Work Report

Soil and Erosion Survey

Land Management Unit No.4

Navajo Project

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1936

U. S. Department of Agriculture

Soil Conservation Service

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All series names are provisional pending final correlation

by the Interbureau Correlation Committee

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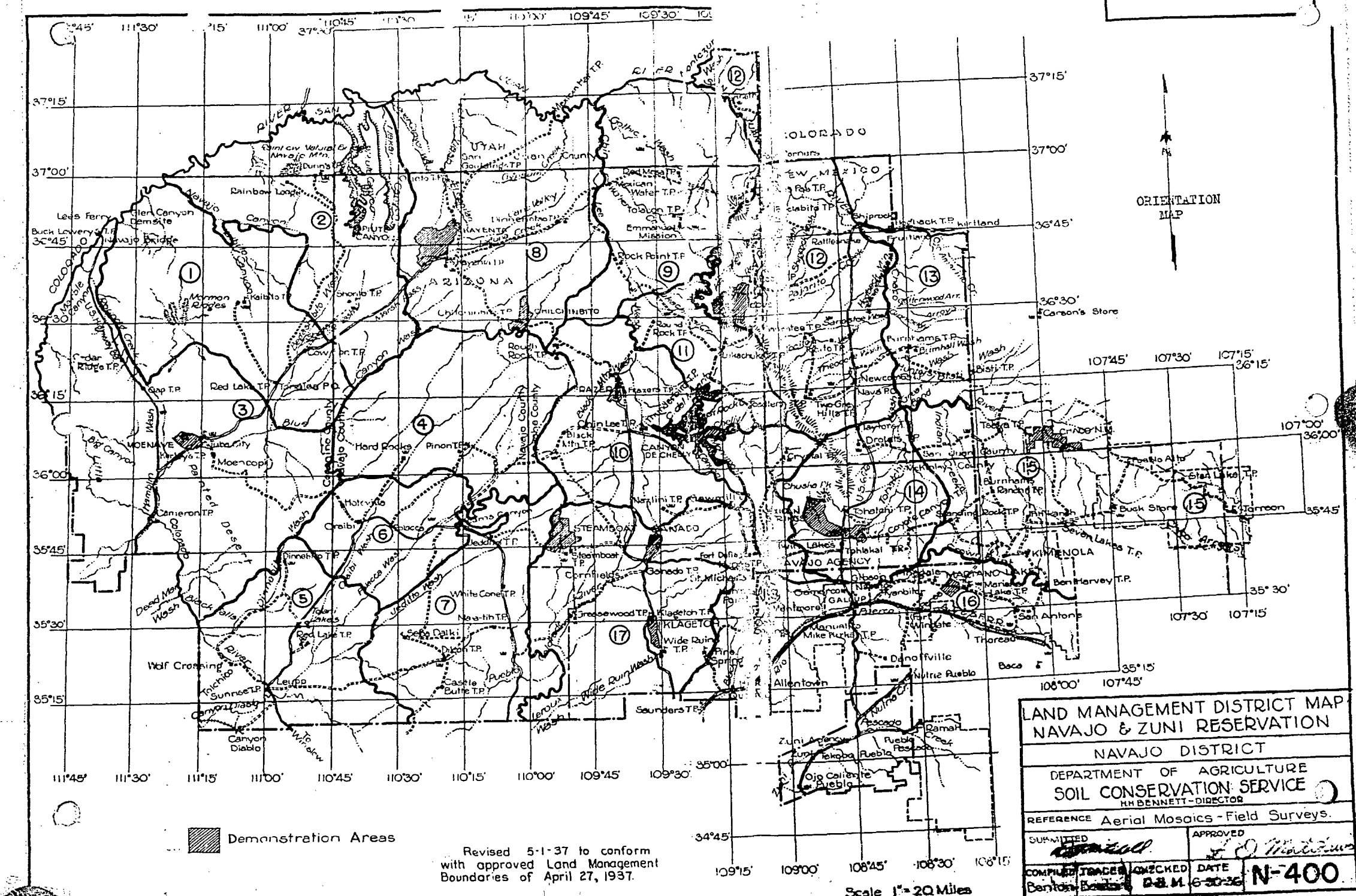

