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SOIL SURVEY

Deschutes Area Oregon

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In Cooperation with
OREGON AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS SURVEY of the Deschutes Area will help you plan the kind of farming that will protect your soils and provide good yields. It describes the soils, shows their location on a map, and tells what they will do under different kinds of management.

Find Your Farm on the Map

In using this survey, start with the soil map, which consists of the 45 sheets bound in the back of this report. These sheets, if laid together, make a large map of the county. The map shows township and section lines, towns and villages, roads, streams, most of the houses in rural areas, and other landmarks.

To find your farm on the large map, use the index to map sheets. This is a small map of the Area on which numbered rectangles have been drawn to show where each sheet of the large map is located.

When you have found the map sheet for your farm, you will notice that boundaries of the soils have been outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Suppose you have found on your farm an area marked with the symbol De. You learn the name of the soil this symbol represents by looking at the map legend. The symbol De identifies Deschutes loamy sand, 0 to 3 percent slopes.

Learn About the Soils on Your Farm

Deschutes loamy sand, 0 to 3 percent slopes, and all the other soils mapped are described in the section, Soil Types and Phases. Soil scientists, as they walked over the fields, described and mapped the soils. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, weeds, brush, or trees; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

After they mapped and studied the soils, the scientists placed them in management groups and subgroups and in capability groups. A management subgroup is a group of similar soils that need and respond to about the same kind of management. A capability group shows the uses that can be made of the soil and the kind of management needed to protect the soil and to obtain useful crops and other plants.

Deschutes loamy sand, 0 to 3 percent slopes, is in management subgroup 1B. Turn to the section, Use and Management of Soils, and read what is said about soils of subgroup 1B. You will want to study table 3, which tells you how much you can expect to harvest from Deschutes loamy sand, 0 to 3 percent slopes.

Make a Farm Plan

For the soils on your farm, compare your yields and farm practices with those given in this report. Look at your fields for signs of runoff and erosion. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service or the county agricultural agent. Members of the staff of your State agricultural experiment station and others familiar with farming in your county will also be glad to help you.

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The Deschutes Area

The Deschutes Area occupies 526.2 square miles in west-central Oregon along the Deschutes River (fig. 1). About half of the Area is in Deschutes County and half in Jefferson County. The climate is semiarid. Much of the Area has been used for range grazing and dry farming, but today large districts are irrigated and the acreage used for dry farming has decreased. The Area contains about three-fourths of the cropland of Deschutes County and Jefferson County. Farming is the most important enterprise. The main crops are potatoes, wheat and other grain, and alfalfa, and clover grown for seed. Livestock is raised for meat and for dairy products. The lumber industry is important in the southern part of the Area.

This is a cooperative soil survey made by the Department of Agriculture and the Oregon Agricultural Experiment Station. It was made to aid the farmers in planning the best use of their soils. It is not intended as a substitute for the detailed information on management and crop varieties that can be obtained from county agricultural agents, local representatives of the Soil Conservation Service, the State experiment stations, or similar sources.

The fieldwork for this survey was completed in 1945. Unless otherwise indicated, all statements in this report refer to conditions in the Area at that time.

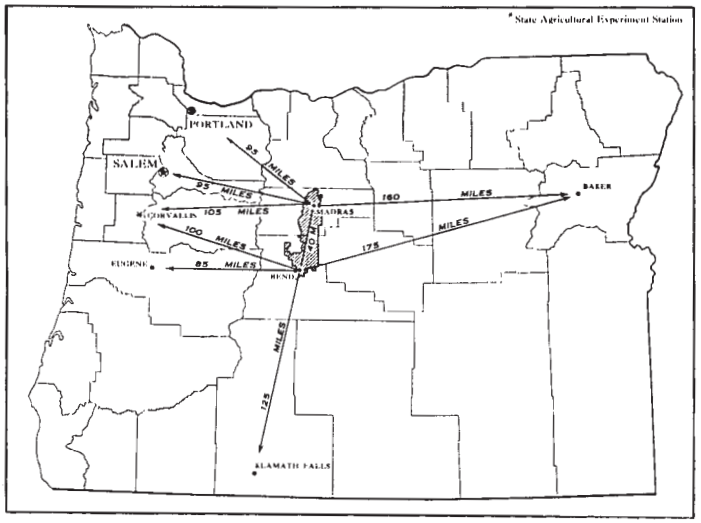

Figure 1.—Location of the Deschutes Area in Oregon.

[1] Fieldwork for this survey was done under the direction of the Division of Soil Survey when it was a part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

Soils of the Deschutes Area

The soils of the Deschutes Area generally are similar to other soils of the semiarid region of central Oregon. This similarity is greatest in those characteristics that were determined mainly by the effects of climate and vegetation. Table 1 gives some important characteristics of the soil series of the Area.

In the extreme southern and southwestern parts of the Area, the climate is similar to that where rather luxuriant grasses grow in parts of Umatilla County, the Palouse region in Washington, and in many places in a belt below the forests of the Blue Mountains. But in the extreme southern and southwestern parts of the Area, the vegetation is sparse, apparently because the coarse texture of the soil material is not suited to a dense growth of grasses. The upper part of these soils is sandy; it developed from a geologically young mantle of pumice. These soils are light colored and low in organic matter and nitrogen. The soils on which the grasses are more dense are darker colored and contain more organic matter.

On and near Haystack Butte and Juniper Butte, the altitude and precipitation generally are higher than in most of the Area, and the parent material is finer. Grasses and other plants are more dense. The upper part of the soil is moderately dark in color and contains a moderate to somewhat high organic-matter and nitrogen content.

The soils of the Area are not so highly leached as the soils in regions of high precipitation. Most of the soils contain a moderate to large amount of plant nutrients, but on some of the soils applications of sulfur, potash, phosphate, boron, and nitrogen are needed for certain crops. Most of the soils of the Area need no lime.

Most of the soils of the Area are sandy loams, but the texture ranges from loamy coarse sand to clay loam. Generally the coarse-textured soils are easier to work and more permeable than the medium-textured or fine-

TABLE 1.—*Important characteristics of the soil series*

Soil series	Topographic position	Drainage	Subsoil	Parent material
Agency	Nearly level to hilly uplands.	Good	Clay loam; calcareous in lower part.	In upper part, weathered pumiceous or tuffaceous sandstone and agglomerate and a little fine wind-carried material; weathered basaltic or other lava material in lower part.
Deschutes	Same	Good to somewhat excessive.	Sandy loam or loamy sand; calcareous in lower part.	Wind-carried pumice sand.
Era	Same	Good	Sandy loam or loam; calcareous in lower part.	In upper part, weathered pumiceous or tuffaceous sandstone and agglomerate and a little fine wind-carried material; weathered basaltic or other lava material in lower part.
Gem	Undulating to hilly uplands.	Good	Clay; calcareous in lower part.	Weathered basalt.
Laidlaw	Nearly level to hilly uplands.	Good to somewhat excessive.	Sandy loam; noncalcareous.	Wind-carried pumice over pumice flow.
Lamonta	Same	Good	Clay; calcareous in lower part.	Weathered, partly consolidated sandstone and agglomerate and old water-spread or colluvial mixed materials, mostly rhyolitic and acid igneous, but includes andesitic and basaltic materials.
Madras	Nearly level to rolling uplands.	Good	Clay loam over lime and silica hardpan or cemented layer.	Weathered pumiceous sandstone and agglomerate with a little fine wind-carried material in the upper part.
Metolius	Level and undulating bottom lands and alluvial fans.	Good	Sandy loam	Alluvial material high in pumice.
Odin	Shallow depressions and swales in uplands.	Imperfect to poor	Clay loam	Pumice sand with a small admixture of waterlaid material.
Redmond	Level and very gently sloping uplands.	Moderately good	Light clay loam or heavy loam.	Pumice sand.

textured soils, but they are less fertile, more likely to erode, and need more water. Loose stones and rock outcrops prevent the economical cultivation of some soils.

