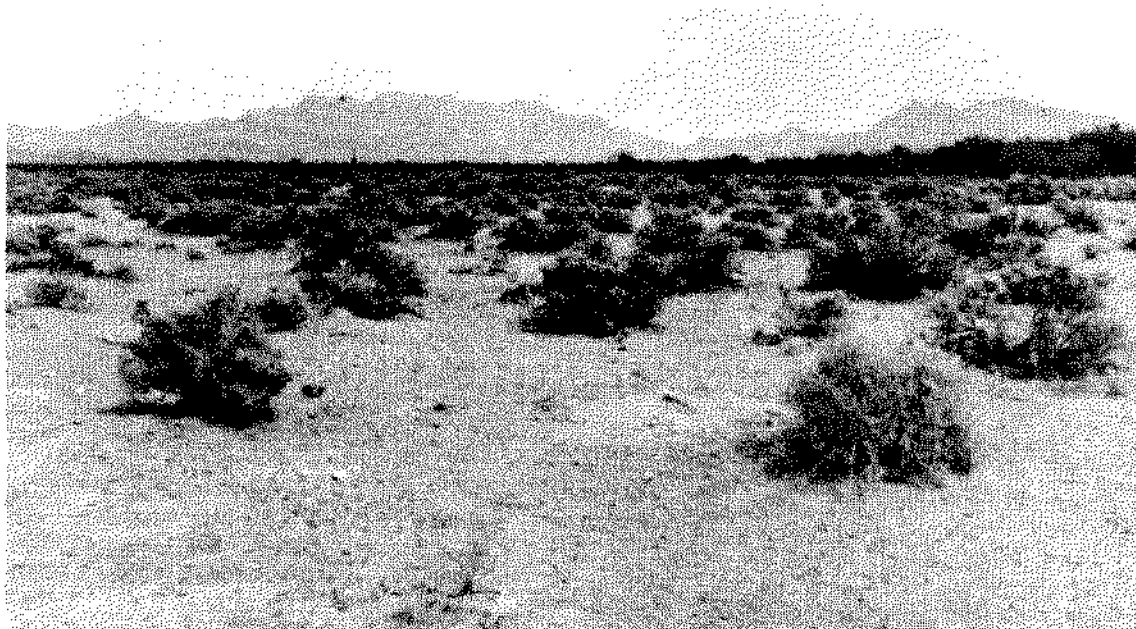


Figure 5.- Saltbrush is common on Gilman very fine sandy loam, saline

SCS PHOTO 2-947-12

The Gilman series are deep, nearly level to gently sloping, stratified, very fine sandy loam and loam soils. They have formed in mixed alluvium from a variety of rock sources, and occupy flood plains of drainageways and the lower portions of alluvial fans.

Typically, the surface layer is light yellowish brown very fine sandy loam, about 3 inches thick. The underlying material is light brown, stratified, very fine sandy loam and loam to 60 inches and more.

Gilman soils are well drained and have high available water capacity. Runoff is medium and permeability is moderate. Effective rooting depth is 60 inches and more. Erosion hazard is slight to moderate.

Native vegetation is dominantly creosotebush with occasional chain fruit or buckhorn cholla cacti, crucifixion bush, bush muhly and a thin understory of sixweeks grama and sixweeks fescue. At places there are scattered plants of bitter condalia and globe mallow. Along the drainageways are paloverde, ironwood, and mesquite trees, wolfberry and cat-claw acacia. The vegetation on the saline phase is dominated by mesquite trees or big galleta grass.

These soils are used for recreation, wildlife refuge, and grazing.

(Gb) Gilman very fine sandy loam

This soil lies on flood plains and alluvial fans that have numerous shallow and few deep drainageways. Slopes range from 0 to 3 percent. Local relief is 5 to 15 feet and areas are 50 to 1000 acres in size. Variations are soils that have more calcium carbonate in the substratum than is typical for the series and occupy somewhat older surfaces 1 to 2 feet above the present flood plain. Additional variations are Gilman-like that differ by being underlain by fine textured materials at depths generally below 30 inches and are found in the area west of the Bates Mountains.

All of these soils are in native desert vegetation. They are used for recreation, wildlife refuge and grazing.

(Gm) Gilman very fine sandy loma, saline

This soil lies on flood plains and the lower portions of alluvial fans. Slopes range from 0 to 3 percent. Local relief is 5 to 15 feet and areas are 50 to 200 acres in size. Inclusions are Torrifluvents, Antho fine sandy loam, and soils with profiles resembling Gilman very fine sandy loam that have underlying layers of gravelly sandy loam and slight to moderate salinity. There are numerous gullies in the vicinity of Gachado and Blankenship Wells.

All of these soils are in native desert shrub vegetation and are used for recreation, wildlife refuge, and livestock.

GROWLER SERIES

The Growler series are deep, nearly level, gravelly sandy loam soils. They formed in very old alluvium from sandstone, rhyolite, andesite and schist and occupy convex portions of the valley floor.

Typically, the soil surface has a 70 percent cover of gravel with a varnished surface. The surface layer is a light brown gravelly loam about 2 inches thick. The subsoil is yellowish red loam about 12 inches thick. The substratum is light brown to pink gravelly loam to 60 inches and more. The soil is strongly saline below the surface, has common segregations of salt crystals, a weak zone of lime accumulation at depths below 7 inches and is moderately to strongly alkaline.

Growler soils are well drained and have fair available water capacity. Effective rooting depth is 60 inches and more. Runoff is slow to medium, permeability is moderately slow and erosion hazard is slight.

This soil is nearly barren. Vegetation consists of a few turks-beard, occasional stunted creosotebush and algae growing on the under side of desert pavement pebbles.

These soils are used for recreation, and produce little or no forage for wildlife or grazing.

(Gr) Growler-Antho Complex

This complex has about 30 to 35 percent Growler soils and about 30 to 55 percent Antho soils in an intricate pattern. The Growler soils lie on slightly elevated convex areas that are generally 1/2 to 3 acres in size. Slopes range from 0 to 2 percent. It is easily recognized by its varnished desert pavement and sparse vegetation. The Antho soils lie between the Growler areas and along the shallow drainageways. Included are about 10 percent Gilman and 5 percent Laveen loam.

All of these soils are in native vegetation and are used for recreation, wildlife refuge and grazing.

GUNSIGHT SERIES

The Gunsight series are deep, nearly level to strongly sloping very gravelly limy soils. They formed in old gravelly alluvium from mixed rock sources. Gunsight soils occupy lower portions of alluvial fans fronting the Ajo Range, the La Abra Plain and higher portions of alluvial fans at the base of the Growler Mountains.

Typically, the surface layer is light brown very gravelly loam about 2 inches thick. The subsoil is pink, very gravelly loam about 8 inches thick. The substratum is white and pinkish gray very gravelly loam and weakly cemented with lime to 60 inches and more.

Gunsight soils are well drained and have low available water capacity. Runoff is medium and permeability is moderate. The effective rooting depth is 60 inches and more. Erosion hazard is slight to moderate.

Vegetation is dominantly creosotebush and triangular bursage with scattered ocotillo, ironwood and paloverde trees, saguaro, chain fruit and buckhorn cholla and barrel cacti, range ratany, white bursage, three-awn, sixweeks grama, and fluff grass. Other plants that occur in some areas are teddy bear cholla, Christmas, hedgehog, and organ pipe cacti, jojoba, and bush muhly.

These soils are used for recreation, wildlife refuge and grazing.

(GuA) Gunsight very gravelly loam, 0 to 2 percent slopes

This soil lies on lower portions of the bajadas. There are numerous shallow and few deeply intrenched drainageways. Local relief is 5 to 15 feet, and mapped areas are 50 to 300 acres in size. Inclusions are Harqua soils 5 to 20 percent, Antho soils 5 percent, Rillito soils 5 to 10 percent and Torrifluvents 5 to 10 percent.

All of these soils are in native desert shrub and cacti. They are used for recreation, wildlife refuge, grazing, and building site.

(GuC) Gunsight very gravelly loam, 2 to 15 percent slopes

This soil lies on old bajadas that have been cut by numerous deep stream channels. Local relief is 10 to 40 feet. Ridges have moderate to strongly sloping side slopes and at places have narrow gently sloping ridge tops that are generally 50 to 200 feet wide. Inclusions are Harqua 5 to 15 percent, Cipriano 5 to 10 percent, and Rock outcrop, 0 to 2 percent.

All of this soil is in native vegetation and is used for recreation, wildlife refuge, grazing, and the Monument's sanitary landfill.

HARQUA SERIES

The Harqua series are deep, nearly level to moderately sloping, gravelly clay loam soils. They formed in alluvium from andesite, rhyolite, tuff and schist and occupy plains and the margins of moderately sloping degrading surfaces.

Typically, the soil surface has a cover of 70 percent varnished gravel. The surface layer is light brown very gravelly loam about one inch thick. The subsoil is yellowish red, gravelly clay loam, strongly saline and about 15 inches thick. The substratum is pink gravelly sandy loam and may be underlain by less gravelly finer textured sediments that are strongly saline and alkaline.

Harqua soils are well drained, and have low available water capacity. Effective rooting depth is 60 inches and more. Runoff is medium, permeability is very slow and erosion hazard is slight.

This soil is nearly barren as vegetation consists of a few turksbeard, an occasional stunted creosotebush or saltbush and at places there are some broom snakeweed, wrights cholla, or senita cacti.

(HaA) Harqua very gravelly loam, 0 to 3 percent slopes

This mapping unit occupies the lower ends of very old alluvial fans along the International boundary west of the community of Lukeville. Mapped bodies are small, generally 20 to 200 acres in size.

Inclusions are Gunsight very gravelly loam and Torrifluvents.

All of these soils are in native vegetation with the vegetation occurring mostly on the Gunsight soils and Torrifluvents. They are used for recreation, wildlife refuge and grazing.

(HbB) Harqua very cobbly loam, 0 to 8 percent slopes

This soil lies on the ends of dissected alluvial fans on which the mantle of gravelly alluvium is generally only 24 to 36 inches thick over very saline and alkaline finer textured sediments. Areas are 20 to 200 acres in size. It has less gravel in the lower part of the subsoil and substratum and is very strongly alkaline.

Inclusions of Harqua very gravelly loam occupy spots 10 to 40 feet in diameter and make up about 5 percent of this unit. Gilman very fine sandy loam, saline lies below dissected areas along the drainageways and makes up about 5 percent of the unit.

All of these soils are in native vegetation that include broom snakeweed in addition to the plants listed under the series. These soils are used for recreation, wildlife refuge and grazing.

(Hc) Harqua-Gunsight Complex

This complex is about 30 to 50 percent each of Harqua and Gunsight very gravelly loams that lie in an intricate pattern. Harqua is easily recognized by the redder color, varnished desert pavement on the surface and very sparse vegetation. They occupy slightly elevated convex areas as spots 50 to several hundred feet across. The Gunsight soils have lighter colored surfaces and surround the Harqua bodies and in places have been mixed by rodents.

Inclusions are Rillito gravelly loam, Cipriano very gravelly loam and Torrifluvents.

This soil is nearly all in native vegetation and used for recreation, wildlife refuge and grazing.

LAVEEN SERIES

The Laveen series are deep, nearly level to gently sloping loam soils. They developed in mixed alluvium on old terraces that have numerous shallow drainageways two to three feet deep.

Typically, the surface layer is light brown loam about 2 inches thick. The underlying layers are pinkish gray loam and gravelly loam to 60 inches and more. These soils are moderately alkaline, have a prominent zone of lime accumulation and slight to moderate salt accumulation.

Laveen soils are well drained, and available water capacity is high. Runoff is slow and permeability is moderate. Effective rooting depth is more than 60 inches and the erosion hazard is slight to moderate.

The area is about 15 percent covered with vegetation that is dominantly creosotebush with scattered triangular bursage, white bursage,

barrel cacti, sixweeks grama, sixweeks fescue and fluff grass. Along the drainageways there are mesquite and catclaw acacia.

This soil is used for recreation, wildlife refuge and grazing.

(La) Laveen loam

This soil is on old terraces and fans. Slopes range from 0 to 3 percent and areas are generally 40 to 300 acres in size.

Inclusions are 15 percent Gilman and Antho soils that lie as narrow bodies along the drainageways. In the western part of the Monument some areas are underlain by finer textured soils at about 30 inches and make up about 10 percent of the unit.

All of this soil is in native vegetation and used for recreation, wildlife refuge and grazing.

LOMITAS SERIES

The Lomitas series are shallow, moderately sloping to steep very stony loam soils. They formed in residuum from schist, granite, andesite, welded tuff, quartzite and conglomerate on low hills and mountains.

Typically, the surface layer is brown very stony loam about 2 inches thick. The subsoil is light brown very gravelly loam about 8 inches thick. The substratum is light brown very gravelly loam that extends to bedrock at about 13 inches. The soil is moderately alkaline and contains a zone of lime accumulation.

Lomitas soils are well drained, and available water capacity is low. Runoff is medium to rapid and permeability is moderate above bedrock. Effective rooting depth is 13 to 20 inches and erosion hazard is slight.

This soil has about 20 percent cover of vegetation that varies with slope and exposure. It consists mostly of brittlebush, triangular bur-sage, Mexican jumping bean, ocotillo, creosotebush; teddy bear, buckhorn and chain fruit cholla cacti; barrel, organ pipe, saguaro, hedgehog, fishhook and sweet potato cacti; paloverde, ironwood, mesquite, and elephant trees; mormon tea, wolfberry, limber bush, jojoba, bush muhly, slim tridens, big galleta, Rothrock and sixweeks grama, sixweeks fescue and annual forbs.

(LoE) Lomitas very stony loam, 8 to 40 percent slopes

This mapping unit lies on low hills and mountains. Areas are generally about 1000 acres in size but some are as small as 50 acres. Inclusions are Rock outcrop about 15 percent, Gunsight gravelly loam 5 to 10 percent, similar shallow soils with a B₂ horizon too thin to qualify for Lomitas 25 percent, and Cipriano very cobbly loam 5 percent.

In the Sonoita Mountains and along the south side of the Puento Blanco Mountains this unit has 15 percent Gachado very cobbly loam.

This unit is used for recreation, wildlife refuge and grazing.

PERRYVILLE SERIES

The Perryville series are deep, nearly level to moderately sloping very limy soils. They formed in mixed alluvium from andesite, rhyolite, welded tuff and basic igneous rocks on old alluvial fans.

Typically, the surface layer is pink cobbly fine sandy loam about 2 inches thick. The underlying layers are pink and light brown gravelly loam and loam that extend to 60 inches and more. These soils are moderately saline.

This soil is well drained and moderately permeable. The available water capacity is fair and the effective rooting depth is 60 inches or more. Runoff is slow to medium and erosion is slight.

About 15 percent of the surface is covered with vegetation. Creosotebush is the main plant with scattered white bursage, a few palo verde trees, ocotillo, saguaro cacti, bush muhly, big galleta and annual forbs and grass.

This soil is used for recreation, wildlife refuge, and grazing.

(PeB) Perryville very cobbly fine sandy loam, 0 to 8 percent slopes

This mapping unit occupies old alluvial fans. Many shallow and moderately deep drainageways dissect the area. Local relief is 5 to 20 feet. Soil bodies are 20 to about 250 acres in size. Inclusions are Rillito gravelly sandy loam, Torrifluvents and Harqua very gravelly loam, 0 to 3 percent slopes.

This unit is used for recreation, wildlife refuge, and grazing.

RILLITO SERIES

The Rillito series are deep, nearly level to gently sloping gravelly limy soils. They formed in mixed gravelly alluvium from andesite, rhyolite, basalt and welded tuff on alluvial fans with numerous shallow drainageways.