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INTRODUCTION

Land Management Unit 4 occupies the upper portion of Black Mesa which is located in the west central portion of the Navajo Indian Reservation. The east and west spread of the Unit is approximately sixty miles and the north and south spread is about forty miles. It lies roughly between the 109°50' and 111°00' W longitude and the 35°50' and 36°30' N latitude.

The Unit comprises an area of 966,685 acres.

The gradient of Black Mesa is southwestward. The topography of the extreme northern portion is steep, rough broken and rough stony. This type of topography breaks gradually toward the south and west into a series of strongly rolling hills, ridges and mesas. The latter are dissected by numerous intervening canyons and drainageways. Between the main ridges are broad valleys which extend northward almost to the steep north rim of Black Mesa. The valley topography is characterized by a broad, level valley floor which is bordered by a gentle toe slope at the base of the surrounding hills and mesas. The southwestern section of the Unit is characterized by gently rolling or undulating plateaus and mesas with steep, rough stony escarpments.

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The upper portion of Black Mesa is composed of Mesa Verde sandstone and shale. In the southern portion, near Howell Mesa, the underlying Mancos Shale appears. Underneath this, on the Moencopi plateau, the Dakota and Morrison (McElmo) formations are present. The uniformity of geologic material and slight variation in climate are factors responsible for considerable uniformity among soils.

All surface drainage leads southwest to the Little Colorado River. Important drainageways named in order, from east to west, are the Polacca, Wepo, Oraibi, Dinnebito, and Moencopi Washes. The Moencopi Wash has a small permanent flow, but the other drainages are intermittent or semi-permanent.

Climatological records are not available for this area. However, climatological information, probably representative for the Unit, has been compiled from records available at Tuba City, Kayenta, Chin Lee, and Keams Canyon.

*Factor	Southern Third	Middle Third	Northern Third
Elevation (Feet)	5800 - 6500	6500 - 7200	7200 - 7900
Precipitation (Inches)	9 - 12	12 - 15	15 - 20
Temperature (F°)	-15 - 100	-20 - 95	-20 - 90
Growing Season (Days)	120 - 140	110 - 120	100 - 110

*These data were compiled by J. W. Deppa.

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SOILS

The material presented in this report, including the erosion and land use maps, is based on information obtained through a detailed-reconnaissance soil and erosion survey. When information conflicts with that of more detailed studies, as the agronomic data on individual farms, the latter should be considered more reliable. The results of a detailed soil and erosion survey of the Wepo Irrigation project are herein presented. The maps will be referred to for clarification in the narrative discussion which follows. Detailed soil and erosion surveys of the Dinnebito and Hard Rocks Crossing Irrigation projects are reported separately.

The soils of Unit 4 are classified, first, according to mode of formation, as alluvial valley filling and residual soils. They are classified further, according to stage of development and physical characteristics, into the following soil series:

Alluvial - - Concho, Wepo, Dinnebito and Oraibi.

Residual - - Floy, Hopi, Todilto and Cibola.

These series are further separated, according to surface textures, into soil types.

Rough broken and rough stony land, indicated on the map by 19B and 19S respectively, are classed as residual. The greater part of the surface area of this land class is composed of exposed geologic shale and sandstone. Appre-

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ciable areas of shallow, intermittent soil cover within this class, are indicated on the map in parenthesis; thus, (32.7).