The soils differ in structure from place to place. Only a few are strongly granular in the surface soil. Some are largely single grained.

The depth of most soils of the Area is between 16 and 26 inches, but depths range from a few inches to many feet. The underlying material is bedrock, hardpan, semiconsolidated material, loose gravel, cobblestones, or other material that obstructs root penetration. The soils that are less than 16 inches deep are mapped as shallow soils. Some soils that are more than 36 inches deep are mapped as deep soils.

Soil Types and Phases

In the following pages the soil types and phases and the miscellaneous land types of the Area are described in detail and their agricultural uses are discussed. Their location and distribution are shown on the soil map at the back of this report, and their approximate acreage and proportionate extent are shown in table 2.

This section was written at the time of the survey. Since that time there have been many changes in the use and management of the soils of the Deschutes Area. Later information on use and management can be obtained from the Oregon Agricultural Experiment Station and from the local representative of the Soil Conservation Service.

TABLE 2.—*Approximate acreage and proportionate extent of the soils mapped*

Soil	Acres	Percent	Soil	Acres	Percent
Agency gravelly loam, 0 to 3 percent slopes	123	(1)	Agency loam, stony, 0 to 3 percent slopes	1, 517	0. 5
Agency gravelly loam, 3 to 7 percent slopes	347	0. 1	Agency loam, stony, 3 to 7 percent slopes	3, 698	1. 1
Agency gravelly loam, 7 to 12 percent slopes	124	(1)	Agency loam, stony, 7 to 12 percent slopes	1, 005	. 3
Agency gravelly loam, eroded, 3 to 7 percent slopes.	446	. 1	Agency loam, stony, 12 to 20 percent slopes	495	. 1
Agency gravelly loam, eroded, 7 to 12 percent slopes.	302	. 1	Agency loam, stony, 20 to 35 percent slopes	114	(1)
Agency loam, 0 to 3 percent slopes	5, 776	1. 7	Agency sandy loam, 0 to 3 percent slopes	2, 997	1. 0
Agency loam, 3 to 7 percent slopes	737	. 2	Agency sandy loam, 3 to 7 percent slopes	181	. 1
Agency loam, 7 to 12 percent slopes	93	(1)	Agency sandy loam, eroded, 0 to 3 percent slopes	908	. 3
Agency loam, 12 to 20 percent slopes	67	(1)	Agency sandy loam, eroded, 3 to 7 percent slopes	215	. 1
Agency loam, eroded, 0 to 3 percent slopes	1, 575	. 5	Deschutes coarse sandy loam, over sandy material, 0 to 3 percent slopes	816	. 2
Agency loam, eroded, 3 to 7 percent slopes	519	. 2	Deschutes loam, stony, 0 to 3 percent slopes	75	(1)
Agency loam, eroded, 20 to 35 percent slopes	65	(1)			

[1] Less than 0.1 percent.

TABLE 2.—*Approximate acreage and proportionate extent of the soils mapped*—Continued

Soil	Acres	Percent
Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent slopes	1, 207	0. 4
Deschutes loamy coarse sand, over gravelly material, 3 to 7 percent slopes	117	(1)
Deschutes loamy sand, 0 to 3 percent slopes	18, 960	5. 6
Deschutes loamy sand, 3 to 7 percent slopes	1, 983	. 6
Deschutes loamy sand, 7 to 12 percent slopes	256	. 1
Deschutes loamy sand, eroded, 0 to 3 percent slopes	432	. 1
Deschutes loamy sand, over cinders, 0 to 3 percent slopes	49	(1)
Deschutes loamy sand, over cinders, 3 to 7 percent slopes	174	. 1
Deschutes loamy sand, over cinders, eroded, 3 to 7 percent slopes	94	(1)
Deschutes loamy sand, over cobbly material, 0 to 3 percent slopes	527	. 2
Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes	3, 660	1. 1
Deschutes loamy sand, over gravelly material, 3 to 7 percent slopes	461	. 1
Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes	576	. 2
Deschutes loamy sand, over semicemented sandy material, 3 to 7 percent slopes	750	. 2
Deschutes loamy sand, over semicemented sandy material, 7 to 12 percent slopes	67	(1)
Deschutes sandy loam, 0 to 3 percent slopes	13, 048	4. 0
Deschutes sandy loam, 3 to 7 percent slopes	2, 018	. 6
Deschutes sandy loam, 7 to 12 percent slopes	152	(1)
Deschutes sandy loam, 12 to 20 percent slopes	98	(1)
Deschutes sandy loam, deep, 0 to 3 percent slopes	2, 077	. 6
Deschutes sandy loam, deep, 3 to 7 percent slopes	328	. 1
Deschutes sandy loam, deep over cinders, 0 to 3 percent slopes	168	(1)
Deschutes sandy loam, eroded, 7 to 12 percent slopes	90	(1)
Deschutes sandy loam, over cinders, 0 to 3 percent slopes	827	. 2
Deschutes sandy loam, over cinders, 3 to 7 percent slopes	172	. 1
Deschutes sandy loam, over cinders, eroded, 3 to 7 percent slopes	64	(1)
Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes	8, 183	2. 4
Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes	1, 191	. 4
Deschutes sandy loam, over semicemented sandy material, 7 to 12 percent slopes	61	(1)
Deschutes sandy loam, over semicemented sandy material, eroded, 12 to 20 percent slopes	62	(1)
Deschutes sandy loam, shallow, 0 to 3 percent slopes	566	. 2
Deschutes sandy loam, shallow, 3 to 7 percent slopes	199	. 1
Deschutes sandy loam, shallow over cinders, 0 to 3 percent slopes	77	(1)
Deschutes sandy loam, shallow over cinders, eroded, 3 to 7 percent slopes	79	(1)
Deschutes sandy loam, stony, 0 to 3 percent slopes	11, 088	3. 3
Deschutes sandy loam, stony, 3 to 7 percent slopes	1, 721	. 5
Deschutes sandy loam, stony, 7 to 12 percent slopes	128	(1)
Deschutes sandy loam, stony, over cinders, 3 to 7 percent slopes	65	(1)
Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes	802	. 2
Deschutes sandy loam, stony, over semicemented sandy material, 3 to 7 percent slopes	274	0. 1
Deschutes sandy loam, stony, over semicemented sandy material, 7 to 12 percent slopes	43	(1)
Era sandy loam, 0 to 3 percent slopes	2, 495	. 7
Era sandy loam, 3 to 7 percent slopes	3, 458	1. 0
Era sandy loam, 7 to 12 percent slopes	1, 030	. 3
Era sandy loam, 12 to 20 percent slopes	226	. 1
Era sandy loam, eroded, 0 to 3 percent slopes	871	. 3
Era sandy loam, eroded, 3 to 7 percent slopes	2, 120	. 6
Era sandy loam, eroded, 7 to 12 percent slopes	735	. 2
Era sandy loam, eroded, 12 to 20 percent slopes	287	. 1
Gem clay loam, eroded, 3 to 12 percent slopes	50	(1)
Gem clay loam, eroded, 12 to 20 percent slopes	58	(1)
Gem clay loam, shallow, 7 to 12 percent slopes	92	(1)
Gem clay loam, shallow, eroded, 7 to 12 percent slopes	93	(1)
Gem loam, 3 to 7 percent slopes	105	(1)
Gem loam, 7 to 12 percent slopes	70	(1)
Gem loam, eroded, 7 to 12 percent slopes	123	(1)
Laidlaw sandy loam, 0 to 3 percent slopes	207	. 1
Laidlaw sandy loam, 3 to 7 percent slopes	612	. 2
Laidlaw sandy loam, 7 to 12 percent slopes	92	(1)
Laidlaw sandy loam, eroded, 7 to 12 percent slopes	69	(1)
Laidlaw sandy loam, eroded, 12 to 20 percent slopes	60	(1)
Lamonta loam, 0 to 3 percent slopes	1, 700	. 5
Lamonta loam, 3 to 7 percent slopes	3, 713	1. 1
Lamonta loam, 7 to 12 percent slopes	744	. 2
Lamonta loam, 12 to 20 percent slopes	128	(1)
Lamonta loam, eroded, 0 to 3 percent slopes	518	. 2
Lamonta loam, eroded, 3 to 7 percent slopes	1, 018	. 3
Lamonta loam, eroded, 7 to 12 percent slopes	470	. 1
Lamonta loam, eroded, 12 to 20 percent slopes	320	. 1
Lamonta loam, shallow, 0 to 3 percent slopes	100	(1)
Lamonta loam, shallow, 3 to 7 percent slopes	45	(1)
Lamonta loam, shallow, eroded, 3 to 7 percent slopes	133	(1)
Lamonta loam, shallow, eroded, 7 to 12 percent slopes	65	(1)
Lamonta loam, stony, 0 to 3 percent slopes	1, 072	. 3
Lamonta loam, stony, 3 to 7 percent slopes	2, 119	. 6
Lamonta loam, stony, 7 to 12 percent slopes	1, 863	. 6
Lamonta sandy clay loam, 0 to 3 percent slopes	312	. 1
Lamonta sandy clay loam, 3 to 7 percent slopes	490	. 1
Lamonta sandy clay loam, 7 to 12 percent slopes	74	(1)
Lamonta sandy clay loam, eroded, 0 to 3 percent slopes	340	. 1
Lamonta sandy clay loam, eroded, 3 to 7 percent slopes	414	. 1
Lamonta sandy clay loam, eroded, 7 to 12 percent slopes	386	. 1
Lamonta sandy clay loam, eroded, 12 to 20 percent slopes	96	(1)
Lamonta sandy clay loam, shallow, 0 to 3 percent slopes	47	(1)
Lamonta sandy clay loam, shallow, 3 to 7 percent slopes	70	(1)
Lamonta sandy clay loam, shallow, eroded, 3 to 7 percent slopes	246	. 1
Lamonta sandy clay loam, shallow, eroded, 7 to 12 percent slopes	169	. 1
Lamonta sandy clay loam, stony, 0 to 3 percent slopes	255	. 1
Lamonta sandy clay loam, stony, 3 to 7 percent slopes	411	. 1