Typically, the surface layer is light brown gravelly sandy loam about 2-1/2 inches thick. The subsoil is light brown gravelly sandy loam about 12 inches thick. The underlying material is moderately alkaline, has much segregated and nodular lime and is moderately saline below depth of about 20 inches.

These soils are well drained and have moderate permeability. The available water capacity is fair. The effective rooting depth is 60 inches and more. Surface runoff is slow and erosion hazard is slight.

Vegetation covers about 15 percent of the soil surface. Creosote-bush is the dominant species with scattered triangular and white bursage, chain fruit and saguaro cacti and ocotillo. Paloverde and ironwood trees occur along the drainageways.

These soils are used for recreation, wildlife refuge, and grazing.

(Ra) Rillito gravelly sandy loam

This soil is on old alluvial fans with slopes ranging from 0 to 3 percent. Areas are generally large and range to 2000 acres in size.

Included in mapping are about 10 percent Laveen gravelly loam on the lower ends of fans and about 10 percent Gunsight very gravelly loam which lies as elongated bodies on the somewhat steeper parts of the fan. Harqua gravelly loam occupies about 5 percent of this unit as small areas generally 10 to 50 feet across that are easily recognized by the redder color, sparse vegetation, and varnished gravel on the surface.

All of these soils are in native desert shrub vegetation and are used for recreation, wildlife refuge and grazing.



Figure 6.- Creosote bush is the dominant vegetation on Rillito series. SCS PHOTO 2-258-15

(Rk) Rock land

This steep and very steep unit lies on mountain slopes at elevations of 1500 to 3500 feet. Slopes range from 30 to 75 percent. It includes small nearly level areas and vertical escarpments. Areas are generally large, 400 to over 2000 acres. Rock outcrop is 50 to 90 percent of this unit and includes andesite, rhyolite, welded tuff, tuff, basalt, granite, gneiss and schist. Soils between the rock outcrops are stony, cobbly, and very gravelly; shallow and very shallow; and have a wide range of other soil characteristics. This unit is well drained, runoff is rapid and erosion hazard is slight.

Seasonal and some perennial water is available for wildlife in tinajas, springs and seeps.

Vegetation varies with elevation and exposure. The principal plants are brittlebush, paloverde trees, lycium, Mexican jumping bean, creosotebush, bush muhly, Rothrock grama, slim tridens and annual forbs and grasses. South facing exposures have saguaro, organ pipe, and hedgehog cacti; and agave. North facing slopes have scaley mosses, ferns, Ajo oak, hackberry, elephant tree and juniper. In favorable moisture sites there are jojoba, babybonnet, whitethorn and emory bush mint.

This unit is used for recreation, wildlife refuge and grazing.

(Ro) Rock outcrop

This very steep unit lies on mountain slopes and peaks at elevations of 2500 to 4800 feet. Slopes range from 50 to 75 percent. Areas are generally 50 to 500 acres in size. More than 90 percent of this unit are outcrops of welded tuff, tuff, andesite, granite, schist or basalt. Soils between the outcrops are stony, cobbly and very gravelly, generally very shallow soils that tongue into rock crevices and have a wide range of other soil characteristics.

This unit is excessively drained by rapid runoff. Erosion hazard is slight.

Vegetation is very sparse. It occurs only in rock crevices and areas of shallow soils. It varies with slope and exposure. Principal plants are brittlebush, paloverde, lycium, Mexican jumping bean, bush muhly, Rothrock grama, slim tridens and annual forbs and grass. South facing slopes have saguaro, organ pipe, and hedgehog cacti, ocotillo and agave. North facing slopes have scaley mosses, ferns, Ajo oak, hackberry, elephant tree and juniper. In favorable moisture sites additional plants are jojoba, babybonnet, whitethorn and emory bush mint.

This unit is used for recreation and wildlife refuge.

(St) Stony land-Rock outcrop association

This very stony unit lies on mountains and hills that have steep and very steep side slopes. Slopes range from 30 to 75 percent and relief is 300 to 1500 feet. The areas are 60 to 75 percent Stony land that have 50 to 90 percent of the surface covered with stones and boulders that dominate the unit and submerge other soil characteristics. The rock outcrop and very shallow soils over bedrock lie on peaks, strike slopes and some lower slopes and makes up to 25 to 40 percent of the unit. This unit is well drained, runoff is rapid and erosion hazard is slight.

Vegetation varies with slope and exposure. It includes paloverde trees, brittlebush, creosotebush, limberbush, ocotillo, saguaro cacti, slim tridens, sixweeks fescue and annual forbs. Present use is recreation and wildlife refuge.

(To) Torrifluvents

This nearly level to gently sloping unit consists of recently deposited stratified alluvium along eroded stream channels. Slopes range from 0 to 5 percent. Texture varies from gravel to loamy sand with stones and cobble that are mainly in the upper reaches of the drainageways. Variations in texture are dependent on fluctuations of stream flow and channel migration.

This unit overflows more than once each year of duration as long as 4 hours with depths as great as 4 feet. They are well to excessively drained. Available water capacity is low and effective rooting depth is 60 inches and more.

Vegetation is mainly trees along the banks which includes mesquite, paloverde, ironwood, acacia, wolfberry, and smoke tree.

Present use is water channels for surface runoff, recreation, wildlife refuge and grazing.

Table 1. Approximate acreage and proportionate extent of the soils

Soil	Acres	Extent
		Percent
Ajo very cobbly sandy loam, 2 to 5 percent slopes	3,252	1.0
Ajo very gravelly loam, 1 to 5 percent slopes	9,380	2.8
Antho fine sandy loam	15,410	4.7
Antho soils, very gravelly variants	1,360	0.4
Cherioni gravelly very fine sandy loam, 0 to 8 percent slopes	12,830	3.9
Cipriano gravelly loam	10,702	3.2
Gachado very cobbly loam, 2 to 8 percent slopes	1,605	.5
Gilman very fine sandy loam	26,380	8.0
Gilman very fine sandy loam, saline	1,960	.6
Growler-Antho complex	14,420	4.4
Gunsight very gravelly loam, 0 to 2 percent slopes	10,452	3.2
Gunsight very gravelly loam, 2 to 15 percent slopes	58,370	17.6
Harqua very gravelly loam, 0 to 3 percent slopes	750	.2
Harqua very cobbly loam, 0 to 8 percent slopes	740	.2
Harqua-Gunsight complex	34,210	10.3
Laveen loam	1,720	.5
Lomitas very stony loam, 8 to 40 percent slopes	33,148	10.0
Perryville very cobbly fine sandy loam, 0 to 8 percent slopes	1,901	.6
Rillito gravelly sandy loam	22,181	6.7
Rock land	30,256	9.1
Rock outcrop	5,530	1.7
Stony land-Rock outcrop association	21,810	6.6
Torrifluvents	12,412	3.8
	330,779	100.0 %



Soil Interpretations

Soil Interpretations and Their
Uses

Estimated Properties of the
Soils

Interpretations of Engineer-
ing Properties

Soil Interpretations for Rec-
reational Development

Campsite.

ORGAN PIPE CACTUS NATIONAL MONUMENT PHOTO

Soil Interpretations and Their Uses

Soil interpretations presented on the following pages include those for engineering and recreation uses. These interpretations based on the assessment of soil characteristics and quantities are predictions as to their behavior for a specific purpose. They enable a user to select soil areas most suitable for a particular use and to predict the hazards and degree of limitation likely to be encountered. They are also useful in determining the kind and amount of on-site investigations needed, thereby permitting adequate soil investigations at minimum cost.

The user is cautioned that the interpretations are based on the representative soil in each mapping unit. At any given point the actual conditions may differ from the information presented because of the inclusion of other soils. These were impractical to map separately at the scale of mapping used. The information presented is not intended to eliminate on-site investigations. It will, however, serve as a guide for screening sites for planning more detailed investigations at minimum costs. On-site investigations are suggested especially where the proposed soil use involves heavy loads, deep excavations, or high costs.

Estimated Properties of the Soils

Table 2, Estimated Properties of Soils, evaluates those soil properties considered most significant to engineering uses of soils. This information is the basis for making many of the interpretations in this report.

Estimates in Table 2 are made for the typical profile in each soil series, with each profile divided into layers significant to engineering. These estimates are based on engineering test data, field observations, past experiences in engineering construction and detailed examination of the soils.

These estimates should be useful in planning detailed investigations at proposed construction sites. They can be useful in assisting the engineer to concentrate on the more suitable soils and thus reduce the number of soil samples needed for laboratory testing.

A brief explanation of the column headings in Table 2 is given in the following paragraphs. Most of these items are also defined in the Glossary in the back of this report.

Depth to Bedrock

The depth in feet from the surface to bedrock is indicated in this column.

Depth from Surface

This column indicates the depth at which the various soil layers occur. The layers indicated are fairly typical of the layers in all the soils of any one series. Soil properties for all the remaining columns are listed for each of these layers except, in some cases, for the surface layer.

Percentage Passing Sieve (Sieve Analysis)

In these columns are given the estimated percentages of the soil in each significant soil layer that will pass through (is smaller than) each particular sieve. These figures serve as a basis for estimating the engineering classification.

Engineering Classification

These two columns show the engineering classification of soils as determined by estimates of sieve analysis, plasticity index and liquid limit. The two systems of engineering classification are the Unified Soil Classification System (2) and the system used by the American Association of State Highway Officials (AASHTO) (3). The Unified Soil Classification System is used to classify soils as to their behavior when used as construction material or as foundation material for uses other than roads.

Range in Permeability

This column indicates the rate of water movement through a saturated soil in inches per hour.

Range in Available Water Capacity

This column indicates the amount of water in the soil which can be extracted and used by plants for growth.

Reaction

Reaction, expressed in pH, shows the range in reaction (relative alkalinity) for each layer. All soils in this area have a pH range of 7.9 to 8.4 except Harqua - 7.9 to 9.6, and Perryville - 7.9 to 9.0 and have not been included in the table.

Shrink-Swell Potential

The shrink-swell potential is an estimate of the soil's tendency to swell when wet and then shrink when drying. In general, soils classified as CH or A-7 have a high shrink-swell potential, while clean sand, gravel and other soils containing small amounts of nonplastic to slightly

plastic materials have a low potential. The shrink-swell potential is moderate for the Gachado and Harqua soils and low for all other soils and therefor has not been included in the table.

Corrosion Potential

This column indicates the tendency of a soil to corrode untreated steel and concrete pipes, culverts, tanks, etc., placed in the soil. The corrosion potential for uncoated steel pipe is high in all soils in this area and has not been included in the table.

Interpretations of Engineering Properties

Table 3, Interpretations of Engineering Properties, gives estimates of the suitability of the soils for specified engineering uses and lists the soil properties that present hazards or difficulties for specific engineering uses. In some cases where the soils have no undesirable features, some important desirable features are listed. The statements in this table are based on the known or estimated physical properties of the soils and represent the judgement and opinion of engineers and soil scientists who have worked with these and similar soils.

The seven components of community development rated in the table are:

Sewage effluent disposal (on-site septic tank disposal fields)

Successful operation of a septic tank tile disposal field depends upon the soil's ability to absorb and filter the effluent that passes through the field. Soil properties considered in rating the soil for this use are depth to bedrock, permeability, slope, stoniness or rockiness and frequency of flooding.

Sewage lagoons

A sewage lagoon is a shallow impoundment designed to hold sewage during the time required for bacterial decomposition of the solids. A suitable soil for a lagoon must be nearly level and relatively impermeable so that seepage from the lagoon will not contaminate water supplies. Soil properties considered in rating the soil for this use are depth to bedrock, depth to seasonal high water table, permeability, slope, stoniness, rockiness and frequency of flooding.

Local roads and streets

The soils are rated for use of locating local roads and streets in the park rather than for major highways. It is assumed that the roads would be of a hard surface type. Slopes generally are more critical for streets in the park than for highways. Steep slopes increase cut and fill requirements.

Streets located on soils subject to flooding will have their use restricted during floods and are subject to damage. Soil properties considered in rating the soils for this use are depth to bedrock, rockiness, slope and frequency of flooding.

Sanitary land fills (trench method)

This rating is for sanitary land fills using the trench method of operation. A good sanitary land fill should operate without contaminating water supplies, reducing land values, or causing health hazards. In addition, it should be usable during all seasons of the year. Soil properties considered in rating soils for this use are depth to bedrock, depth to seasonal high water table, slope, permeability, stoniness, rockiness and flood hazard. No importation of fill or cover material is considered in this rating.

Suitability as source of

The suitability of a soil for topsoil, sand and gravel and road fill is rated as good, fair, poor, or unsuitable in these columns. In estimating the ratings of the soils as sources of topsoil, the uppermost 8 to 12 inches was generally considered; while in estimating ratings of the soils as sources of sand and gravel, the soil profile below the surface layer was considered.

The suitability of the soil as a source of road fill material depends largely on the texture of the soil and its bearing capacity. Plastic soils (those in classes A-5, A-6, or A-7 - see Table preceding) are difficult to handle, slow to dry, and hard to compact. Such soils are rated as poor. Soils in classes A-3 and A-4 are rated as fair for road fill; while soils in classes A-1 and A-2 are rated as good. Fine sand and silt, and other highly erodible soils, require nearly level slopes, close control of moisture while compacting, and rapid vegetation of side slopes to prevent erosion. These soils are rated poor to fair.

Soil Interpretations For Recreational Development

Today, outdoor recreation is an important and necessary part of our way of life. A knowledge of soils is essential in selecting sites for various outdoor recreational development.

Table 4, Soil Limitations for Components of Recreational Development, lists the soil hazards and limitations for four major aspects of recreational development. Each soil is rated for these uses in terms of the degree of limitation - slight, moderate or severe. This degree of limitation indicates the severity of problems expected to be encountered. Major hazards are listed when the soil has a moderate or severe rating.

Decisions as to whether or not a soil will be used for these specific purposes, regardless of its limitation, are beyond the scope of this report. The three degrees of limitation are defined as follows:

Slight. These soils have few known limitations for the use indicated.

Moderate. These soils have one or more properties that limit their use. Correcting these factors will increase the installation and maintenance costs.

Severe. These soils have one or more properties that seriously limit their use. Using soils with a severe limitation will increase the probability of failure and add to the cost of installation and maintenance.

At a price, almost any limitation can be overcome. The information contained in this table will be valuable in planning more detailed field surveys to determine the in-place condition of the soil at the site.

Soil properties considered in rating soils for recreational development include depth to bedrock, depth to seasonal high water table, slope, surface texture and coarse fragments, stoniness and frequency of flooding. Each property affects the way a soil will respond to a specific recreational use. Information presented in the table should be used for screening sites for more detailed on-site investigations. The four components of recreational development rated in the table are discussed below.

Playgrounds

These soil ratings apply to areas to be developed for hiking, and casual play where only light foot traffic is expected. The ratings are based on soil features only and do not include other features such as the presence of trees, which may affect the desirability of a site. Suitability of soil for supporting vegetation is a separate item to be considered in the final evaluation of selecting sites for these uses.

Camp areas

These soil ratings apply to areas suitable for camp sites and the accompanying activities for outdoor living. These areas are used frequently during the camping season which normally extends from September 30 until April 15. The soils are rated assuming little site preparation other than shaping and leveling tent and parking areas. The site should be suitable for heavy foot traffic by humans, horses or vehicular traffic.

Suitability of soil for supporting vegetation is a separate item to be considered in the final evaluation of selecting sites for these uses.