ALKALI

Alkali is not present in sufficient quantities to limit vegetative growth in many places. The heavy-textured soil types of the Concho Series are affected to some extent by heavy concentrations of alkali. Local areas of high concentration are indicated on the accompanying maps by the symbol "A". Most areas affected are easily recognized by the "slick spot" and "piping holes" associated with the condition. A table containing analyses of random reconnaissance alkali samples and one of the proposed Depo Diversion area samples is included in this report. (See maps for sample location.) The alluvial soils are predominantly heavy-textured. Shales and the primary soils derived from them are susceptible to erosion by water because of their slower rate of permeability. These will be referred to more specifically in the soil type discussion which follows.

CONCHO SERIES

This series is characterized by a slightly compact and calcareous surface soil, varying in color from light gray to medium brown. The subsoil is compact, heavy in texture, with lime accumulations along fracture planes.

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The soils of this series are developed from deep alluvium, located in all the main valleys and in some secondary drainageways. In general the clay and heavy clay types occur on the level, main valley floors. The lighter-textured types are located on the gentle toe slopes, as fans at the mouth of secondary drainages, and occasionally as flood plains on the valley bottom. The topography is level or gently sloping and smooth, except for local areas broken by severe gully erosion and occasional wind hummocks. Chamise, yellow brush, and Russian thistle comprise the vegetative cover on the friable soil types, and greasewood, shadscale, and western wheat grass are native plants adapted to the heavy clay. Water erosion is active where the vegetative cover is damaged by overgrazing. The usual inverse correlation exists between density of cover and degree of sheet erosion. These soils are predominantly heavy in texture, often to the extent of lowering their agricultural adaptation. However, local areas, scattered throughout the Unit, are adapted to Navajo farming. Three types - - Concho sandy loam, clay loam, and clay - - are mapped.

Concho Sandy Loam: The surface soil is moderately permeable, and the subsoil has a high water-holding capacity. This type is among the best agricultural soils in the Unit except where local detrimental conditions occur. It is rated as Grade "B"

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agricultural land. This type occurs at the mouth of secondary drainageways and along the base of mesa escarpments.

Concho Clay Loam: The Concho Clay Loam is very similar to the sandy loam type except that it is heavier in texture throughout the profile. This characteristic lowers the rate of water penetration and makes it more difficult to till when wet. Except for local spots, the alkali content is low. Agricultural adaptation is usually dependent on the permeability of the subsoil. Concho Clay Loam with a friable subsoil, rated "B", is adapted and recommended for agricultural purposes, but areas having a dense heavy clay subsoil, rated "D", are not recommended. The type is generally mapped on the toe slope bordering the main valley.

Concho Clay:

This type consists of light and heavy clay undifferentiated. The surface soil of the former is frequently friable and tillable with moderate water penetration. If the subsoil is also friable, facilitating adequate sub-drainage, this type is rated "C" agricultural land and recommended for crops which tolerate a heavy soil.

The surface soil of the heavy clay is characterized by a crust mulch underlain by a heavy impervious clay. Water penetration is rapid at first, but when the crust mulch is satu-

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rated further absorption is slow. The soils of this type, having an impervious subsoil, or a high alkali content, are rated as "D" or non-agricultural.

A significant portion of Concho Heavy Clay is impregnated with alkali. These areas can usually be recognized by the occurrence of "slick spots" and by the presence of alkali-tolerant vegetation, such as greasewood and shadscale. This vegetation has relatively low grazing value; and the soil is rated "C" or "D" from the standpoint of range adaptation.

Concho Overwash Phase:

A deposit of undeveloped soil materials over the Concho soils, in the form of alluvial fans, is common at the mouth of secondary drainages, or where the main wash spreads out over the valley floor. This material has been classed as an overwash phase, and is indicated on the map by the symbols 55.1S, 55.7S, and 55.13S. With the possible exception of the loamy sand phase (55.1S), these soils are all adapted to agricultural development and are recommended for that purpose. From the standpoint of agricultural adaptation, these soil type phases are rated as follows: 55.1S, "B" or "C"; 55.7S, "A", 55.13S "A" or "B".

Precautions:

1. Alkali affected areas, referred to above, are indicated on the accompanying map by the symbol "A". These should be avoided when subjugating this soil for agricultural use.