[1] Less than 0.1 percent.

TABLE 2.—*Approximate acreage and proportionate extent of the soils mapped*—Continued

Soil	Acres	Percent
Lamonta sandy clay loam, stony, 7 to 12 percent slopes	259	0. 1
Lamonta sandy clay loam, stony, 12 to 20 percent slopes	433	. 1
Madras loam, 0 to 3 percent slopes	10, 759	3. 2
Madras loam, 3 to 7 percent slopes	3, 169	1. 0
Madras loam, 7 to 12 percent slopes	542	. 2
Madras loam, eroded, 0 to 3 percent slopes	3, 977	1. 2
Madras loam, eroded, 3 to 7 percent slopes	1, 598	. 5
Madras loam, eroded, 7 to 12 percent slopes	519	. 2
Madras loam, over sandstone, 0 to 3 percent slopes	1, 888	. 6
Madras loam, over sandstone, 3 to 7 percent slopes	483	. 1
Madras loam, over sandstone, eroded, 0 to 3 percent slopes	164	(1)
Madras loam, over sandstone, eroded, 3 to 7 percent slopes	127	(1)
Madras loam, stony, 0 to 3 percent slopes	634	. 2
Madras loam, stony, 3 to 7 percent slopes	1, 049	. 3
Madras loam, stony, 7 to 12 percent slopes	176	. 1
Madras loamy sand, over sandstone, 3 to 7 percent slopes	100	(1)
Madras loamy sand, over sandstone, eroded, 3 to 7 percent slopes	95	(1)
Madras sandy loam, 0 to 3 percent slopes	8, 313	2. 5
Madras sandy loam, 3 to 7 percent slopes	1, 982	. 6
Madras sandy loam, 7 to 12 percent slopes	246	. 1
Madras sandy loam, deep over sandstone, 0 to 3 percent slopes	246	. 1
Madras sandy loam, deep over sandstone, 3 to 7 percent slopes	97	(1)
Madras sandy loam, deep over sandstone, eroded, 3 to 7 percent slopes	150	(1)
Madras sandy loam, eroded, 0 to 3 percent slopes	3, 632	1. 1
Madras sandy loam, eroded, 3 to 7 percent slopes	985	. 3
Madras sandy loam, eroded, 7 to 12 percent slopes	62	(1)
Madras sandy loam, over sandstone, 0 to 3 percent slopes	3, 048	1. 0
Madras sandy loam, over sandstone, 3 to 7 percent slopes	1, 832	. 5
Madras sandy loam, over sandstone, 7 to 12 percent slopes	260	. 1
Madras sandy loam, over sandstone, 12 to 20 percent slopes	262	. 1
Madras sandy loam, over sandstone, eroded, 0 to 3 percent slopes	1, 174	. 3
Madras sandy loam, over sandstone, eroded, 3 to 7 percent slopes	2, 244	. 7
Madras sandy loam, over sandstone, eroded, 7 to 12 percent slopes	1, 170	. 3
Madras sandy loam, over sandstone, eroded, 12 to 20 percent slopes	809	0. 2
Madras sandy loam, shallow over sandstone, 0 to 3 percent slopes	171	. 1
Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes	212	. 1
Madras sandy loam, shallow over sandstone, 12 to 20 percent slopes	48	(1)
Madras sandy loam, shallow over sandstone, eroded, 3 to 7 percent slopes	116	(1)
Madras sandy loam, shallow over sandstone, eroded, 7 to 12 percent slopes	206	. 1
Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes	959	. 3
Madras sandy loam, stony, over sandstone, 3 to 7 percent slopes	953	. 3
Madras sandy loam, stony, over sandstone, 7 to 12 percent slopes	480	. 1
Madras sandy loam, stony, over sandstone, 12 to 20 percent slopes	747	. 2
Metolius sandy loam, 0 to 3 percent slopes	8, 332	2. 5
Metolius sandy loam, 3 to 7 percent slopes	1, 366	. 4
Metolius sandy loam, 7 to 12 percent slopes	310	. 1
Metolius sandy loam, eroded, 0 to 3 percent slopes	1, 646	. 5
Metolius sandy loam, eroded, 3 to 7 percent slopes	612	. 2
Metolius sandy loam, terrace position, 0 to 3 percent slopes	182	. 1
Metolius sandy loam, terrace position, 3 to 7 percent slopes	72	(1)
Odin clay loam, 0 to 3 percent slopes	285	. 1
Odin clay loam, 3 to 7 percent slopes	43	(1)
Odin sandy loam, 0 to 3 percent slopes	208	. 1
Pits and dumps	7	(1)
Redmond clay loam, 0 to 3 percent slopes	134	(1)
Redmond loam, 0 to 3 percent slopes	405	. 1
Redmond sandy loam, 0 to 3 percent slopes	3, 282	1. 0
Redmond sandy loam, 3 to 7 percent slopes	365	. 1
Redmond sandy loam, deep, 0 to 3 percent slopes	439	. 1
Riverwash	91	(1)
Rough broken land, Era and Deschutes soil materials, 12 to 50 percent slopes	3, 351	1. 0
Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes	45, 029	13. 4
Scabland, 0 to 3 percent slopes	6, 132	1. 8
Scabland, 3 to 12 percent slopes	82, 887	25. 0
Volcanic ash, 0 to 3 percent slopes	40	(1)
Total	336, 795	100. 0

[1] Less than 0.1 percent.