An example of how the detailed soil survey map may be used to develop single-purpose maps is shown in Figure 7. An area around the Monument headquarters was reproduced from the detailed soil survey map. Using the interpretations in Table 4 for each of the soil mapping units, an interpretive map for camp areas was developed. These ratings are suitable for most general planning purposes.

Picnic areas

This rating applies to soils considered for intensive use as park-type picnic areas. Vehicular traffic will be confined to established access roads. Soil factors considered in this rating are flooding, slope, texture and coarse fragment content.

Paths and trails

This soil rating applies to areas that are to be used for trails, cross-country hiking, bridle paths and nonintensive uses which allow for random movement of people. It is assumed that these areas are to be used as they occur in nature with little soil moved (excavated) for the planned recreational use. Areas such as sand dunes and the like, are considered as having very severe soil limitations.

TABLE 2 ESTIMATED PROPERTIES OF SOILS
(Estimates not shown for land types--example Rock land)

Map Symbol and Soil Series	Depth to Bedrock or Hardpan	Depth from Surface	Classification			Coarse fragments more than 3"	Percent less than 3" passing sieve size					Liquid limit	Plasticity index	Permeability	Available water capacity	Corrosivity
	-ft.-	-in.-	USDA	Unified	AASHO	3"	4	10	40	200				in./hr.	in./in.	Concrete
			Texture			-%										
2, 3 Ajo Series (AhB, AkB)	1 1/2-3 1/2	0-24	vgcl Hardpan	GC	A-2	5-10	35-40	25-35	20-30	15-25	30-40	10-20		.2-.6	.06-.09	Low
4 Antho series (An)	> 5	0-60	sl	SM	A-2	---	85-95	75-85	60-70	25-35	NP	NP		2.0-6.0	.08-.12	Low
5 Antho, very gravelly variant (Ao)	> 5	0-60	vgsl	GM-GP, SM	A-1	---	40-60	20-35	10-20	5-15	NP	NP		2.0-6.0	.05-.07	Low
6 Cherioni Series (ChB)	1/2-1	0-9	gvfsl Bedrock	SM	A-1	25-40	65-75	40-50	30-40	15-20	30-40	NP-4		.6-2.0	.07-.09	Low
7 Cipriano Series (Cp)	1-1 1/2	0-15	vgl Hardpan	GM-GP, GM	A-1	0-10	25-40	20-35	20-30	10-25	NP	NP		.6-2.0	.07-.09	Low
8 Gachado Series (GaB)	1-2	0-13	gcl Bedrock	SC, GC	A-6	15-35	70-75	60-70	45-55	35-45	30-40	15-25		.06-0.2	.12-.16	Low
9, 10 Gilman Series (Gb, Gm)	> 5	0-60	vfs1, l	ML	A-4	---	100	95-100	65-75	50-65	20-35	NP-10		.6-2.0	.15-.18	Low
11 Growler Series (Gr) (For Antho part, see Antho series)	> 5	0-60	gl	SM, GM	A-2	---	60-70	50-60	40-50	25-35	35-40	5-10		0.2-2.6	.13-.15	High
12, 13 Gunsight Series (Gua, GuC)	> 5	0-60	vgl	GM	A-1	5-10	35-45	25-35	20-30	15-20	NP	NP		.6-2.0	.05-.07	Low
14, 15 Harqua Series (HaA, Hc) (For Gunsight part of Hc, see Gunsight Series) (HbB)	> 5	0-16	gcl	GC	A-2	10-20	40-55	35-50	30-40	25-35	30-40	10-20		.2-.6	.12-.14	High
		16-60	gsl	GM	A-1	0-5	40-65	35-55	25-35	10-20	NP	NP		.6-2.0	.03-.05	High
	> 5	0-29	vk1	GC	A-2	25-45	40-55	35-50	30-40	25-35	30-40	10-20		.2-.6	.10-.12	High
		29-60	cl	CL	A-6, A-7	0-5	75-85	70-80	65-75	50-65	35-45	15-20		.2-.6	.14-.16	High
17 Laveen Series (La)	> 5	0-60	gl	ML	A-4	---	75-95	70-90	60-80	45-60	30-40	NP-10		.6-2.0	.14-.16	Low
18 Lomitas Series (LoE)	1-1 1/2	0-13	vst1 Bedrock	GM, GW-GM	A-1	35-50	25-30	20-25	15-20	10-15	NP	NP		.6-2.0	.03-.05	Low
19 Perryville Series (PaB)	> 5	0-60	gl	SM, ML	A-4	15-25	75-90	65-85	45-90	35-60	20-35	NP-10		.6-2.0	.11-.13	Low
20 Rillito Series (Ra)	> 5	0-60	gsl	SM,	A-2	0-10	55-90	50-75	35-55	20-35	NP	NP		.6-2.0	.09-.11	Low

TABLE 3 INTERPRETATIONS OF ENGINEERING PROPERTIES

Map Symbol and Soil Series	Degree or kind of limitation for:					Suitability as a source of:	
	Septic Tank Absorption Field	Sewage Lagoons	Sanitary Landfill-- Trench Method	Local Roads and Streets	Roadfill	Sand and Gravel	Top Soil
Ajo Series (AhB, AkB)	SEVERE-- 20-40" to hardpan	SEVERE-- 20-40" to hardpan	SEVERE-- 20-40" to hardpan	MODERATE-- 20-40" to hardpan	POOR-- 20-40" to hardpan	UNSUITED	POOR--gravelly and cobbly
Antho Series (An)	SLIGHT	SEVERE-- moderately rapid perme- ability	SEVERE-- moderately rapid perme- ability	SLIGHT	GOOD	POOR--Sand SM material UNSUITED-- Gravel	GOOD
Antho, very gravelly variant (Ao)	SLIGHT-- severe where flooded	SEVERE-- very gravelly moderately rapid perme- ability	SEVERE-- moderately rapid perme- ability, some areas flooded	SLIGHT-- severe where flooded	GOOD	POOR-- Gravel, GM material UNSUITED-- Sand	POOR--gravelly
Cherioni Series (ChB)	SEVERE-- less than 12" to hardpan	SEVERE-- less than 12" to hardpan	SEVERE-- less than 12" to hardpan	SEVERE-- less than 12" to hardpan	POOR-- less than 12" to hardpan	UNSUITED-- SM material	POOR--cobbly
Cipriano Series (Cp)	SEVERE-- less than 20" to hardpan	SEVERE-- less than 20" to hardpan	SEVERE-- less than 20" to hardpan	SEVERE-- less than 20" to hardpan	POOR-- less than 20" to hardpan	UNSUITED	POOR--gravelly
Gachado Series (GaB)	SEVERE-- 12-24" to bedrock	SEVERE-- 12-24" to bedrock	SEVERE-- 12-24" to bedrock	SEVERE-- 12-24" to bedrock	POOR-- 12-24" to bedrock	UNSUITED	POOR--gravelly
Gilman Series (Gb, Gm)	SLIGHT	MODERATE-- moderate perme- ability	MODERATE-- moderate perme- ability	MODERATE-- ML & ML-CL material	FAIR-- ML & ML-CL material	UNSUITED	GOOD
Growler Series (Gr) (For Antho part, see Antho series)	SEVERE-- moderately slow permeability	MODERATE-- gravelly	SLIGHT	SLIGHT	GOOD	POOR--SM material	POOR--gravelly
Gunsight Series (GuA, GuC)	SLIGHT-- 0-8% slopes; MODERATE-- 8-15% slopes; SEVERE--more than 15% slopes	SEVERE-- very gravelly and more than 15% slopes	SLIGHT-- more than 15% slopes; MODERATE-- 15-25%	SLIGHT-- less than 8% slopes MODERATE-- 8-15% slopes SEVERE-- more than 15% slopes	GOOD	POOR-- gravel, GM material; UNSUITED-- sand	POOR--gravelly
Harqua Series (HaA, Hc) (HbB) (For Gunsight part of Hc, see Gunsight series)	SLIGHT SEVERE-- moderately slow permeability	SEVERE-- gravelly SEVERE-- gravelly	SLIGHT	SLIGHT	GOOD FAIR--CL material	UNSUITED UNSUITED	POOR--gravelly POOR--cobbly
Laveen Series (La)	SLIGHT	MODERATE-- moderate perme- ability	SLIGHT	MODERATE-- ML material	FAIR-- ML material	UNSUITED	GOOD
Lomitas Series (LoE)	SEVERE-- 12-24" to bedrock; slope; very cobbly	SEVERE-- 12-24" to bedrock; slope; very cobbly	SEVERE-- 12-24" to bedrock; slope; very cobbly	SEVERE-- 12-24" to bedrock; slope	POOR-- 12-24" to bedrock; slope	UNSUITED	POOR--very cobbly
Perryville Series (PeB)	SLIGHT	MODERATE-- gravelly	SLIGHT	MODERATE-- excess fines	FAIR--ML or SM material	UNSUITED	POOR--gravelly
Rillito Series (Ra)	SLIGHT	MODERATE-- moderate perme- ability; gravelly	SLIGHT	SLIGHT	GOOD	UNSUITED	POOR--gravelly

TABLE 4. SOIL LIMITATIONS FOR COMPONENTS OF RECREATIONAL DEVELOPMENT

Map Symbol	Soil Name	Camp Areas	Picnic Areas	Playgrounds	Paths and Trails
2 AhB	Ajo very cobbly sandy loam, 2 to 5 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
3 AkB	Ajo very gravelly loam, 1 to 5 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
4 An	Antho fine sandy loam	SLIGHT	SLIGHT	SLIGHT	SLIGHT
1 Ao	Antho soils, very gravelly variant	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
6 ChB	Cherioni gravelly very fine sandy loam, 0 to 8 percent slopes	MODERATE <u>1</u> /	MODERATE <u>1</u> /	SEVERE <u>2</u> /	MODERATE <u>1</u> /
7 Cp	Ciprioni gravelly loam	MODERATE <u>1</u> /	MODERATE <u>1</u> /	SEVERE <u>1</u> / <u>2</u> /	MODERATE <u>1</u> /
GaB	Gachado very cobbly loam, 2 to 8 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> / <u>2</u> /	SEVERE <u>1</u> /
7 Gb	Gilman very fine sandy loam	SLIGHT	SLIGHT	SLIGHT	SLIGHT
10 Gm	Gilman very fine sandy loam, saline	SLIGHT	SLIGHT	SLIGHT	SLIGHT
11 Gr	Growler-Antho complex Antho Growler	SLIGHT MODERATE <u>1</u> /	SLIGHT MODERATE <u>1</u> /	SLIGHT SEVERE <u>1</u> /	SLIGHT MODERATE <u>1</u> /
12 GuA	Gunsight very gravelly loam, 0 to 2 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
13 GuC	Gunsight very gravelly loam, 2 to 15 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
14 Haa	Harqua very gravelly loam, 0 to 3 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
15 HbB	Harqua very cobbly loam, 0 to 8 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
16 Hc	Harqua-Gunsight complex Harqua Gunsight	SEVERE <u>1</u> / SEVERE <u>1</u> /	SEVERE <u>1</u> / SEVERE <u>1</u> /	SEVERE <u>1</u> / SEVERE <u>1</u> /	SEVERE <u>1</u> / SEVERE <u>1</u> /
La	Laveen loam	SLIGHT	SLIGHT	SLIGHT	SLIGHT
LoE	Lomitas very stony loam, 8 to 40 percent slopes	MODERATE <u>1</u> / <u>3</u> /	SEVERE <u>1</u> / <u>3</u> /	SEVERE <u>1</u> / <u>4</u> /	MODERATE <u>1</u> /; SEVERE on slopes >25%
PeB	Perryville very cobbly fine sandy loam, 0 to 8 percent slopes	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /	SEVERE <u>1</u> /
20 Ra	Rillito gravelly sandy loam	MODERATE <u>1</u> /	MODERATE <u>1</u> /	SEVERE <u>1</u> /	MODERATE <u>1</u> /
Rk	Rock land	SEVERE <u>1</u> /	SEVERE <u>6</u> /	SEVERE <u>6</u> /	SEVERE <u>6</u> /
Ro	Rock outcrop	SEVERE <u>6</u> /	SEVERE <u>6</u> /	SEVERE <u>6</u> /	SEVERE <u>6</u> /
St	Stony land-Rock outcrop association	SEVERE <u>1</u> / <u>6</u> /	SEVERE <u>6</u> /	SEVERE <u>1</u> / <u>6</u> /	SEVERE <u>6</u> /
To	Torrifluvents	SEVERE <u>1</u> / <u>7</u> /	SEVERE <u>1</u> / <u>7</u> /	SEVERE <u>1</u> / <u>7</u> /	SEVERE <u>1</u> / <u>7</u> /

1/ Gravelly, cobbly or stony 4/ More than 15 percent slopes 7/ Flooding

2/ Bedrock less than 20 inches 5/ May be dusty

3/ 8 to 15 percent slopes 6/ Rocky



LEGEND

Moderate Limitations



Severe Limitations



Figure 7.- Soil interpretations for Camp Areas



Appendix

Common and Scientific Names
of Plants

Guide to Mapping Units

Literature Cited

Glossary

Palo Verde.

ORGAN PIPE CACTUS NATIONAL MONUMENT PHOTO

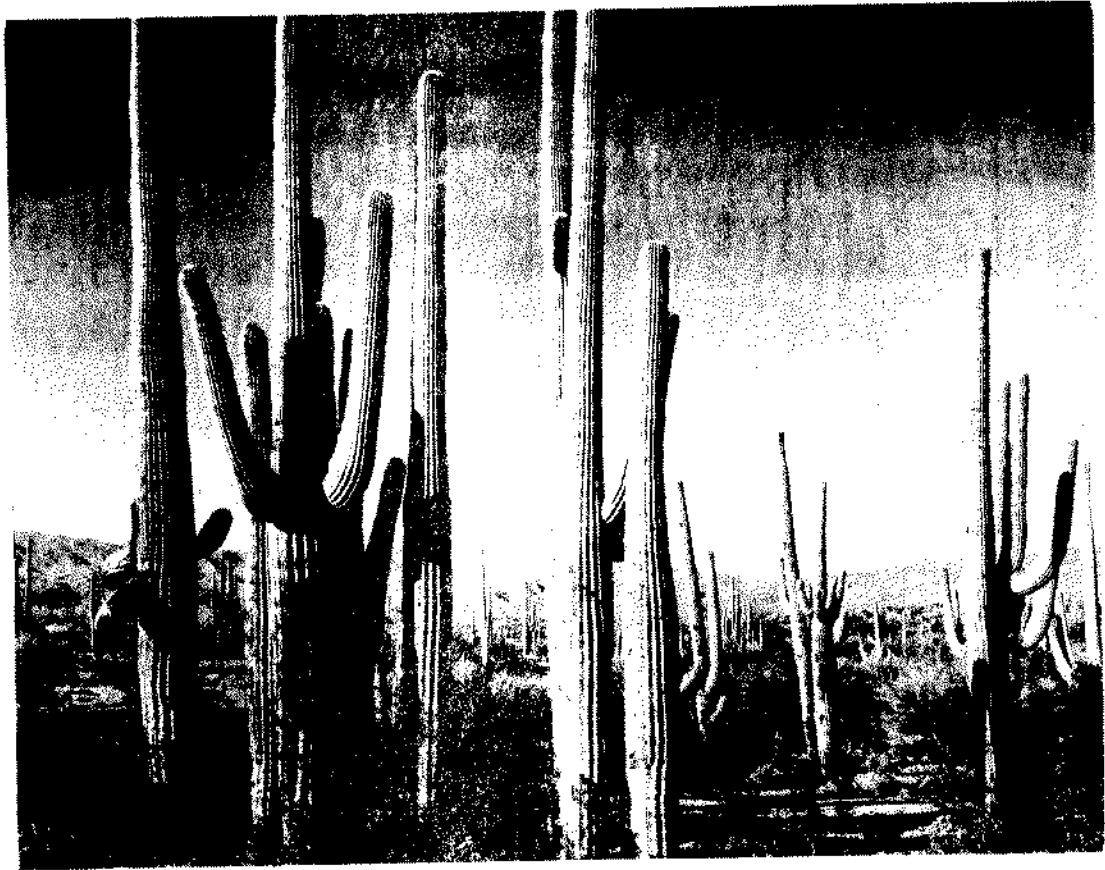


Figure 8.- Saguaro cactus is one of the major kinds of cactus on the monument.