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2. Clay and colloidal clay are sufficiently high to cause excessive heaving and cracking with alternate wetting and drying. This warrants the utmost care in selecting materials for earth structures, especially the heavier soil types.

3. The position of this series makes it especially susceptible to gully and sheet erosion, which originate on the denuded watersheds.

4. In places, erosion on this series is in the early stages of progress. Proper land use will aid the return of native vegetation and protect these areas from further erosion.

5. Wind erosion is sufficiently active on sandy, alluvial fans to warrant some means of control when cultivated.

Recommendations:

1. Mechanical treatment is recommended where head erosion is encroaching upon good grazing, or where farm land is being endangered either directly by cutting, or indirectly by excessive loss of water. These conditions are indicated on the soils map by appropriate symbols.

2. Water can be spread from small side drainages or from alluvial fans. These fans are usually adapted to the development of small farms.

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3. Revegetation is recommended on denuded water spreading areas. All livestock should be excluded by fencing or mutual agreement until the new growth has opportunity to establish itself.

4. Detailed soil and alkali investigations are recommended where large areas are to be developed for agricultural purposes.

5. Detailed laboratory analysis should be made of all earth materials proposed for use in large structures.

WEPO SERIES

The surface soil is a friable, medium to light-brown material often with a faint reddish cast. The subsoil is heavier in texture than the surface soil and very compact. The zone of maximum lime accumulation occurs at a depth of from eighteen to twenty-four inches. This is also the horizon of pronounced structural development, either a nut or in some places a tendency toward a Solonetz structure. The profile shows evidence of leaching of clay from the surface to the subsoil.

The soils of these series occur on the toe slope at the base of hills and mesas bordering the valley. The topography is smooth and gently sloping. The native vegetation consists of blue grama, galleta, and rabbit brush.

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Two types, the Wepo Sandy Loam and Clay Loam are indicated on the accompanying maps by the symbols 74.7 and 74.13 respectively.

Wepo Sandy Loam and Clay Loam:

The sandy loam is highly permeable, and the clay loam is moderately high. The subsoil has a high water-holding capacity with moderate or good sub-drainage. The salt content of these soils is low. With water available, they are well adapted to agricultural development and are recommended for that purpose. This series is classed as "A" or "B" agricultural soil and "A" range soil.

Precautions and recommendations:

1. The slope, depth, permeability and water-holding capacity will warrant contour furrowing.

2. Where water is available for irrigation purposes the sandy loam type is adapted to dry land farming. Both types are recommended for agricultural development.

3. This soil, especially the sandy loam type, is adapted to water spreading.

4. These soils can be used satisfactorily for earth structures.

5. Under cultivation, these soils are susceptible to wind erosion. Approved tillage and cropping practices will

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reduce this hazard to a minimum.

6. Mechanical treatment of head erosion is recommended.

DINNEBITO SERIES

In mapping, the Dinnebito Series was separated from the Wepo Series on the basis of a calcareous surface soil. From the standpoint of erosion and land use, the above discussion may be regarded as applicable to this series also.

ORAIBI SERIES

The Oraibi series is characterized by a friable, calcareous, grey or brown surface soil and a deep, slightly compact substratum varying little in texture throughout the profile. The organic content of the soil is low. The typical large block structure, showing little or no evidence of leaching, is characteristic of an undeveloped profile. The soil is derived from a deep recent alluvial deposit with a gently sloping, hummocky topography. Small areas are mapped in the southwestern portion of the Unit. Chamise and Russian thistle are native plants most common to this series. Oraibi sandy loam is the only type mapped.

Oraibi Sandy Loam

The Oraibi sandy loam is capable of absorbing water rapidly, but because of the light texture of the subsoil, it has a low water-holding capacity. It is adapted to Navajo farming methods and is recommended for development.