Agency gravelly loam

Almost all of this well-drained soil lies north of the Crooked River in nearly level to somewhat rolling plains. The natural vegetation consists of big sagebrush, rabbitbrush, bunchgrasses, scattered junipers, and associated plants. The normal annual precipitation is 8.5 to 10 inches.

The parent material of this soil consists of old water-laid or partly consolidated sedimentary materials and volcanic materials. In most places the upper part of the soil was derived from the somewhat consolidated agglomerates and sandstones of the Dalles formation (*5*)[2] mixed with a little fine pumice and volcanic ash. The lower part of the profile contains fragments of basalt or material weathered from basalt. The underlying material is basalt or other lava bedrock.

Typical profile:

0 to 9 inches, light brownish-gray to grayish-brown noncalcareous gravelly loam; very dark grayish brown and friable when moist.

9 to 18 inches, brown to grayish-brown noncalcareous gravelly clay loam; breaks into subangular blocky aggregates; mildly alkaline.

18 to 24 inches, brown to pale-brown or light yellowish-brown gravelly clay loam; contains basalt stones; breaks into subangular blocky aggregates; noncalcareous except in places in the lower part or on the under side of pebbles and stones.

24 inches+, lime-coated fragments of basalt that overlie basalt bedrock.

[2] Italic numbers in parentheses refer to Literature Cited, p. 81.

The depth to the underlying rock ranges from about 1½ to 3 feet. In some areas the underlying material is partly consolidated sandstone or agglomerate instead of basalt.

This soil contains many red rhyolitic and dark-colored basaltic or andesitic pebbles, but the content varies from place to place. In some areas subangular or rounded cobblestones occur. Commonly there are enough pebbles to interfere with tillage. The upper part of the soil contains small amounts of fine pumice.

Although low in organic matter, this soil is moderately fertile. The surface soil is permeable to water and roots. The subsoil is slightly less permeable. The underlying basalt is relatively impermeable, but in places fissures or cracks allow water to move downward. Because of the content of pebbles and the moderate depth of the soil, water-holding capacity is moderate to somewhat low.

To show variations in slope and erosion, five phases of this soil are mapped.

Agency gravelly loam, 0 to 3 percent slopes (Aa).—This soil occurs in several small tracts in Jefferson County in association with other Agency soils and soils of the Era, Madras, and Lamonta series. Runoff is fairly slow, and water erosion is slight. In a few places wind erosion is moderate.

Use and management (subgroup 2A)[3].—About 80 percent of this soil is used for grain under a dryland summer-fallow system. Most of the rest is idle or in annual or perennial grasses and used for grazing. Average yields of grain are low.

Some of this soil probably will be irrigated under the Deschutes Irrigation Project. The soil appears to be only fair to good for irrigated crops. The gravel impedes cultivation and would hinder the growth and harvesting of potatoes. If irrigated, the soil would be suited to permanent pasture, hay, clover for seed, and grain.

Management needs are similar to those of Agency loam, 0 to 3 percent slopes. Growth of weeds should be prevented so that the available moisture can be used by crops and pasture plants. While the soil is fallow, much of the stubble should be left on the ground to prevent wind erosion.

Agency gravelly loam, 3 to 7 percent slopes (Ab).—This soil is gently sloping or undulating; consequently, it has more rapid runoff than Agency gravelly loam, 0 to 3 percent slopes, and is more likely to erode if irrigated. Distribution and control of irrigation water will be more difficult.

Use and management (subgroup 2B).—About 60 percent of this soil is in sagebrush and grass; about 10 percent has been cropped but is now in grass. These areas are used for grazing. The carrying capacity is rather low. The rest of this soil has been used for grain under a dryland summer-fallow system. Average yields are low.

Some of this soil probably will be irrigated, though it is only fair for irrigated crops. The relief will make it difficult to distribute water evenly, and the gravel impedes cultivation. This soil is better suited to permanent grass-legume pasture, hay, clover seed, and grain than to potatoes or other row crops.

Agency gravelly loam, 7 to 12 percent slopes (Ad).—Small areas of this sloping or rolling soil are widely scattered in Jefferson County. Runoff is greater than on Agency gravelly loam, 0 to 3 percent slopes. This soil is fair to poor in workability and is likely to erode if irrigated.

Use and management (subgroup 2C).—About 60 percent of this soil is in sagebrush and grass and is used for grazing. The rest is used for dry-farmed grain. Yields are low.

Some areas of this soil lie below the canals and possibly will be irrigated. These areas are best suited to permanent grass-legume pasture. The soil would be poor for irrigated crops. Management needs are similar to those of Agency gravelly loam, eroded, 7 to 12 percent slopes.

Agency gravelly loam, eroded, 3 to 7 percent slopes (Ac).—This soil is moderately eroded. Most of it has lost one-fourth or more of the original surface soil through erosion. Deep plowing may turn up some of the subsurface soil or subsoil. Runoff has caused most of the erosion, but in places wind has caused some. In most areas there is enough gravel on the surface and in the surface soil to interfere with cultivation, especially with the harvesting of potatoes. In some areas the pebbles are subangular rock fragments, and in a few places cobblestones occur.

Use and management (subgroup 2B).—Nearly 40 percent of this soil has been cropped but is now idle or in annual or perennial grasses. Another 15 percent has a cover of sagebrush and grass. All these tracts are used for range. Most of the rest of the soil is used for dry-farmed grain and left fallow every other summer. Average yields are low.

Some of this soil will be irrigated. It is only fairly well suited to irrigation. It is better suited to permanent grass-legume pasture, hay, clover seed, vetch seed, and grain than to potatoes or other row crops. Management needs are similar to those of Agency loam, 3 to 7 percent slopes.

It is difficult to distribute water evenly without causing erosion. The corrugation method is probably the best method of irrigating most areas. Runs should be short. Deep cuts should not be made when this soil is being leveled.

Agency gravelly loam, eroded, 7 to 12 percent slopes (Ae).—Most of this soil has lost between 25 and 75 percent of the surface soil through erosion. A few acres have lost almost all the surface soil. Shallow gullies have formed in a few places east of Madras. Runoff has caused most of the erosion. Some wind erosion may have occurred. Runoff is medium where the soil is not protected by vegetation. The erosion hazard under irrigation would be high. Workability is fair to poor.

Use and management (subgroup 2C).—About 20 percent of this soil has a cover of sagebrush and grass; slightly more than 30 percent has been cultivated but is now idle or in annual or perennial grass. These tracts are used for grazing. Their carrying capacity is low. Nearly half of this soil is used for dry-farmed wheat under a summer-fallow system. Average yields are low, perhaps about 7 bushels per acre.