ORGAN PIPE CACTUS NATIONAL MONUMENT PHOTO

Common and Scientific Names of Plants in the Organ Pipe Cactus National Monument

Following is a list of the plants named in the Soil Series and Mapping Unit descriptions. It is not intended to be a complete list of all plants on the Monument since a special vegetative study was made for release by another agency.

Scientific names of the plants were checked by Dr. Scott Steenberg of the Park Service and Albert F. Thatcher, SCS. Recommended references for information on the plants are: Arizona Flora, Kearney, T.H. and Peebles, R. H., University of California Press, 1085 pages, illus., glossary supplement 1960; Manual of the Grasses of the United States, Hitchcock, A. S., Vol. I and II, 1051 pages, illus.

Table 5. COMMON AND SCIENTIFIC NAMES OF PLANTS

Common Name Used in Report	Class*	Scientific Name	Common Name Used in Report	Class*	Scientific Name
Agave	S	Agave deserti, Agave Schottii and others	Limber bush	S	Jatropha cardiophylla or Jatropha cuneata
Ajo oak	T	Quercus ajoensis	Mesquite	T	Prosopis juliflora
Annual buckwheat	F	Eriogonum sp.	Mexican jumping bean	S	Sapium beloculare
Babybonnet	S	Coursetia glandulosa	Mormon tea	S	Ephedra trifurca
Barrel cactus	C	Ferocactus Coveillei and others	Ocotillo	S	Fouquieria splendens
Big galleta	G	Hilaria rigida	Organ pipe cactus	C	Lemaireocereus Thurberi
Bitter condalia	F	Condalia globosa	Paloverde	T	Cercidium microphyllum
Brittlebush	S	Encelia farinosa	Pencil cholla	C	Opuntia arbuscula
Broom snakeweed	S	Gutierrezia sp.	Prickly pear	C	Opuntia Engelmannii, Opuntia chlorotica and others
Buckhorn cholla	C	Opuntia acanthocarpa	Range ratany	S	Krameria Grayi
Bush muhly	G	Muhlenbergia porteri	Rothrock grama	G	Bouteloua Rothrockii
Catclaw acacia	S	Acacia greggii	Saguaro	C	Carnegiea gigantea
Chain fruit cholla	C	Opuntia fulgida	Saltbush	S	Atriplex polycarpa and Atriplex linearis
Christmas cactus	C	Opuntia leptocaulis	Sinita cactus	C	Lophocereus Schottii
Club moss	F	Selaginella	Sixweeks grama	G	Bouteloua barbata
Creosotebush	S	Larrea tridentata	Slim tridens	G	Tridens muticus
Crucifixion thorn	S	Holacantha Emoryii	Smoke tree	T	Dalea spinosa
Desert lavender	F	Hyptis Emoryii	Sweet potato cactus	C	Wilcoxia Diguetii
Elephant tree	T	Bursera microphylla	Teddy bear cholla	C	Opuntia Bigelovii
Fluff grass	G	Tridens pulchellus	Three-awn	G	Aristida divaricata
Globe mallow	F	Spheralcia sp.	Triangular bursage	S	Franseria deltoidea
Hackberry	T	Celtis pallida	Turksbeard	F	Chorizonthe rigida
Hedgehog cactus	C	Echinocereus pectinatus	White bursage	S	Franseria dumosa
Ironwood	T	Olneya Tesota	Wolfberry	S	Lycium macrodon
Jojoba	S	Simmondsia chinensis	Wrights cholla	C	Opuntia Staniyi
Juniper	T	Juniperus monosperma			

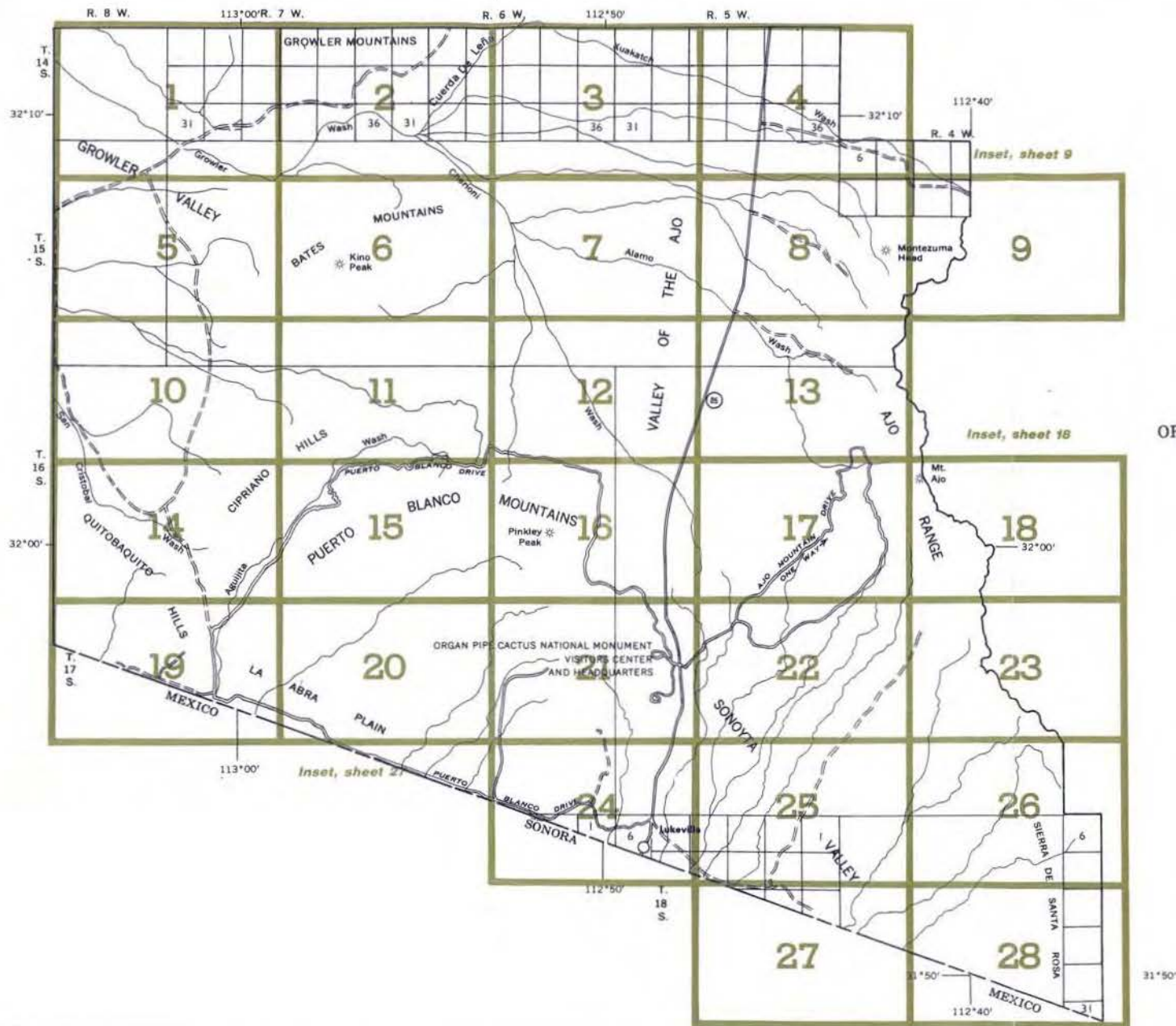
* S - Shrub
T - Tree
F - Forb
C - Cactus
G - Grass

TABLE 6. GUIDE TO MAPPING UNITS

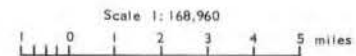
Map Symbol	Mapping Unit	Description on page
AhB	Ajo very cobbly sandy loam, 2 to 5 percent slopes	6
AkB	Ajo very gravelly loam, 1 to 5 percent slopes	7
An	Antho fine sandy loam	8
Ao	Antho soils, very gravelly variant	8
ChB	Cherioni gravelly very fine sandy loam, 0 to 8 percent slopes	9
Cp	Cipriano gravelly loam	10
GaB	Gachado very cobbly loam, 2 to 8 percent slopes	11
Gb	Gilman very fine sandy loam	13
Gm	Gilman very fine sandy loam, saline	13
Gr	Growler-Antho complex	14
GuA	Gunsight very gravelly loam, 0 to 2 percent slopes	14
GuC	Gunsight very gravelly loam, 2 to 15 percent slopes	15
HaA	Harqua very gravelly loam, 0 to 3 percent slopes	15
HbB	Harqua very cobbly loam, 0 to 8 percent slopes	16
Hc	Harqua-Gunsight complex	16
La	Laveen loam	17
LoE	Lomitas very stony loam, 8 to 40 percent slopes	17
PeB	Perryville very cobbly fine sandy loam, 0 to 8 percent slopes	18
Ra	Rillito gravelly sandy loam	19
Rk	Rock land	20
Ro	Rock outcrop	20
St	Stony land-Rock outcrop association	21
To	Torrifluvents	21

LITERATURE CITED

1. Soil Survey Manual, U. S. Dept. of Agriculture Handbook No. 18 by Soil Survey Staff.
2. Waterways Experiment Station, Corps of Engineers, 1953. The Unified Soil Classification System. Tech Memo 3-337, v.1 and Appendix, 48 pp and charts.
3. American Association of State Highway Officials, 1961. Standard Specifications for Highway Materials and Methods of Sampling and Testing, Ed. 9-2v, 401 and 617 pp. Illus.



INDEX TO MAP SHEETS
ORGAN PIPE CACTUS NATIONAL MONUMENT
PIMA COUNTY, ARIZONA



CONVENTIONAL SIGNS

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows a class of slope. Most symbols without a slope letter are those of nearly level soils or land types but some are for soils or land types that have a considerable range in slope.

Map Symbol	Approved Name
1 AhB	Ajo very cobbly sandy loam, 2 to 5 percent slopes
2 AkB	Ajo very gravelly loam, 1 to 5 percent slopes
3 An	Antho fine sandy loam
4 Ao	Antho soils, very gravelly variants
5 ChB	Cherioni gravelly very fine sandy loam, 0 to 8 percent slopes
6 Cp	Cipriano gravelly loam
7 GaB	Gachado very cobbly loam, 2 to 8 percent slopes
8 Gb	Gilman very fine sandy loam
9 Gm	Gilman very fine sandy loam, saline
10 Gr	Growler-Antho complex
11 GuA	Gunsight very gravelly loam, 0 to 2 percent slopes
12 GuC	Gunsight very gravelly loam, 2 to 15 percent slopes
13 HaA	Harqua very gravelly loam, 0 to 3 percent slopes
14 HbB	Harqua very cobbly loam, 0 to 8 percent slopes
15 Hc	Harqua-Gunsight complex
16 La	Laveen loam
17 LoE	Lomitas very stony loam, 8 to 40 percent slopes
18 PeB	Perryville very cobbly fine sandy loam, 0 to 8 percent slopes
19 Ra	Rillito gravelly sandy loam
20 Rk	Rock land
21 Ro	Rock outcrop
22 St-	Stony land-Rock outcrop association
23 To	Torrifluvents

WORKS AND STRUCTURES

Highways and roads	
Good motor	=====
Poor motor	==
Trail	- - - - -
Highway markers	
State or county	○
Buildings	■
Mine and quarry	⋈
Gravel pit	⋈
Dams	◡
Tanks	⊙
Windmill	⋈

BOUNDARIES

National or state	— — — — —
Project area	=====
Reservation	- . - . - .
Land survey division corners	┌ ┴ ┐
Plane coordinate grid tick	— 1 100 000 FEET

DRAINAGE

Streams, single-line	
Intermittent	~~~~~
Unclassified	~~~~~
Lakes and ponds	~~~~~
Perennial	~~~~~
Spring	~~~~~
Alluvial fan	~~~~~
Drainage end	~~~~~
Well, water	○

RELIEF

Escarments	
Other than bedrock	~~~~~
Prominent peak	⋈

SOIL SURVEY DATA

Soil boundary and symbol	○
Gravel	⋈
Stoniness	⋈
Rock outcrops	⋈
Saline spot	+
Soil sample site	⊙

Soil map constructed 1972 by Cartographic Division, Soil Conservation Service, USDA. Photobase from 1961 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona plane coordinate system, central zone, transverse Mercator projection.



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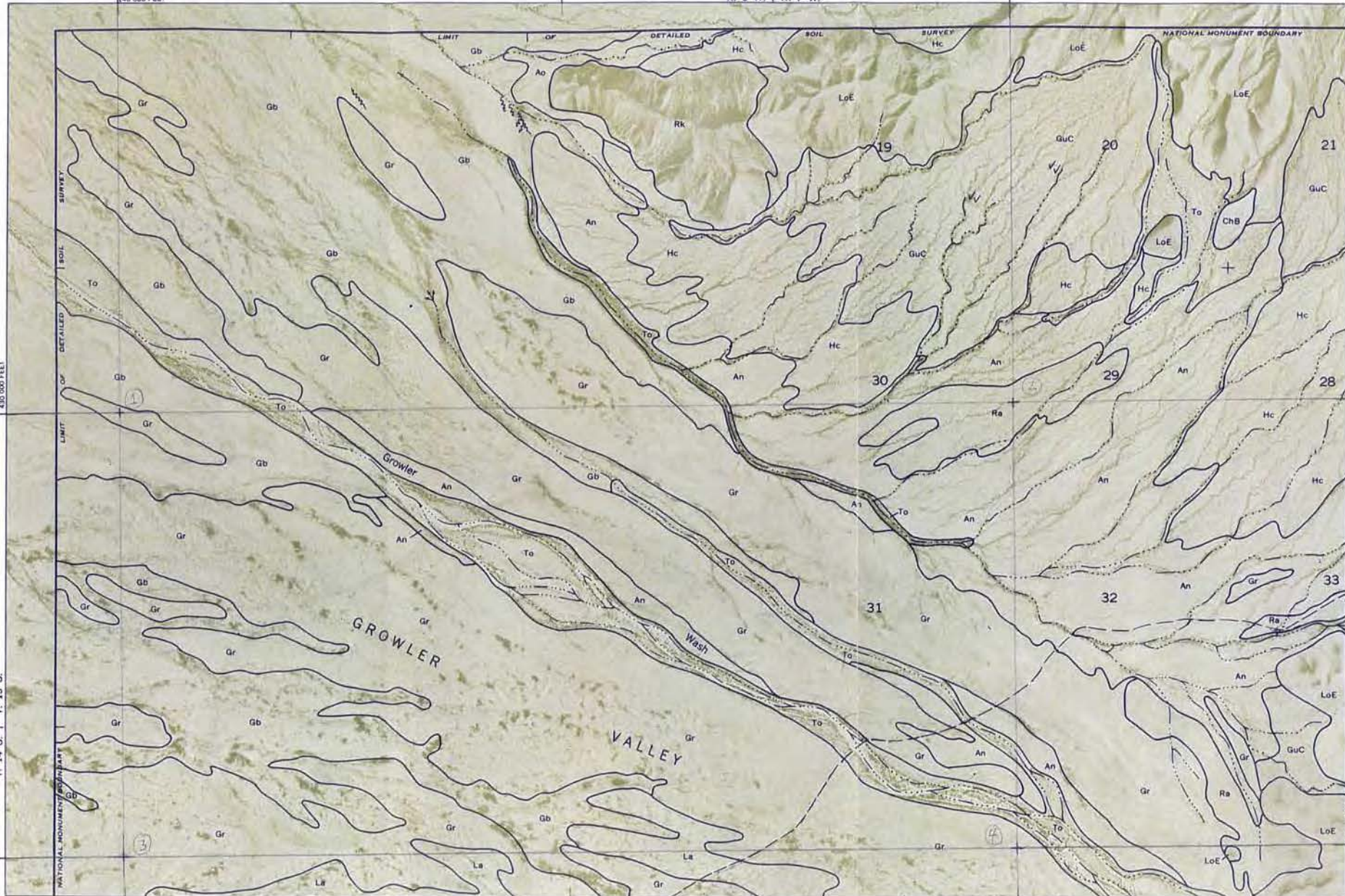
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Photobase from 1961 aerial photography. Features of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone. Land division corners are approximately positioned on this map.