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Precautions and recommendations:

1. This soil is very susceptible to wind erosion. Strip cropping and windbreaks are recommended on cultivated areas.

2. The loose, porous nature of this soil type makes it susceptible to deep head erosion.

3. This type is adapted to agricultural development.

RESIDUAL SOILS

FLOY SERIES

The surface soil of this series is light-brown in color and loose or friable. The subsoil is heavier in texture and compact. In this horizon there is a pronounced structural development. This is usually a fragmentary or nut structure. Lime is present in varying amounts along fracture planes. A light gray sandstone underlies this soil.

This series is the most extensive mapped in the Unit. It covers the productive rolling hills and level mesa tops in the central portion. On the rough broken sections of the Unit it occurs as a shallow, intermittent soil cover. In many places the soil is entirely eroded away. In spite of a permeable surface soil, the rolling topography characteristic of this series, is very conducive to erosion by water. The condition of erosion is most severe under the woodland vegetative cover. (See erosion map.) Two vegetative types are found on this series, namely: (1) blue grama grass, galleta grass, sage

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brush, yellow brush, and Mormon tea on the deep soils, and, (2) coniferous woodland and browse on the shallow phase. Two types, sandy loam and clay loam, are indicated on the map. (Small, intermittent loamy sand areas are undifferentiated from the sandy loam.)

Floy Sandy Loam and Clay Loam

The sandy loam is highly permeable and the clay loam is moderately so. Both types have a high water-holding capacity. Low rainfall is a primary factor limiting the production of native vegetation. The soil is not adapted to cultivated crops, but it is rated as good to excellent for range purposes where arid conditions exist. (See Grades "A" and "B" on map.)

HOPI SERIES

In mapping, the Hopi Series was separated from the Floy Series on the basis of a calcareous surface soil and a mature subsoil. From the standpoint of erosion and land use the two series are essentially the same. Therefore, the discussion of the Floy series may apply here also.

TODILTO SERIES

This series is characterized by a friable, light-textured reddish-brown surface soil which is calcareous and the occurrence of lime spicules at about eight inches. The subsoil is compact and heavier in texture. Lime occurs in large soft nodules immediately above the parent sandstone at about fifty inches.

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The topography is marked by a series of paralleled ridges and troughs, which extend in the direction of prevailing winds. The ridges are sand dunes which have been stabilized by a vegetative cover consisting of galleta and blue grama grass. Mormon tea occupies the more recent hummocks. The series is mapped extensively in the southwestern portion of the Unit. One type, Todilto Loamy Sand, is mapped (21.1 on the map).

Todilto Loamy Sand

The surface soil is highly permeable and the subsoil has a moderately high water-holding capacity. These properties permit the soil to make maximum use of precipitation in the production of native vegetation. The productive capacity of this soil is limited more by low rainfall or soil moisture than by other soil characteristics. The soil is not adapted to agricultural use, but from the standpoint of range adaptation, it is rated as a soil of high quality. This series is very susceptible to wind erosion because of its level topography and very light texture. Approved grazing management will protect the present vegetative cover and minimize the hazard of wind erosion.

CIBOLA SERIES

The surface soil is a light brown, loose, calcareous material which grades into a moderately compact, heavier

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textured, dark-grey subsoil underlain at shallow depths by grey parent shale.

From the standpoint of acres mapped, this series is relatively unimportant. Areas of intermittent soil generally too small to delineate, occur throughout the rough broken class. Browse comprises most of the native vegetation. Cibola Clay Loam and Clay are mapped.

Cibola Clay Loam and Clay

Water penetration is rapid until the loose, shallow topsoil is saturated; after saturation further penetration is slow on these clay loams and clays. The water-holding capacity is relatively high. As a result of slow water penetration and a relatively steep topography, run-off is high, both as to rate and amount. This soil is susceptible to super-saturated erosion, a type of erosion exemplified by soils having loose fragmental surface soil underlain by impervious subsoils near enough to the surface to allow temporary filling of pore space by heavy rains, with subsequent flowing off of soils.* This soil has a low organic content and is highly alkaline. It has no agricultural value. Slow permeability and the concentration of alkali limits native vegetation. These types are classed as poor soils from the standpoint of range adaptation.