The density and vigor of the grasses could be improved by controlling grazing. Some areas may need to be reseeded to crested wheatgrass.

Most of the straw and stubble of dry-farmed grain should be returned to the soil to supply organic matter. Stubble mulching and contour tillage help to reduce erosion. A rotation of 6 or 8 years of crested wheatgrass

[3] The use suitability and suggested management of the soils of the Area are given by management groups and subgroups in the section, Use and Management of Soils.

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and 8 years of alternate wheat and fallow is well suited to this soil.

Some of this soil lies below the irrigation canal, and probably part of it will be irrigated. If irrigated it will be suitable for grass-legume pasture. It is poorly suited to irrigated crops.

Agency loam

Agency loam occurs in Jefferson County, most extensively on the Agency Plains and near Culver and Opal City. Much of it will be irrigated by the Deschutes Irrigation Project. Practically all of this soil lies north of the Crooked River. Most of it is nearly level or gently undulating, but some is strongly undulating, rolling, or hilly. It is well drained. The natural vegetation consisted of big sagebrush, rabbitbrush, bunchgrasses, scattered junipers, and associated plants. The normal annual precipitation is about 8.5 to 10 inches.

This soil was derived from old sedimentary materials and volcanic materials. Most of the sediment was of volcanic origin. The upper part of the soil developed mainly from partly consolidated sedimentary materials weathered from the Dalles formation. This formation consists of sandstones, agglomerates, gravels, sands, tuffs, cinders, ashes, and agglomerate-mudflows (*5*). The sandstones and agglomerates are dominant in this region. They contain large amounts of rhyolitic and other acidic igneous materials and materials that are andesitic and more basic. The upper part of the profile may contain a small amount of fine pumice, volcanic ash, or loess. The lower part of the profile typically has been affected by basaltic rock fragments and materials weathered from these fragments.

Agency loam is associated with the Madras, Era, and Lamonta soils. The Agency soils generally lack the caliche layer that is characteristic of the Madras soils. Agency soils have been affected more than Madras by basaltic materials. They differ from the Era and Lamonta soils in the development and texture of the subsoil. The Agency subsoil is fine textured and moderately developed, whereas the subsoil of the Era soils is coarser in texture. The texture of the Lamonta subsoils is finer and more dense than that of the Agency. Agency soils are somewhat similar to Redmond but contain less pumice.

Typical profile:

to 10 inches, light brownish-gray or grayish-brown noncalcareous slightly hard loam; very fine granular structure; when moist, very dark grayish brown and friable; neutral reaction; grades to the layer below.

10 to 20 inches, brown noncalcareous hard clay loam that breaks into moderate fine subangular blocky or rounded aggregates; aggregates thinly coated with darker glossy material; few to moderate number of fine pores; when moist, dark brown to dark grayish brown and firm to friable; when wet, slightly sticky and plastic; mildly alkaline.

20 to 28 inches, brown to pale-brown or light yellowish-brown hard clay loam that breaks into moderate fine subangular blocky aggregates; aggregates have a thin colloidal coating; few to moderate number of fine pores; when moist, dark brown and firm to friable; when wet, slightly sticky and plastic; mildly to moderately alkaline; noncalcareous except in places in the lower part; contains a few or a moderate number of pebbles and angular basalt stones as much as 8 or 10 inches in diameter; some of the pebbles and stones are lime coated on their lower sides.

28 inches +, lime-coated fragments of basalt over basalt bedrock.

In some areas the surface soil is sandy loam or fine sandy loam, and the subsoil is sandy clay loam. In a few areas the subsoil is loam or clay. The depth to the underlying rock ranges from about 20 to 35 inches. In some areas, particularly on the Agency Plains, the underlying material is partly consolidated sandstone or other sedimentary material, and the soil is similar to Madras loam.

The upper part of this soil contains a small amount of pumice the size of fine and medium sand. This pumice may have been derived from deposits that fell from the air following a volcanic eruption, or from the sedimentary parent material. In most places the upper layers contain a few red rhyolitic and dark-colored basaltic or andesitic pebbles. In the lower layers the pebbles are more numerous. The organic-matter content is low.

The surface soil is permeable to water and roots; the subsoil is slightly less permeable. The underlying basalt or other rock commonly is relatively impermeable, but in places water can move downward through fissures or cracks. Under natural conditions, the water table does not affect the soil, but excessive irrigation may produce a perched water table above the underlying rock in depressed areas. In such places, salts may accumulate, but normally the soil is not affected by soluble salts or alkali.

To show variations in slope, erosion, and stoniness, 12 phases of this soil are mapped.

Agency loam, 0 to 3 percent slopes (Af).—Most of this soil is in the Agency Plains and in the plains near Culver, Metolius, and Opal City. Runoff is slow, and water erosion is negligible or slight. Slight wind erosion has occurred in places. This soil is low in organic matter and nitrogen, but generally it is moderately fertile. The water-holding capacity is moderate to somewhat high.

Use and management (subgroup 2A).—Nearly all of this soil is used for grain under a dry-farming system and left fallow every other summer. About 43 percent of this soil is used for wheat, 1 percent for barley, and 5 percent for small grains to be cut for hay. Each year an equal area is summer-fallowed. A few acres are used for rye and for grazing.

Generally about 85 percent of the wheat is winter wheat, which appears better suited to this soil than spring wheat. In spring the stubble generally is plowed and a trashy cover is left for the period of fallow. To control weeds a rod weeder or other tillage implement is used two or three times during the summer. The wheat is planted late in October or early in November. Fertilizer or other amendments are rarely used. Yields, which vary with the amount and distribution of rainfall, are low. The average yield of dry-farmed spring wheat is a little less than that of winter wheat. The wheat stubble may be used for grazing. About 5 acres is required to graze a 1,000-pound cow for 1 month in years of high yields, and about 10 acres is needed in years of low yields (*10*).

Because rainfall is low and the soil is moderately deep, this soil is only moderately to poorly suited to dry-farmed wheat and other small grains. Crop residues should be returned to the soil, to supply organic matter. The stubble and straw should not be burned. A stubble mulch helps to reduce wind and water erosion. If the combine is equipped to spread straw at the time of the harvest, subsequent plowing will be made easier. Timely cultivation to control weeds helps to conserve moisture. The choice of crop rotations suitable for dry farming is limited.

A considerable part of this soil will be irrigated. Probably about the same kind of crops will be grown on the irrigated areas as are now grown on the Redmond and Deschutes soils in Deschutes County—alfalfa, potatoes, oats, barley, and wheat; Ladino, alsike, and red clovers for hay and seed; and peas for seed. Under irrigation, this soil will be suitable for the same crops as Redmond loam, 0 to 3 percent slopes, and after a few years of cropping it will produce slightly higher yields.

This soil should be well suited to many irrigated crops. In most areas it will need only slight leveling to prepare it for irrigation. Because the subsoil is fine textured and the soil is only moderately deep, deep cuts should be avoided while grading. The strip-border system would be suitable for irrigating small grains, hay, and pasture, and the furrow system for row crops.

Organic matter must be added to this soil to make it highly productive under irrigation. Organic matter can be added by several methods, including the use of a crop rotation that includes legumes and grasses, the conservation and return to the soil of all manures, and the proper use of crop residues. Organic matter can be effectively and quickly added by turning under a green-manure crop of annual sweetclover. The sweetclover can be sown broadcast when the grain crop, which is seeded early, is first irrigated. If it is irrigated once after the grain harvest, the sweetclover will grow rapidly. It can be plowed under later in the fall.