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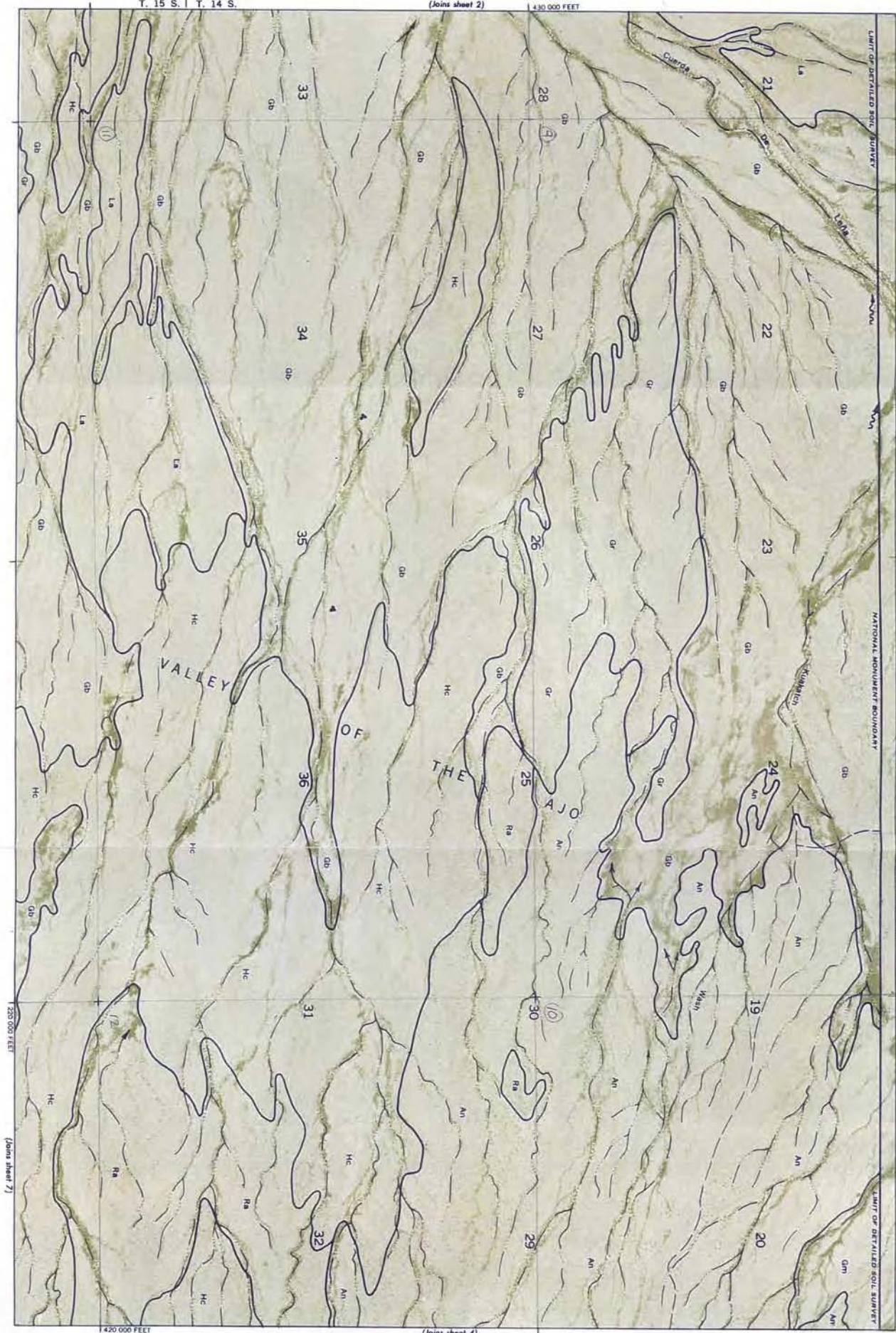
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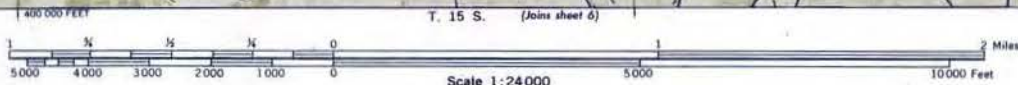
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sheet 3 of 28





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ORGAN PIPE CACTUS NATIONAL MONUMENT, PIMA COUNTY, ARIZONA — SHEET NUMBER 6

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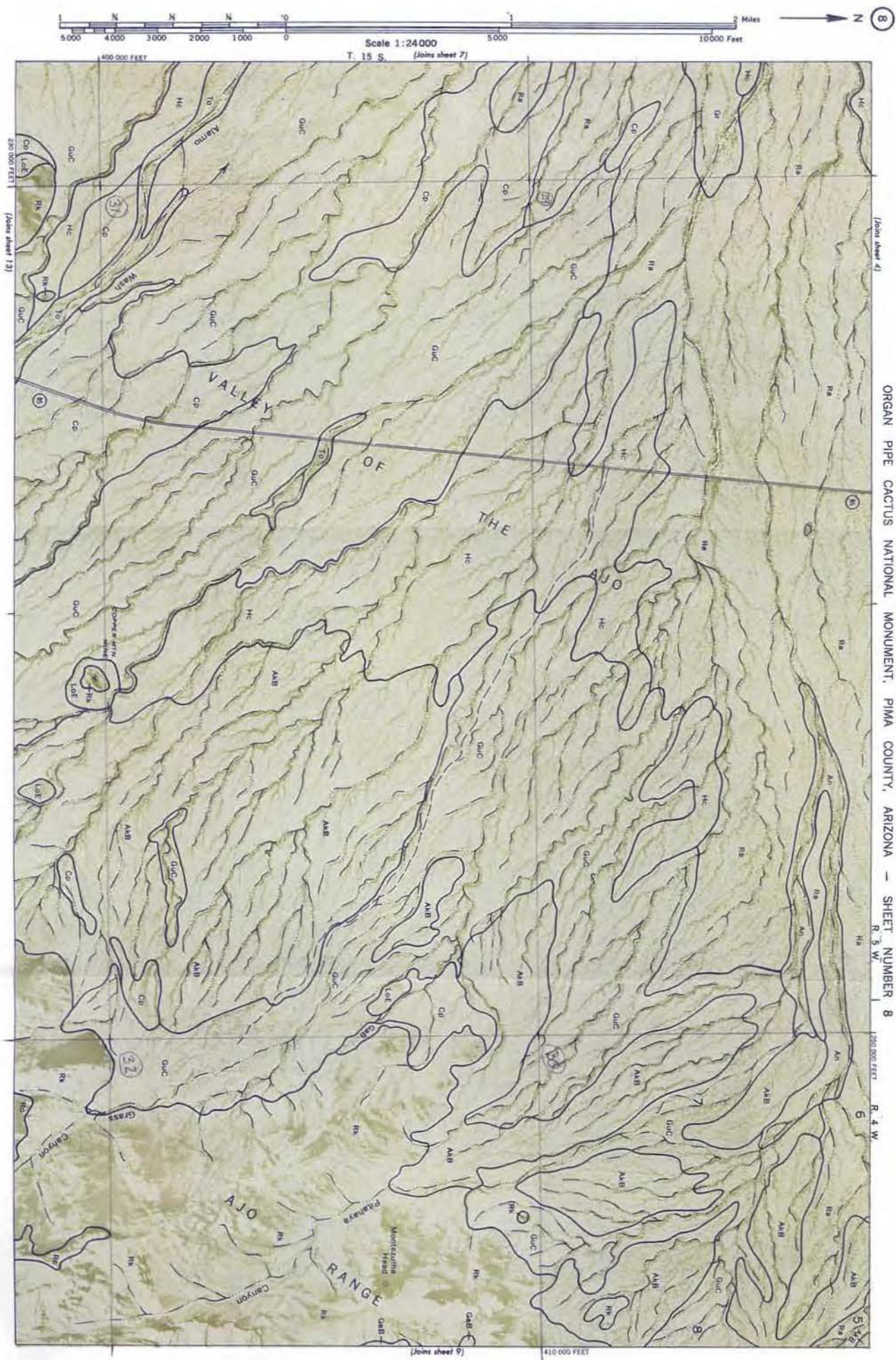
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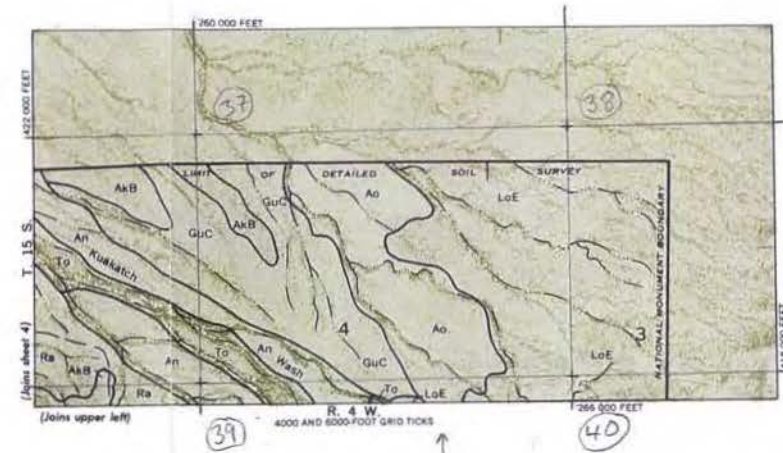
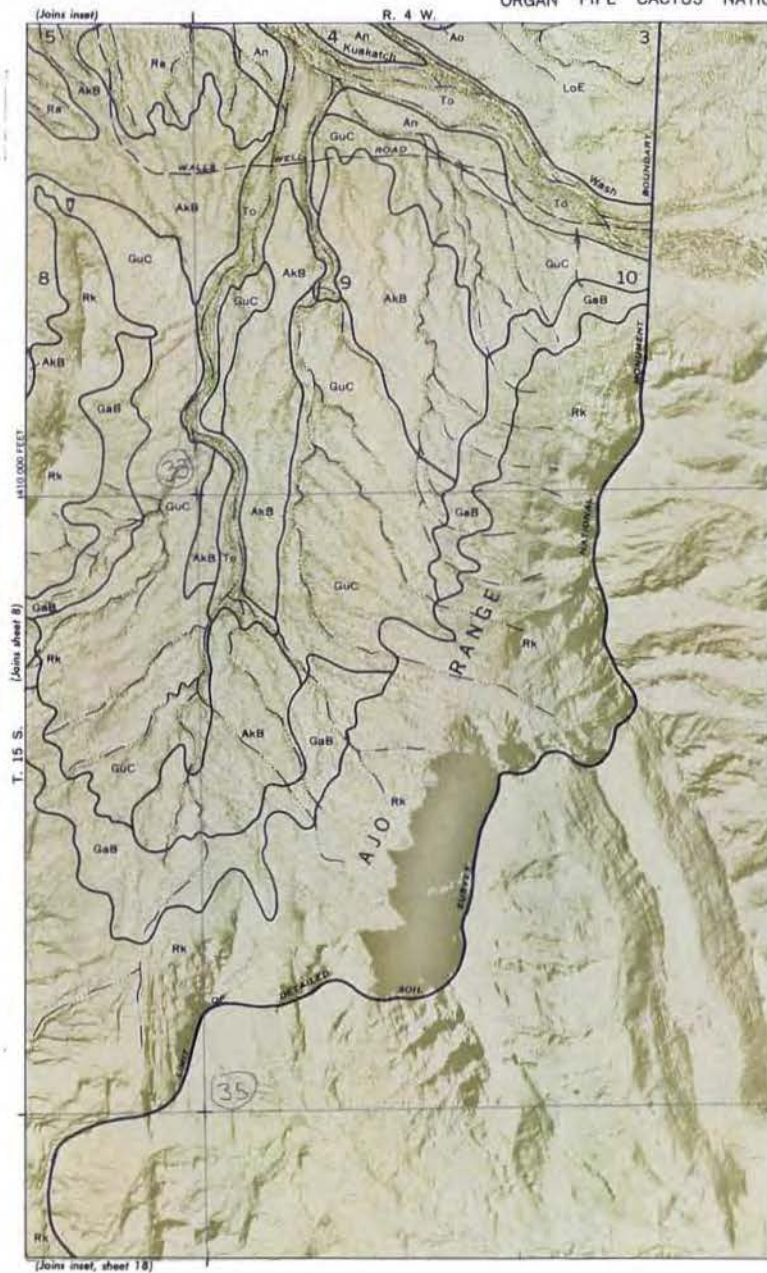
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Land division corners are approximately positioned on this map.
Photobase from 1961 aerial photographs. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone.

Photocopy from 1951 aerial photography. Positions of 10,000-foot grid lines are approximate and based on the Arizona coordinate system, central zone. Land division corners are approximately positioned on this map.





Photobase from 1951 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone. Land division corners are approximately positioned on this map.

This map is one of a set of 5 that was published in 1979 as part of a cell atlas to the United States Department of Agriculture. Soil Conservation Service and the National Soil Survey. It is a reprint of the 1979 aerial photography. Positions of 10,000 foot grid ticks are approximate and based on the Arizona coordinate system, central zone.