*H. H. Bennet. SCS-T-7 pg. 24

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Precautions and recommendations for Residual Soils

The residual soil series of this unit have many characteristics in common and consequently present similar problems from the standpoint of management. For this reason, precautions and recommendations for the residual soils are listed as follows:

1. Geologic erosion has always exceeded soil forming processes on some of these areas; on others the delicate balance of nature has been upset by man, thus contributing excessive accelerated erosion. In the latter areas approved range management and forestry practices will be most effective.

2. Light mechanical treatment to supplement range control on upper watershed areas is recommended.

EROSION

Erosion on Land Management Unit 4 is varied both in kind and severity. Strong southwesterly winds prevail during a large portion of the year and torrential rains seasonally fall over the entire unit. Wind and water erosion are recognized and indicated on the accompanying map in the composite symbols. The degree of sheet erosion is also indicated by colors.

The mountainous, rough broken portion of Black Mesa is an important part of the Little Colorado watershed. It represents an area eroded primarily by water. The rough terrain,

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the coniferous timber cover with little brush and duff, the nature of the precipitation, and the moderate permeability of the soil are factors contributing to a high run-off and concomitant erosion.

The extreme upper portion of Black Mesa is mountainous and cut by deep, steep-walled canyons. The topography flattens somewhat toward the lower or southern portions of the section but in places, is still very rough and broken. Rapid erosion on the steep slopes is probably a normal condition, but the present degree or severity, with little doubt, places it in the class of accelerated erosion. Sheet erosion is very severe on the hills and slopes. Numerous gullies, most of which have cut to bedrock, carry great quantities of silt during torrential rains. Deep gullies are actively cutting through all the valleys, and much of the alluvial soil is either being removed or has been removed.

Water erosion is less severe on the residual soils of the central section of the unit than on the more mountainous northern part. Sheet erosion is generally slight except on the crest of hills and under woodland cover. Occasional "B" gullies are present. Both sheet and gully action are decreasingly severe southwestward. Erosion by water is of minor significance. Wind erosion is active on the Moencopi Plateau in the vicinity of Howell Mesa. It decreases in severity to

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the northeast until it is slight or unrecognisable on the north central section. The soil is slightly less permeable and the topography more rolling in the central section, factors which contribute to water run-off and subsequent erosion. Due to the highly permeable, light-textured soil and the less rugged topography in the southwestern section, sheet and gully erosion are moderate, but wind modification is severe.

Large volumes of silt-laden water discharged from the steep denuded escarpments during torrential storms are largely responsible for the severe gully erosion occurring in all the main valleys. Many of these valleys are severely dissected by deep, steep-sided gullies. The banks slough into the channels during dry seasons and this material is removed by the next large flow; this condition, combined with new cutting heads and side drainages, has resulted in reducing many fertile alluvial valleys to wasteland. Deep gullies through valleys cause excessive drainage by lowering the water table and hastening surface run-off. Sheet erosion is generally slight or moderate and wind erosion is slight.

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TOTAL SALT CONTENT, MECHANICAL ANALYSIS AND pH OF RANDOM SAMPLES
COLLECTED ON UNIT #4, 1936

(Collected by Johnson, Hill, Miller)