Fertilizer requirements should be determined by field trials. Greenhouse tests (*10*) on several associated soils and experience with somewhat similar soils under irrigation in Deschutes County indicate that (1) for several crops this soil is deficient in nitrogen; (2) legumes may respond well to sulfur; and (3) potatoes and other row crops respond to a complete fertilizer.

Agency loam, 3 to 7 percent slopes (Ah).—Almost all of this soil lies north of the Crooked River. Many of the areas are associated with Agency loams that are less strongly or more strongly sloping than this soil. A few areas are on high benches surrounded by Rough stony land, which is in the river canyons.

This soil is easy to till. It is slightly shallower, on the average, than Agency loam, 0 to 3 percent slopes. Runoff is slow; nevertheless, there will be some difficulty in irrigating this soil without causing erosion.

Use and management (subgroup 2B).—About 45 percent of this soil is under a natural cover of sagebrush and grass. From 10 to 15 percent was once in cultivation, but it is now idle or in annual or perennial grasses. These areas are used for grazing. Under common practices about 8 to 9 acres are required to graze a 1,000-pound cow for 1 month. Most of the rest of this soil is used for dry-farmed wheat and is left fallow every other summer. Yields are about the same as or slightly less than on Agency loam, 0 to 3 percent slopes.

One-half to two-thirds of Agency loam, 3 to 7 percent slopes, will be irrigated under the Deschutes Irrigation Project; the rest lies above the canal or in positions to which water cannot easily be conveyed. This soil is fairly well suited to irrigation. Use suitability and management needs are similar to those of Agency loam, 0 to 3 percent slopes, but, because of the higher hazard of erosion, this soil is somewhat less well suited to potatoes and other row crops. It should be used as much as possible for alfalfa, clover, or pasture. Additions of organic matter are especially important. Smooth bromegrass or big bluegrass or some other grass should be grown with the alfalfa. Because water spreads less uniformly on this soil than on Agency loam, 0 to 3 percent slopes, productivity may be slightly lower.

Irrigating this soil may cause it to erode unless the water is applied carefully. The corrugation method may be better suited to the stronger slopes than the strip-border method. If the strip-border method is used to irrigate the gentler slopes, the runs should be short and the strips narrow. This soil should be carefully leveled crosswise between borders, but, because it is moderately shallow, deep cutting should be avoided.

Agency loam, 7 to 12 percent slopes (Al).—This sloping or rolling soil is shallower than Agency loam, 0 to 3 percent slopes. It occurs in small areas east of Metolius and near Haystack Butte and Juniper Butte. It is associated with Era, Lamonta, and other Agency soils. About one-fourth of the acreage is moderately eroded. Workability is good. Included are about 20 acres in which the surface soil is a sandy loam.

Use and management (subgroup 2C).—Almost all of this soil is used for nonirrigated range. Sagebrush and grass cover about three-fourths of the acreage; such areas have a grazing capacity of about 10 acres a cow-month. The rest of the soil has been cultivated but is now idle or in annual or perennial grasses.

This soil is poorly suited to irrigation, and probably none of it will be irrigated. Some of it lies above the canal and some in other locations to which it would be difficult to supply water. Particularly on row crops, control and distribution of water would be difficult.

Agency loam, 12 to 20 percent slopes (Am).—This inextensive soil occurs in a few scattered areas in Jefferson County. It is shallower than Agency loam, 0 to 3 percent slopes, and, because of its stronger slopes, has more rapid runoff and is more likely to erode. Furthermore, this soil differs more from place to place. Included are some areas in which the surface soil is sandy loam.

Use and management (subgroup 2D).—Slightly more than one-third of this soil is in sagebrush and grass; almost as much of it has been cultivated but is now either idle or in grass. These areas are used for grazing. The rest of the soil is used for dry-farmed grain. Yields are low. Probably none of this soil will be irrigated, because of its location and the difficulty of distributing water without causing serious erosion.

Agency loam, eroded, 0 to 3 percent slopes (Ag).—This soil has been moderately eroded by wind. A considerable part of it has lost one-fourth or more of the original surface soil. Deep plowing may turn up some of the subsurface soil or upper subsoil.

This soil is similar to the associated Agency loam, 0 to 3 percent slopes, except that it is more eroded and somewhat less fertile and the thickness of the surface soil is generally 2 to 4 inches less.

Use and management (subgroup 2A).—Most of this soil is used for wheat under a dryland summer-fallow system. Yields are low.

Much of this soil will be irrigated under the Deschutes Irrigation Project. Use suitability under irrigation would be similar to that of Agency loam, 0 to 3 percent slopes, but larger additions of organic matter are needed, and slightly larger applications of nitrogen for potatoes or row crops may be effective. Wind erosion can be retarded by

stripcropping, by stubble mulching, and by keeping the surface rough and uneven.

Agency loam, eroded, 3 to 7 percent slopes (Ak).—This soil is gently sloping or undulating. It has been moderately eroded by water or wind, or both. A considerable part of the acreage has lost about one-fourth or more of the surface soil, and deep plowing turns up some of the subsurface soil or upper subsoil. This soil is like Agency loam, 0 to 3 percent slopes, but it is more eroded and the thickness of the surface soil generally is 2 to 4 inches less.

Use and management (subgroup 2B).—The present use, suitability for use, and management needs of this soil are similar to those of Agency loam, 3 to 7 percent slopes. Average yields are slightly lower. The need for additions of organic matter is slightly greater on this soil, and somewhat larger applications of nitrogen fertilizer may be effective.

Agency loam, eroded, 20 to 35 percent slopes (An).—This inextensive soil occurs in a few scattered areas near Haystack Butte. Because of the moderately steep or steep slopes, runoff is medium or rapid. Much of this soil is moderately eroded. Except for its thinner surface soil and shallower depth to bedrock, this soil resembles Agency loam, 0 to 3 percent slopes.

Use and management (group 5).—All of this soil is used for range. Its carrying capacity is low. Most of it is covered with sagebrush and grass. A few acres have been dry-farmed to grain, but these areas are now in grass or are idle. Because of the strong slopes, this soil is not well suited to dry farming or to irrigation. It is best suited to range. The carrying capacity could be increased if grazing were controlled and if more areas were seeded to crested wheatgrass and bulbous bluegrass.

Agency loam, stony, 0 to 3 percent slopes (Ao).—All of this soil is in Jefferson County. Most of it is too stony to be tilled; a few areas are less stony and could be made suitable for cultivation by removing the stones. Most of the stones are angular fragments of basalt. They range up to 20 inches in diameter. The basalt bedrock outcrops in places. About one-fourth of the acreage is eroded; these areas are identified on the soil map by erosion symbols.

Included are some areas in which the subsoil is a stony loam that is coarser than the typical subsoil of Agency loam. In other areas the subsoil is finer than typical.

Use and management (group 6).—Almost all of this soil is covered with sagebrush and grass and is used for grazing. This stony soil would be difficult to till so that grass could be seeded. The pastures should not be overgrazed and should not be grazed too early in spring or too late in fall.

This soil is not suitable for crops. If it can be irrigated, permanent pastures should do well. Applications of sulfur and nitrogen should be effective. Subdividing the pasture into three or four tracts to be grazed in rotation should increase carrying capacity.

Agency loam, stony, 3 to 7 percent slopes (Ap).—This extensive soil is gently sloping or undulating. Runoff therefore is more rapid than on Agency loam, stony, 0 to 3 percent slopes, and areas not well protected by vegetation may erode. About 40 percent of this soil is moderately eroded.