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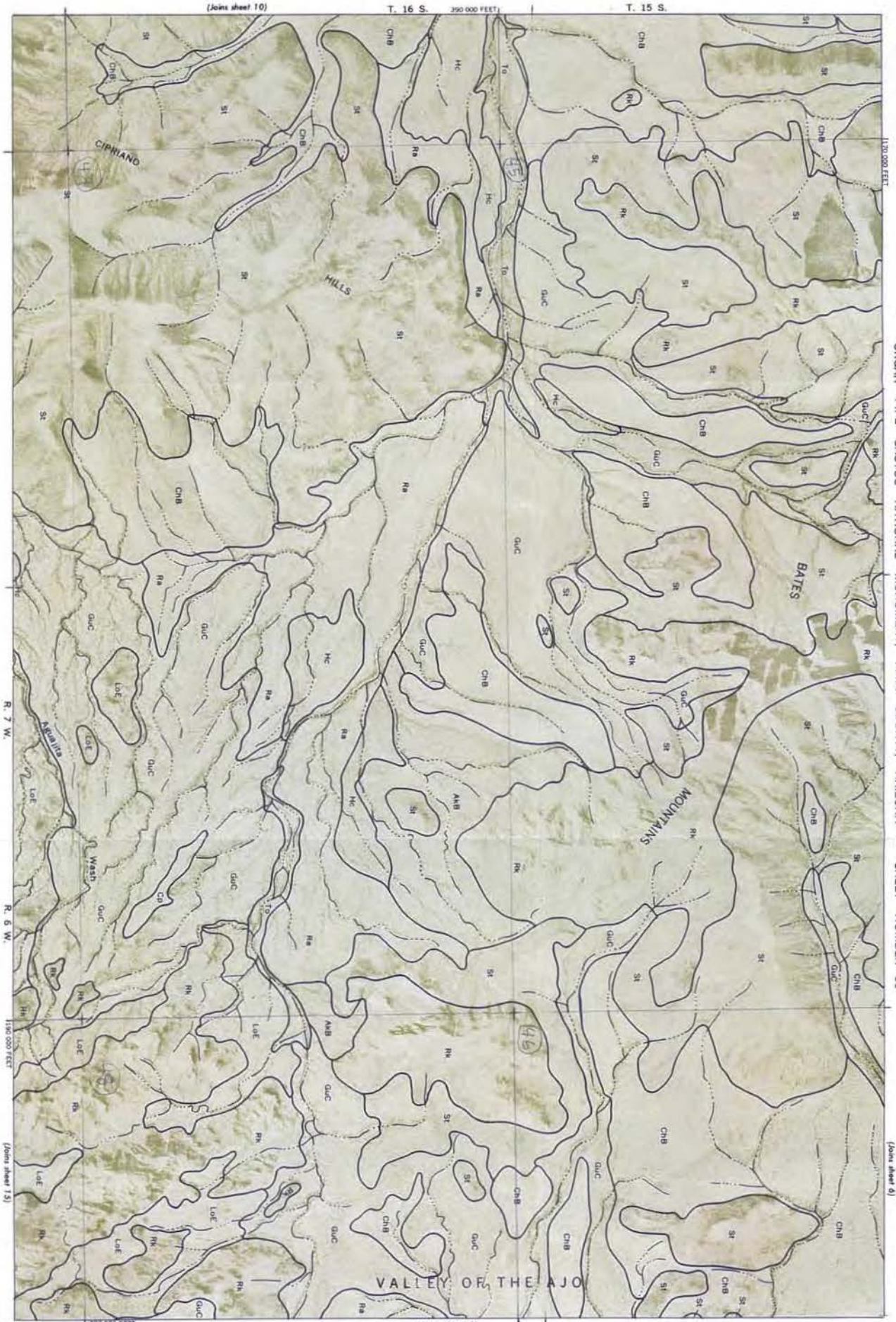
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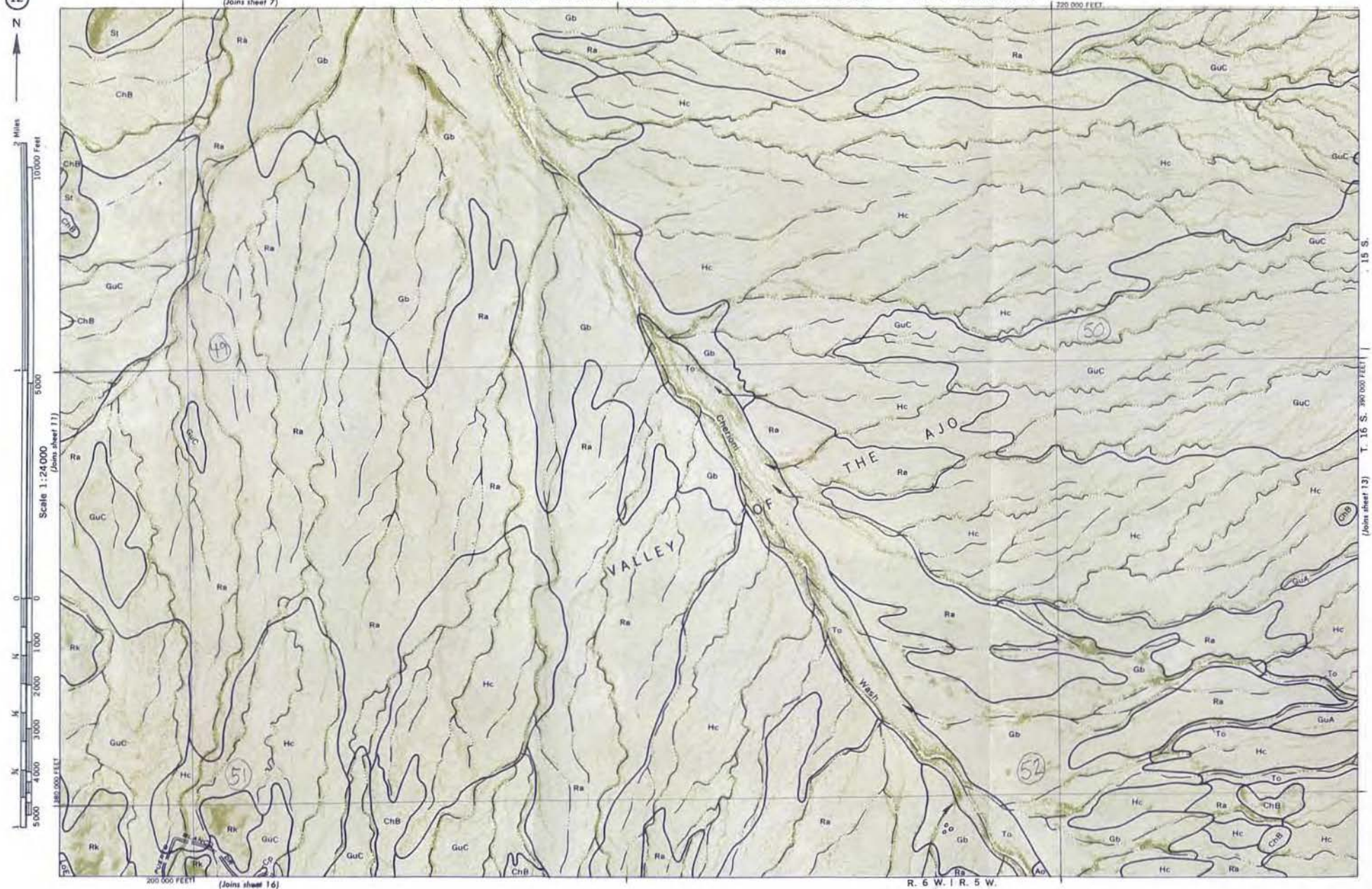
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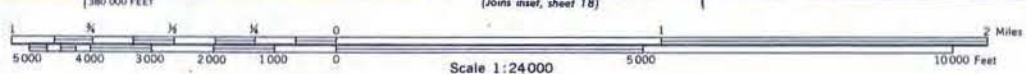
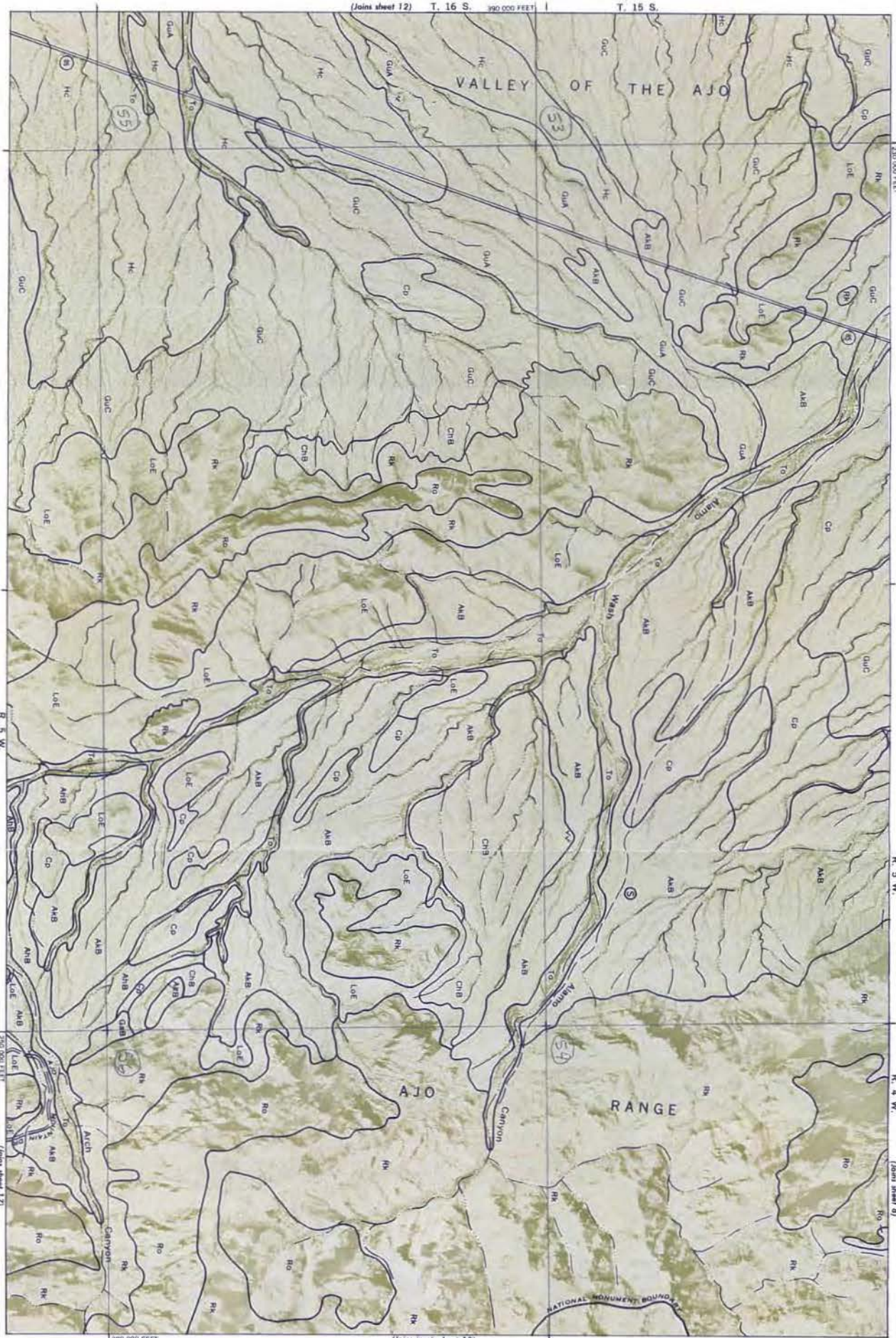
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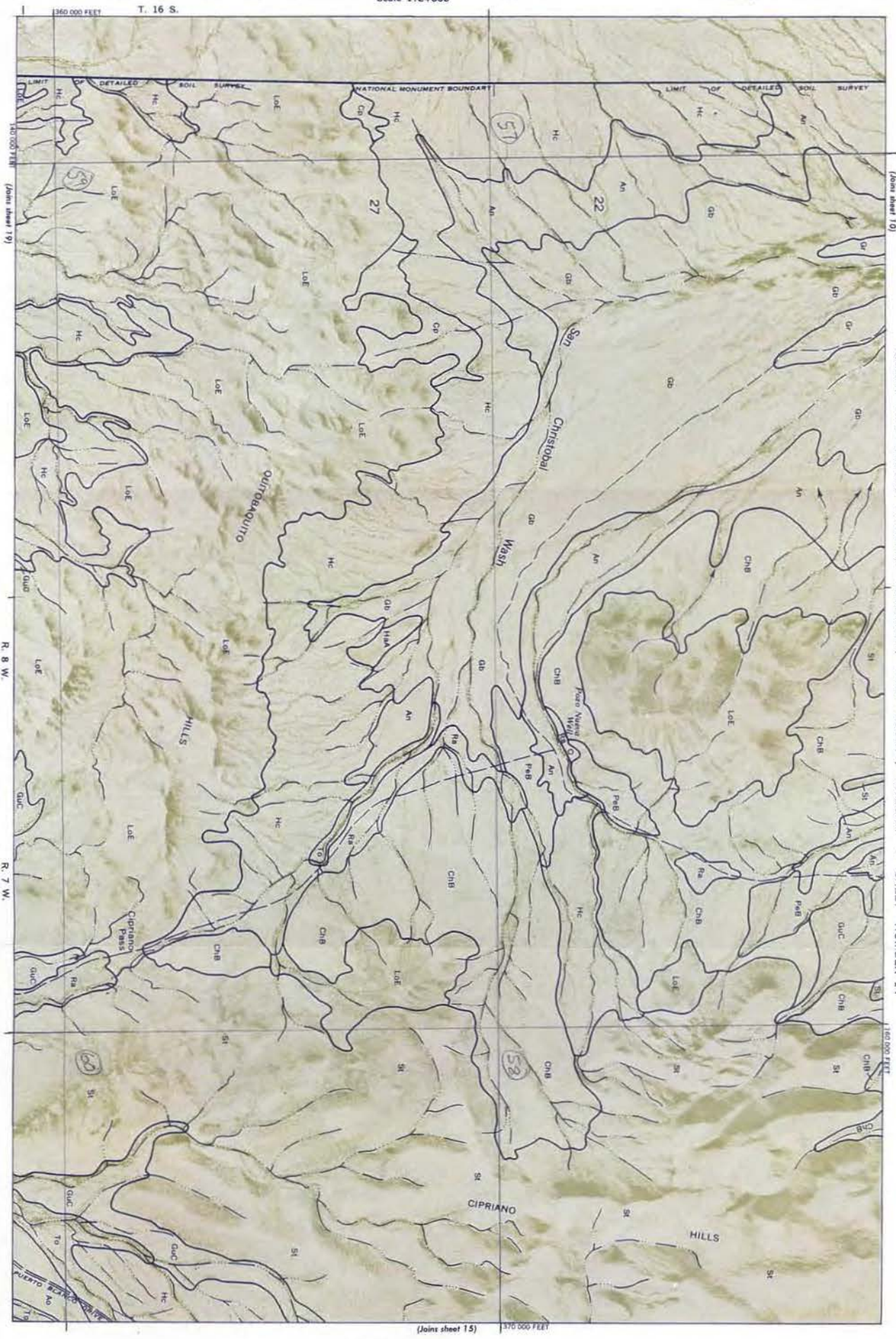


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Land division corners are approximately positioned on this map.

Photostere from 1961 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone.