Lab. No.	Field No.	Soil Type (Reconnaissance)	Depth (In.)	pH	Total Salts	Na_2CO_3 P.P.M.	MECHANICAL ANALYSIS Sand %	Silt %	Clay %
	S11-04								
3523	-01	55.18	0-4	7.9	.14	0	12.2	21.3	66.5
3523	-02		4-8	8	.145	0	6.8	23.8	69.4
3525	03		8-20	8	.22	0	13.6	29.2	57.2
3526	04		20-40	8	.25	0	5.3	20.2	74.5
3527	05		40	8	.17	0	25.1	43.0	31.9
3528	06	55.16	0-12	8.5	.20	147	8.3	42.9	48.8
3529	07		12-24	8	.46	0	4.5	38.4	57.1
3530	08		24-36	8	.40	[illegible]	5.4	26.0	68.6
3531	09	55.16	0-5	6.3		0	8.1	52.4	39.5
3532	10		5-16	7.0	.14	0	13.2	38.8	48.
3533	11		16-40	8.0	.13	0	31.0	25.7	43.3
3534	12		40	8.0	.11	0	56.0	18.0	26.0
3535	13	65.1	0-24	8.0	.02-	0			
3536	14	65.1	0-12	8.0	.105	0			
3537	15		12-24	8.0	.17	0			
3538	16	55.13	0-8	8.0	.16	0	50.9	15.4	33.7
3539	17		8-20	8.0	.16	0	77.6	3.4	19.0
3540	18		20	8.0	.115	0	83.0	2.1	14.9
3541	19	32.7	0-10	6.8	.08				[illegible].6
3542	20		10-16	8.0	.10	0	89.7	1.5	[illegible].8
3543	21		16-40	8.0	.02-	0	90.4	1.7	7.9
3544	22		40	8.0	.02-	0	89.8	0.4	9.8
3545	23	55.7	0-10	8.0	.09	0	73.9	12.7	13.4
3546	24		10-25	8.0	0	0	56.7	20.8	22.5
3547	25		24-40	8.0	.09	0	61.9	17.7	20.4
3548	26		40	8.0	.155	0	47.4	27.3	25.3
3549	27	74.1	0-12	8.0	.02-	0	85.2	6.3	8.5
3550	28		12-34	8.0	.02-	0	91.6	1.3	7.1
3551	29		34-42	8.0	.102-	0	80.5	7.3	12.2
3552	30		42	7.9	.02-	0	94.4	0	5.6
3556	34	22.13	0-3	8.0	.10	0	60.4	12.7	26.9
3557	35		3-6	8.3	.105	Tr*	55.6	8.8	35.6
3558	36		6-18	8.3	.08	Tr	71.0	4.3	24.7
3559	37		18	8.0	.36	0			

*Trace by chemical test.

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TOTAL SALT CONTENT, MECHANICAL ANALYSIS AND pH OF RANDOM SAMPLES
COLLECTED ON UNIT #4, 1936

Lab. No.	Field No.	Soil Type (Reconn.)	Depth (In.)	pH	Total Salts	Na_2CO_3 P.P.M.	MECHANICAL ANALYSIS Sand %	Silt %	Clay %
3560	38	21.1	0-10	8.3	.02-	Tr.	83.0	6.7	10.9
3561	39		10-24	8.3	.02-	Tr.	74.3	10.0	16.0
3562	40		24-40	8.3	.03	Tr.	71.3	12.7	16.0
3563	41		40	8.5	.02	Tr.	79.5	2.9	17.6
3564	42	76.13	0-12	8.0	.095	0	67.6	7.0	25.4
3565	43		12-24	8.0	.13	0	71.6	12.0	26.4
3566	44		24-40	8.0	.11	0	56.0	12.3	31.7
3567	45		40	8.3	.07	Tr.	69.8	8.2	22.0
3573	50(1)	55.18	0-12	8.0	.147	0	21.4	25.1	53.5
3574	51		12-24	8.0	.147	0	37.8	16.1	46.1
3575	53		24-36	8.0	.13	0	51.2	14.6	34.2
3576	54	32.7	0-12	8.0	.08	0	75.1	9.8	15.1
3577	55		12-24	8.3	.08	Tr.	62.0	15.8	22.2
3578	56	74.7	0-24	8.3	.075	Tr.	68.0	13.8	18.2
3579	57	55.	0-12	8.3	.115	Tr.	43.7	19.0	37.3
3580	58		12-24	8.3	.105	Tr.	56.0	14.0	30.0
3581	59		0-12	8.3	.07	Tr.	61.2	16.4	22.4
3582	60		12-24	8.3	.07	Tr.	55.5	23.7	20.8
3583	61	55.	0-12	8.5	.46	157	55.5	22.2	22.3
3584	62		12-24	8.0	.14	0	16.1	25.9	58.0
3585	63	32	0-3	7.3	.055	0	73.4	11.9	14.7
3586	64		3-10	8.3	.115	Tr.	64.6	9.8	25.6
3587	65		10-18	8.5	.11	Tr.	58.1	9.3	32.6
3588	66		18-36	8.0	.16	0	50.9	15.7	33.4
3589	67	74.	0-6	7.5	.11	0	59.8	14.5	25.7
3590	68		6-18	7.3	.035	0	79.5	5.1	15.4
3591	69		18-42	8.3	.02-	Tr.	83.1	4.3	12.6
3592	70	40.	0-3	8.0	.02-	0	73.9	14.9	11.2
3593	71		3-14	8.3	.02-	Tr.	7.25	10.2	17.3
3594	72	55.	0-8	8.0	.10	0	54.0	14.9	31.1
3595	73		8-20	8.0	.115	0	49.0	12.6	38.4
3596	74		20-40	8.3	.115	Tr.	68.3	10.7	21.0
3596	75		40	8.3	.08	Tr.	68.6	12.1	19.3