Use and management (group 6).—Most of this soil is too stony to be tilled. Its use, suitability for use, and management needs are similar to those of Agency loam, stony, 0 to 3 percent slopes. Because it is more strongly sloping, however, this soil would be more difficult to irrigate for permanent grass-legume pasture.

Agency loam, stony, 7 to 12 percent slopes (Ar).—This sloping or rolling soil is similar to Agency loam, stony, 0 to 3 percent slopes, but is more likely to erode if not protected by vegetation.

This soil is in management group 6. It is more difficult to irrigate evenly than Agency loam, stony, 0 to 3 percent slopes. Many areas are not suitable for irrigated pasture.

Agency loam, stony, 12 to 20 percent slopes (As).—Because this soil is very strongly sloping or hilly, runoff is more rapid and the erosion hazard is greater than on Agency loam, 0 to 3 percent slopes. The many stones on and in the surface soil prevent ordinary tillage.

This soil differs from place to place. About 80 acres of this mapping unit is predominantly gravelly instead of stony and consequently is less difficult to till than the stony areas. In places the subsoil is loam or stony loam instead of clay loam or stony clay loam. Almost 60 percent of this soil has been moderately eroded by water or wind, or both. Eroded areas are marked on the soil map by erosion symbols.

Use and management (group 6).—Nearly all of this soil is covered with sagebrush and grass and is used for grazing, the use to which it is best suited. Because of the strong slope, it would be very difficult to control irrigation water.

Agency loam, stony, 20 to 35 percent slopes (At).—If this moderately steep to steep soil is not protected by vegetation, runoff is likely to be rapid and erosion may occur. Nearly one-half of this soil is moderately eroded. In some areas the surface soil is sandy clay loam or heavy loam and the subsoil is heavy clay loam or clay. Many stones are on the surface and in the surface soil, and bedrock outcrops in places.

This soil is not suited to crops or irrigated pasture. It is best suited to range. Grazing should be regulated so that the perennial bunchgrasses can increase in density and vigor. This soil is in management group 6.

Agency sandy loam

Almost all of the Agency sandy loam in the Area is in Jefferson County. This soil occurs in the upland. Drainage, climate, and natural vegetation are similar to those described for the associated Agency loam.

This soil is more easily tilled than Agency loam, but its water-holding capacity and natural fertility are lower. It developed from slightly sandier parent material, and it probably contains somewhat more pumice. It is moderately developed.

Representative profile:

0 to 9 inches, light brownish-gray or grayish-brown noncalcareous sandy loam; neutral reaction; weak very fine granular structure; when moist, very dark grayish brown and very friable.

9 to 19 inches, brown noncalcareous hard clay loam or sandy clay loam; breaks into fine subangular blocky aggregates that have thin colloidal coating; when moist, dark brown to dark grayish brown and firm to friable; mildly alkaline.

19 to 26 inches, brown to pale-brown or light yellowish-brown hard clay loam or sandy clay loam; breaks into fine subangular blocky aggregates that have thin colloidal coating; when moist, dark brown and firm to friable; mildly to moderately alkaline; noncalcareous except in the lower part;

few or moderate number of pebbles and angular basalt stones, some of which are coated with lime on their under sides.
26 inches +, lime-coated fragments of basalt, which overlie basalt bedrock.

The depth to the underlying bedrock ranges from 20 to 35 inches. In some areas the soil is underlain by partly consolidated sandstone or other sedimentary material instead of lava. In most places the soil contains a few red rhyolitic and dark-colored pebbles. The upper part of the profile contains a small amount of pumice.

Included are a few small tracts that have a loam surface soil and a few areas that have a loam or a clay subsoil.

The surface soil and the subsoil are permeable to water and roots. The underlying bedrock is relatively impermeable, but in places there are fissures through which water can drain. Under natural conditions, this soil is not affected by the water table or by salts or alkali.

To show differences in slope and erosion, four phases of Agency sandy loam are mapped.

Agency sandy loam, 0 to 3 percent slopes (Au).—This soil occurs mostly in Agency Plains and in the plains near Culver, Metolius, and Opal City. Runoff is slow, and water erosion has been negligible or slight. Slight wind erosion has occurred in places.

Use and management (subgroup 2A).—Nearly three-fourths of this soil is used for dry-farmed wheat under a summer-fallow system similar to that used on Agency loam, 0 to 3 percent slopes. A small part of the total area was formerly cultivated but is now idle or in grass; almost one-fourth of the soil has a sagebrush-grass cover. These tracts are used for grazing, but the carrying capacity is low.

Because of its coarser texture and lower water-holding capacity, average yields on this soil are somewhat lower than on Agency loam, 0 to 3 percent slopes. Management needs of the two soils are similar, but this soil has a slightly greater need for nitrogen, phosphorus, and organic matter than Agency loam, 0 to 3 percent slopes. Stripcropping would help to reduce wind erosion.

Much of this soil will be irrigated under the Deschutes Irrigation Project. It should be fairly good for alfalfa, potatoes, and small grains, and for legumes grown for seed, and good for Ladino, alsike, and red clovers, vetch, and peas. Apparently it is one of the better soils for Ladino clover seed. It is similar to Agency loam, 0 to 3 percent slopes, in use suitability and management needs under irrigation, but may yield less under the same kind of management. This soil should be irrigated somewhat more frequently than Agency loams, and more lightly by use of larger heads and shorter runs.

Agency sandy loam, 3 to 7 percent slopes (Aw).—Because this soil is more strongly sloping, it has more rapid runoff and a more serious erosion hazard than Agency sandy loam, 0 to 3 percent slopes. Row crops are more difficult to irrigate properly without causing erosion.

Use and management (subgroup 2B).—About 20 percent of this soil has a sagebrush cover; about 40 percent, formerly cultivated, is idle or in annual or perennial grasses. These tracts are used for grazing. Most of the rest of the soil is used for dry-farmed wheat.

A considerable part of this soil will be irrigated. The soil is similar in crop suitability and management needs to Agency loam, 3 to 7 percent slopes, but its need for additional organic matter, nitrogen, and phosphorus is somewhat greater. Furthermore, irrigation water should be applied somewhat more frequently, in slightly smaller amounts, under larger heads, and in shorter runs. Yields under similar management probably will be slightly less than on Agency loam, 3 to 7 percent slopes.

Agency sandy loam, eroded, 0 to 3 percent slopes (Av).—This soil has lost one-fourth or more of the original surface soil through wind erosion. Water erosion has been negligible. Some of the subsurface soil and upper subsoil may be turned up by deep plowing; then the plow layer may be slightly finer in texture, slightly less permeable, and somewhat browner than it was before plowing.

Use and management (subgroup 2A).—Crop suitability and management needs are similar to those of Agency sandy loam, 0 to 3 percent slopes, but average yields are somewhat less. Wind erosion can be reduced by stubble mulching, stripcropping, and keeping the surface rough and uneven.

Much of this soil will be irrigated. Under irrigation it will need somewhat larger additions of organic matter and nitrogen than Agency sandy loam, 0 to 3 percent slopes. Organic matter can be added quickly by growing an annual sweetclover with a small grain and plowing the sweetclover under in fall after the grain is harvested.

Agency sandy loam, eroded, 3 to 7 percent slopes (Ax).—This soil has been moderately eroded by wind or water, or both. A small part of the subsurface soil or upper subsoil may be turned up by deep plowing.

Use and management (subgroup 2B).—Most of this soil is used for dry-farmed wheat. Average yields are low. About 12 percent of the soil, formerly cropped, is idle or in grass. An additional 8 percent is still under the natural cover of sagebrush and grass.