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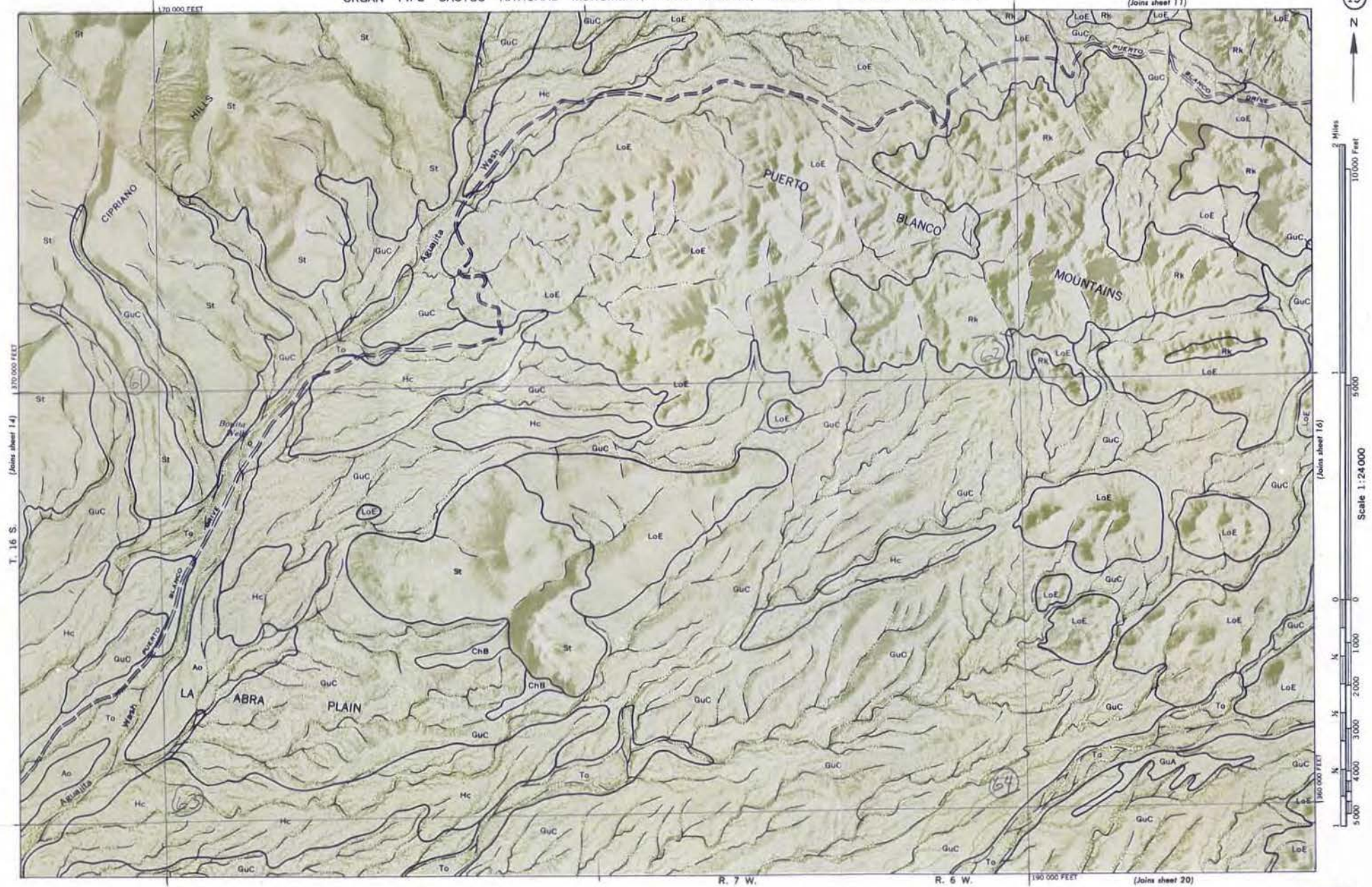
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Photobase from 1961 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone. Land division corners are approximately positioned on this map.





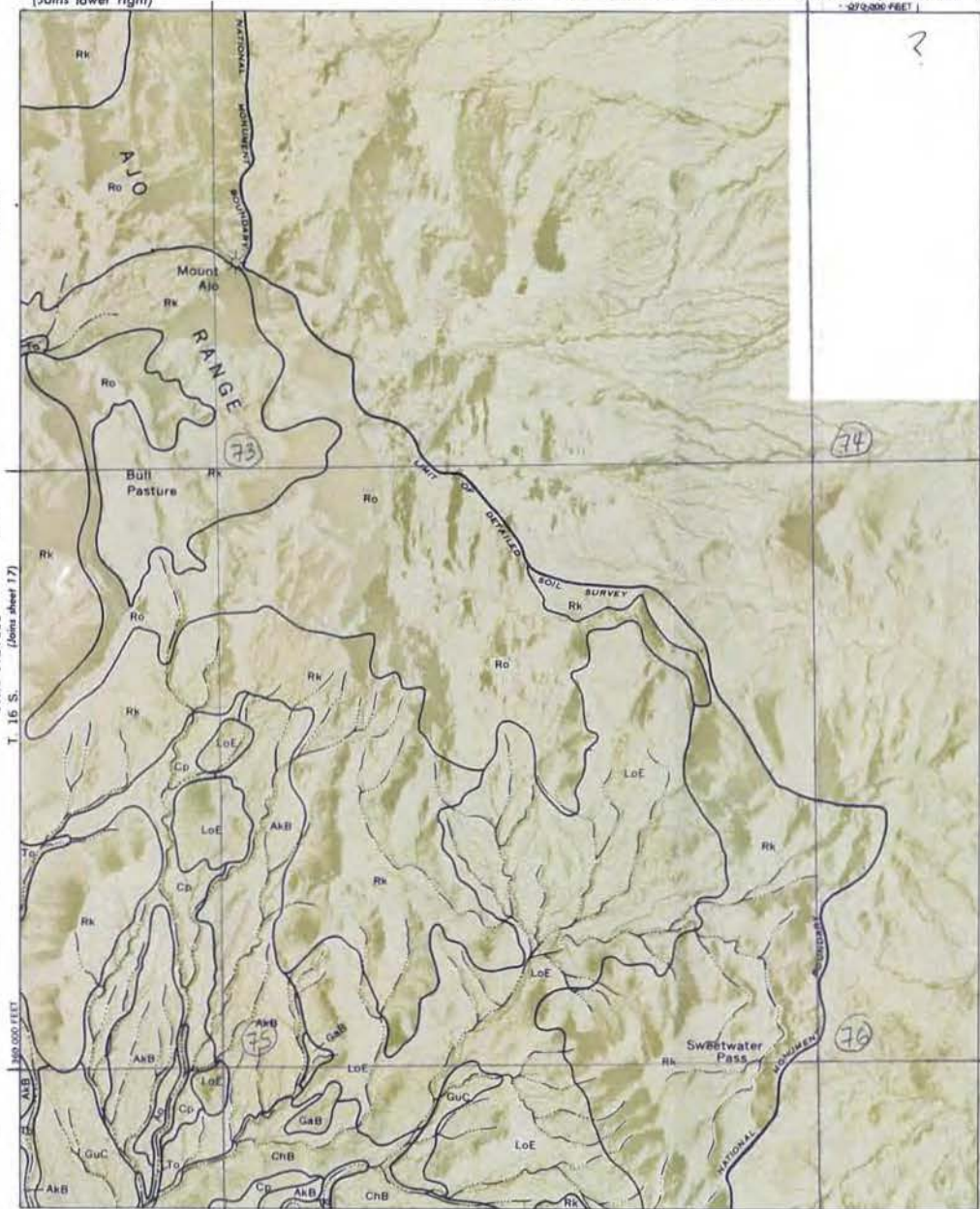
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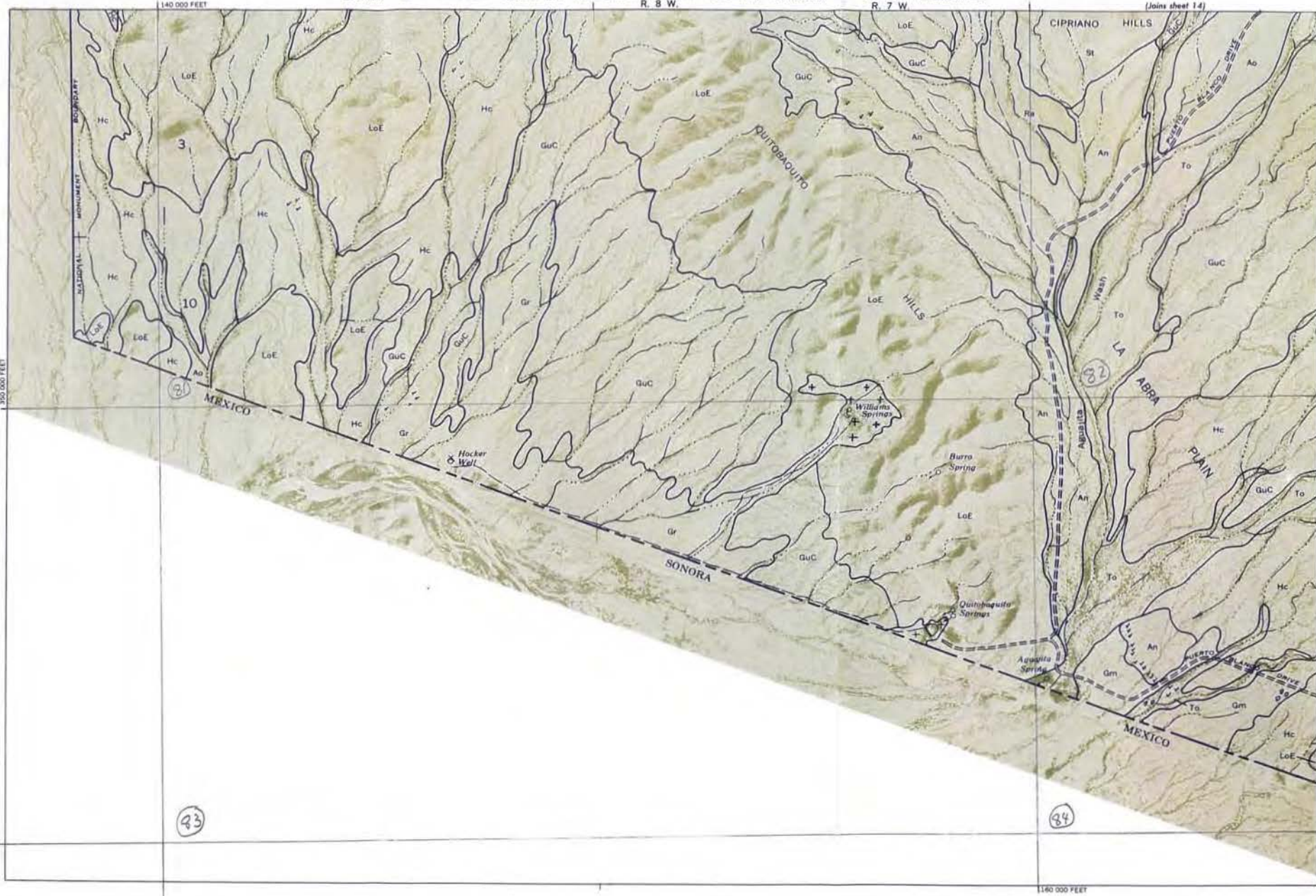
R. 4 W.

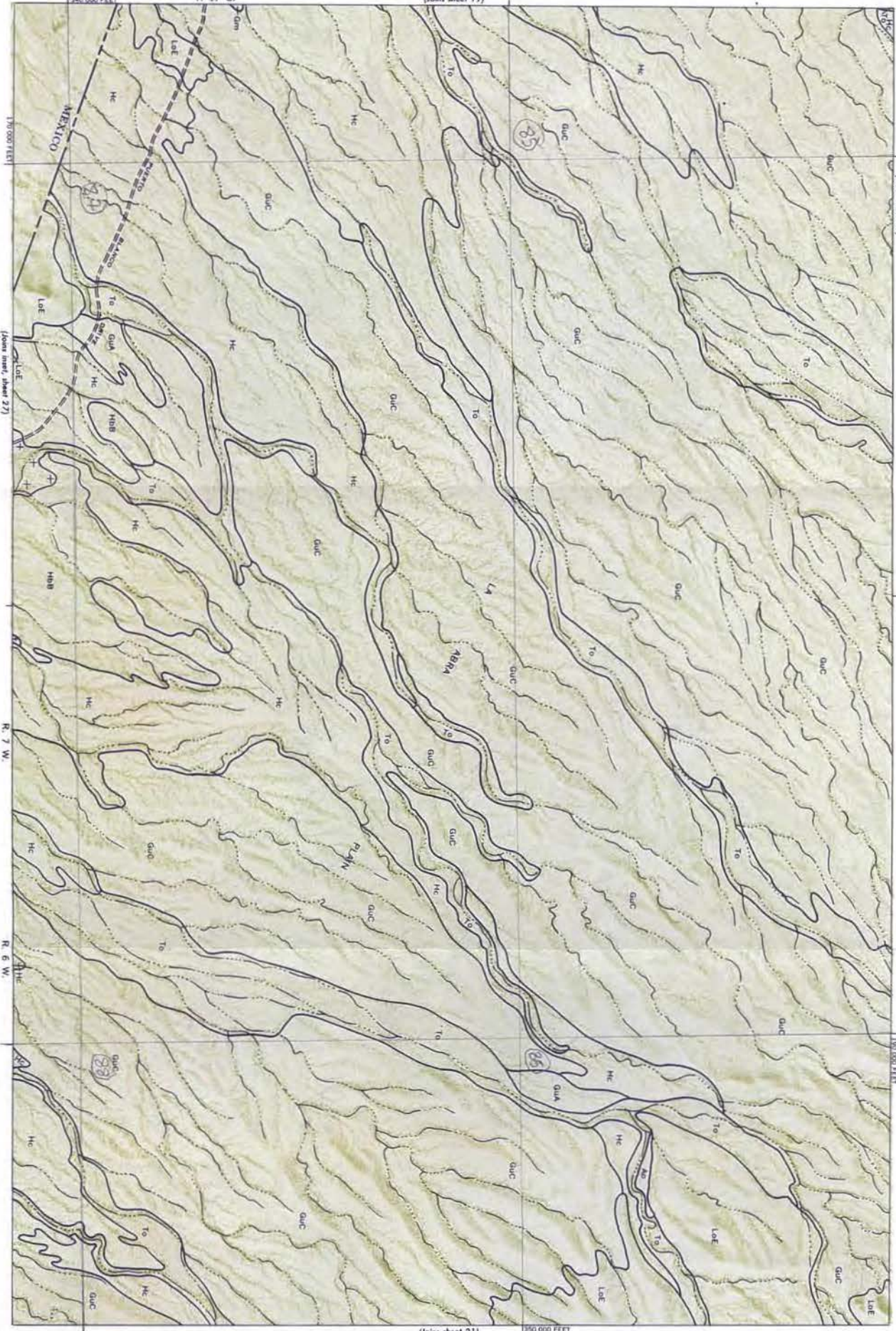
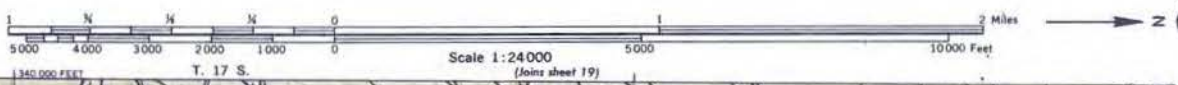
INSET