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TOTAL SALT CONTENT, MECHANICAL ANALYSIS AND pH OF SAMPLES
COLLECTED ON PROPOSED WEPO IRRIGATION
PROJECT
(Johnson and Miller)

Lab. No.	Field No.	Soil Type	Depth (In.)	pH	Total Salts	Na_2CO_3 P.P.M.	MECHANICAL ANALYSIS Sand %	Silt %	Clay %
3553	31	55.	S 0-12	7.9	.13	0	7.0	11.6	81.4
3554	32		12-24	8.0	.03	0	73.0	9.4	17.6
3555	33		24-36	8.0	.07	0	54.6	25.1	20.3
3568	46	55.	S 0-12	7.5	.12	0	29.2	24.4	46.4
3569	47		12-24	8.0	.12	0	15.2	28.4	56.4
3570	48		24-36	8.0	.11	0	23.7	45.2	31.1
3571	49		36-48	8.3	.08	Tr*	29.5	39.4	31.1
3572	50		48-60	8.0	.127	0	47.5	27.2	25.3
3598	75(1)	55.	S 0-12	8.0	.125	0	34.0	30.8	35.2
3599	76		12-24	8.3	.08	Tr	56.0	13.7	30.3
3600	77		24-36	8.0	.08	0	44.9	28.6	26.5
3601	78	55.	S 0-12	8.0	.11	0	44.5	30.6	24.9
3602	79		12-24	8.0	.08	0	71.8	13.5	14.7
3603	80		24-36	8.0	.11	0	48.7	19.4	31.9
3604	81	55.	S 0-12	8.0	.10	0	33.5	40.5	26.0
3605	82		12-24	8.0	.17	0	8.7	37.3	54.0
3606	83		24-36	8.0	.13	0	63.7	15.8	20.5
3607	84	55.	S 0-12	8.0	.105	0	26.6	41.6	31.8
3608	85		12-24	8.0	.12	0	31.5	27.4	41.1
3609	86		24-36	8.0	.06	0	42.7	37.2	20.1
3610	87	55.	S 0-12	7.5	.02-	0	88.8	5.6	5.6
3611	88		12-24	8.0	.06	0	44.2	29.4	24.6
3612	89		24-36	8.0	.115	0	19.0	18.2	62.8
3613	90	55.	S 0-12	7.3	.02-	0			
3614	91		12-24	8.0	.06	0			
3615	92		24-36	8.0	.105	0			

Note: Total salts determined by modified wheatstone (electrolytic)bridge.
* Trace by chemical test.

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