255,000 FEET

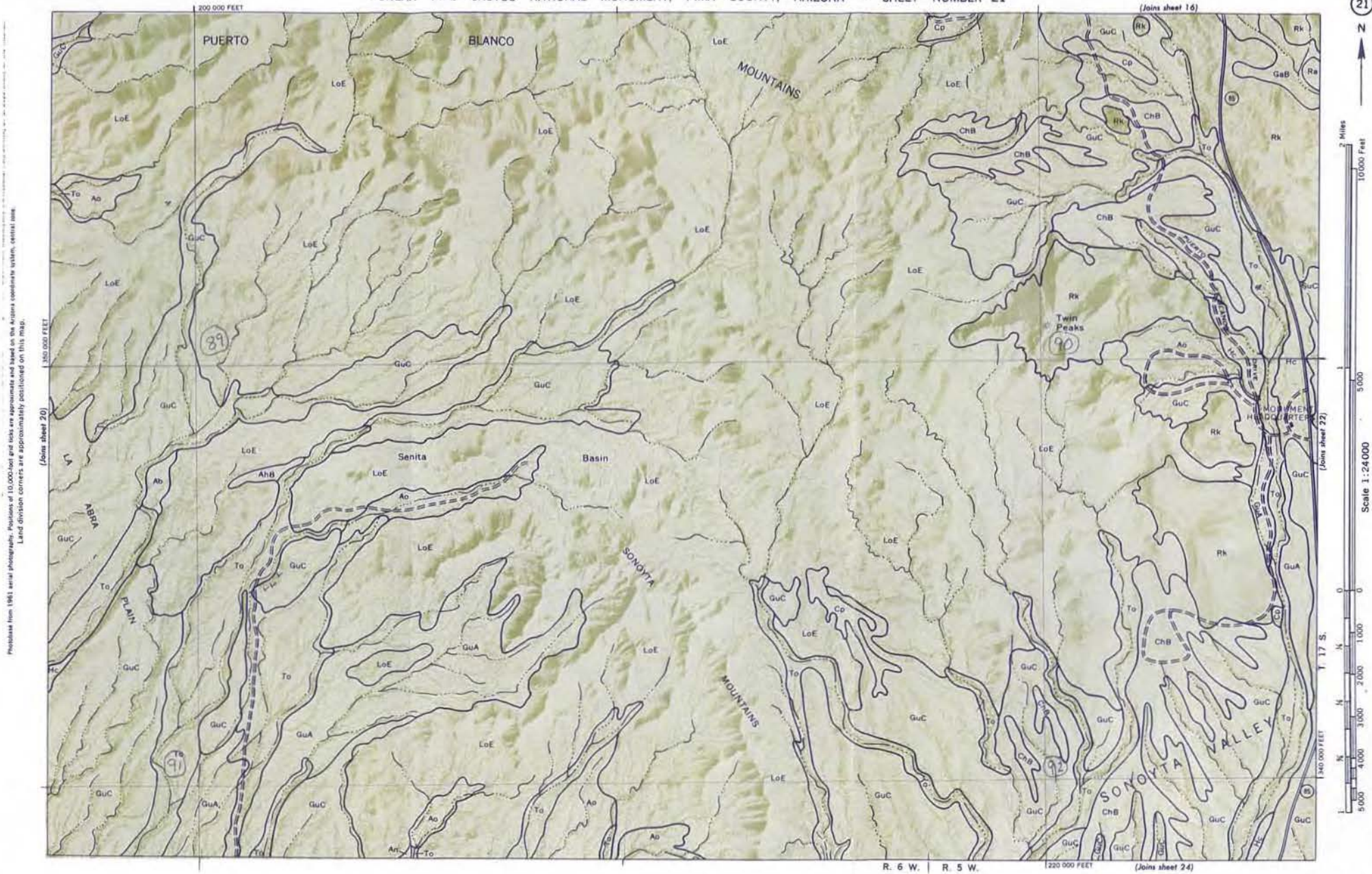


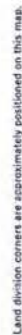
This map is one of a set compiled in 1972 as part of a soil survey for the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station, and the National Park Service U. S. Department of the Interior. Land division corners are approximately positioned on this map. Please use from 1961 aerial photographs. Please use the Arizona coordinate system, unless noted.



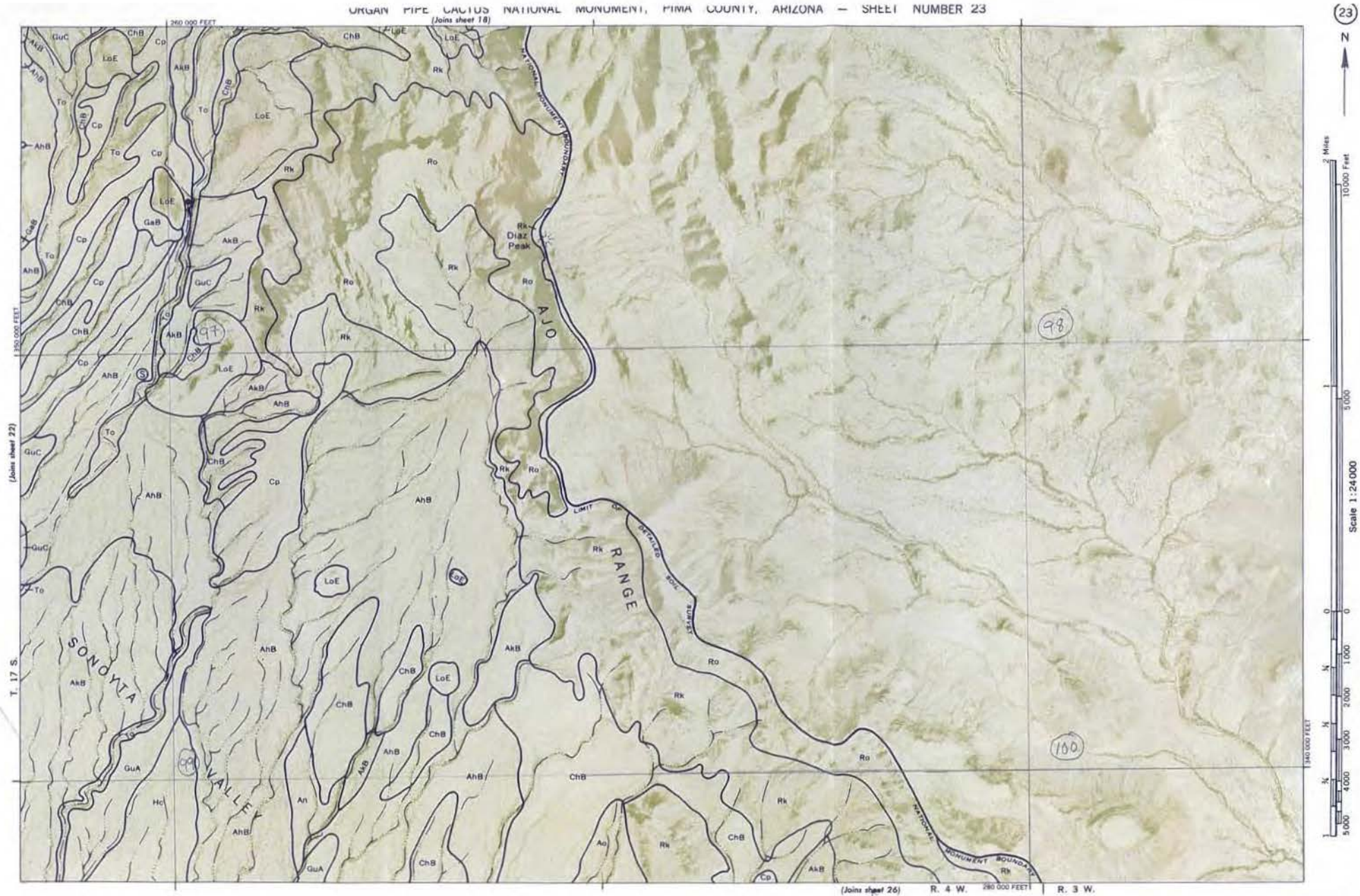


Land division corners are approximately positioned on this map.
Photobase from 1961 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone.

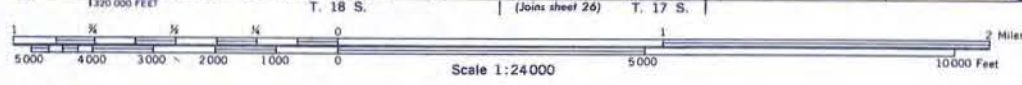
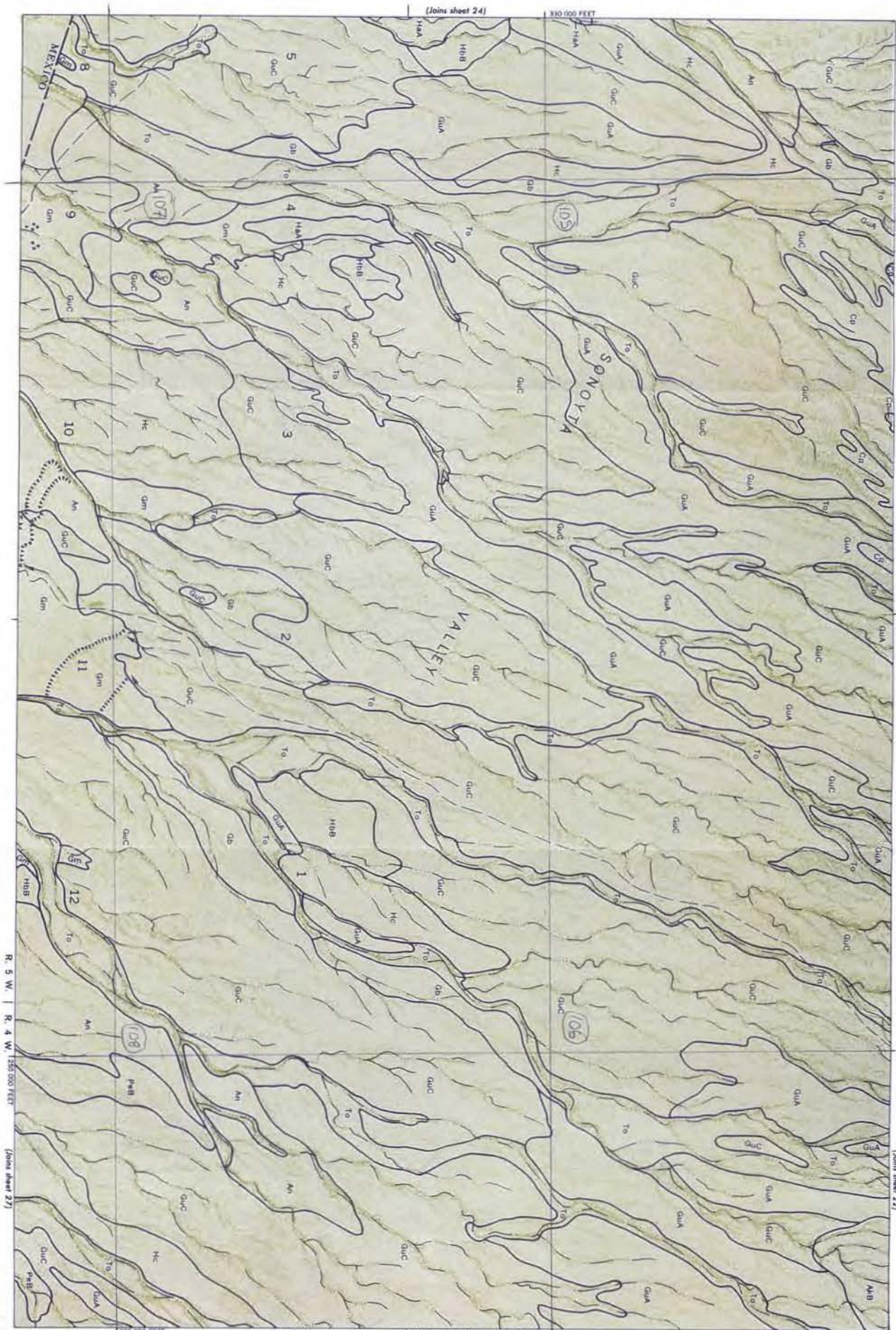




Photobase from 1961 aerial photography. Positions of 10,000 foot grid ticks are approximate and based on the Arizona coordinate system, entire zone. Land division corners are approximately positioned on this map.







R. 5 W. | R. 4 W. 120,000 FEET 130,000 FEET

M7-N-23519 sheet 25 of 28

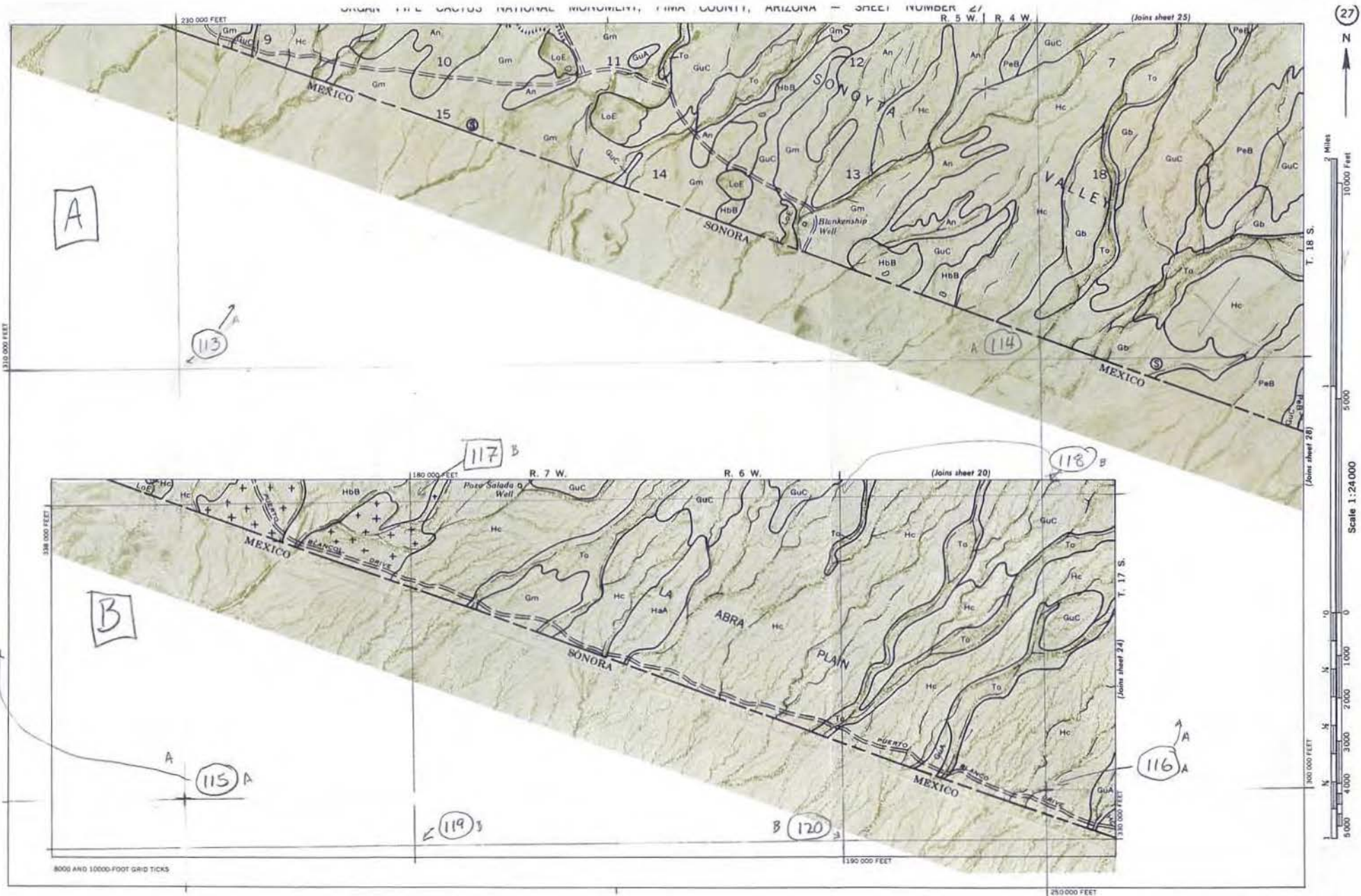


T. 18 S.	T. 17 S.
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and division corners are approximately positioned on this map.

Photobars from 1963 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone.

Photobase from 1961 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, central zone. Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map.

Photographs from 1963, aerial photography. Positions of 10,000-foot grid lines are approximate and based on the Arctoid coordinate system, central time. They were in use of a wet combed in 1972 as each of a such survey by the United States Department of Agriculture, Forest Service, and the National Aeronautics and Space Administration.