Probably a considerable part of this soil will be irrigated. This soil is similar in crop suitability and management requirements to Agency loam, 3 to 7 percent slopes, but its need for organic matter and nitrogen is greater. Furthermore, water should be applied more frequently and in slightly smaller amounts, under larger heads and in shorter runs.

This soil should be kept in legumes or pasture two-thirds or more of the time. Organic matter can be quickly and effectively added by plowing under a crop of annual sweetclover sown in the grain.

Deschutes coarse sandy loam

This soil occurs near Cloverdale on the nearly level outwash plain that slopes gently from the Cascade Mountains. The normal annual precipitation—probably about 12 or 13 inches—is somewhat higher than for most of the Deschutes Area, but apparently the frost-free season is shorter. The natural vegetation is mainly juniper, big sagebrush, and grasses. Ponderosa pine and bitterbrush grow about one-half mile to the westward.

Much of the upper part of this soil was derived from pumice, with which some water-laid material is mixed. The water-laid material originated from lava. The lava was mainly andesite and basalt, but it included some rhyolitic material.

This soil is associated with Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes, and Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes. It has a looser, more pervious sub-

stratum than the associated soils, and it is lower in water-holding capacity.

Deschutes coarse sandy loam is very slightly developed; its subsoil is slightly finer in texture and more compact than its surface soil.

Typical profile:

0 to 7 inches, grayish-brown to dark grayish-brown or brown coarse sandy loam; soft; single grain; contains a few or a moderate number of small lava pebbles and a moderate amount of pumice the size of coarse, medium, and fine sand; when moist, very dark grayish brown and very friable.
7 to 16 inches, grayish-brown to brown very porous light coarse sandy loam; single grain; contains pumice and pebbles, like layer above; when moist, very dark grayish brown and very friable.
16 to 28 inches, similar to material in layer above but firmer and more gravelly.
28 inches+, gray and dark-gray loose gravelly sand or coarse sand; single grain; when moist, very dark gray; subangular and rounded pebbles, mostly of medium- and dark-colored lava, but some reddish or light-colored, and generally less than 1 inch in diameter; layer contains a little pumice sand.

The organic-matter content is generally low. In places it is somewhat higher than typical, and in such places the surface soil is dark grayish brown. The soil is noncalcareous throughout; the reaction ranges from neutral or slightly acid to mildly alkaline. The content of gravel varies to some extent. In places the subsoil is loamy coarse sand or gravelly loamy sand.

The surface soil and subsoil are somewhat rapidly permeable to water and allow roots to penetrate freely. Water passes very rapidly through the underlying loose gravelly sand, which has a low water-holding capacity. Consequently, this soil is somewhat excessively drained and needs large amounts of water for irrigation. This soil has not been affected by salts or alkali, and the erosion hazard is negligible.

Only one phase of Deschutes coarse sandy loam is mapped.

Deschutes coarse sandy loam, over sandy material, 0 to 3 percent slopes (Da).—This soil differs from a typical Deschutes soil in the following ways: (1) In most places it is noncalcareous; (2) it has a slightly darker colored surface soil; (3) it contains less pumicy material and more water-laid material; (4) it occurs in an area of higher precipitation; and (5) internal drainage is more rapid.

Use and management (subgroup 1A).—Nearly all of this soil is used for irrigated crops and pasture. The principal crops are alfalfa, oats, barley, wheat, alsike clover for hay and seed, vetch for seed, and potatoes. About 6 percent of the soil has a juniper-sagebrush-grass cover.

This soil is managed in about the same way as Deschutes sandy loam, 0 to 3 percent slopes, but it requires more water for irrigation, and it produces slightly lower yields.

Deschutes loam

Deschutes loam developed from less sandy material than Deschutes sandy loam. The two soils have the same type of natural vegetation. Deschutes loam is similar to Redmond loam except that its subsoil is less compact and more coarse textured.

Representative profile:

0 to 11 inches, light brownish-gray or grayish-brown, noncalcareous, slightly hard, light loam; contains a large amount of light yellowish-brown or very pale brown pumice particles the size of coarse to very fine sand.
11 to 23 inches, pale-brown or light yellowish-brown loam that grades toward light brownish gray or grayish brown; noncalcareous; breaks under considerable pressure of the fingers into weak subangular blocky aggregates ¼ to ¾ inch in diameter; contains pumice similar to that in layer above.
23 to 28 inches, material similar to that in layer above except that it is slightly calcareous.
28 inches +, basalt bedrock, generally thinly coated with lime.

During rains, the pumice in the surface soil accumulates in miniature depressions. When the surface is dry, these spots are browner than other parts of the surface soil. In most places small angular fragments or rounded pebbles of basalt or other lava rock occur throughout the profile.

This soil is nonsaline. It is relatively low in organic matter and nitrogen. Above the bedrock it is moderately permeable to water, roots, and air. Water drains through the bedrock only if there are fissures or openings.

Deschutes loam, stony, 0 to 3 percent slopes (Db).—This inextensive soil occurs in scattered tracts near Terrebonne and southwest of Redmond. It has enough angular and subangular stones—generally basalt—to interfere with tillage. In most places, however, there are not enough stones to prevent all cultivation. Stones have been removed from a few tracts. The water-holding capacity is moderate, and the soil is easily irrigated.

Use and management (subgroup 1A).—About one-half of this soil has been cultivated, but much of this acreage is now idle or in grass. The rest of the soil is under its natural cover.

This soil is fairly well suited to irrigated grass-legume pasture. Areas that can be irrigated can be made suitable for cropping by removing the stones. If stones are removed, the management needs of this soil would be similar to those of Deschutes sandy loam, 0 to 3 percent slopes, but this soil would be better suited to most crops, and it would need less frequent irrigation.

Deschutes loamy coarse sand

Deschutes loamy coarse sand has a slightly sandier surface soil and more fine material in its substratum than Deschutes coarse sandy loam. It is coarser than Deschutes loamy sand, over gravelly material, with which it occurs in Deschutes County in the western part of the Area.

Typical profile:

0 to 8 inches, brown or grayish-brown soft loamy coarse sand; single grain; when wet, very dark grayish brown.
8 to 29 inches, coarse sandy loam or loamy sand that is similar in color to, or slightly paler than, the layer above; slightly hard to soft; gravelly in lower part.
29 inches+, fairly loose porous gravelly loamy sand, somewhat similar in color to layer above; contains much gray and dark-gray sand and gravel.

The upper part of this soil was derived mainly from pumice sand, with which was mixed considerable gray and dark-gray sand and small pebbles. The lower layer consists mainly of the same kind of dark-colored sand and gravel, but in most places it contains considerable light-colored pumice sand. In some places the lower layer contains cobblestones. The darker colored material is water-laid outwash deposits, probably glacial outwash from the nearby mountains. This material was derived from andesite, basalt, and probably other rocks. The

pebbles range from rounded to subangular. The texture of each layer varies somewhat from place to place.

Most of this soil is noncalcareous throughout. The reaction is about neutral, but the range is from slightly acid to mildly alkaline. The organic-matter content is rather low.

To show variations in slope, two phases of this soil are mapped.

Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent (Dc).—This soil occurs in a few fairly extensive tracts northwest of Tumalo near Plainview. Runoff is very slow and water erosion is negligible. Drainage is rapid through the surface soil and subsoil and very rapid through the gravelly lower material. The water-holding capacity is low. The frost hazard is moderate to high. This soil is very easily worked, but its natural fertility is low.

Use and management (subgroup 1B).—This soil needs large amounts of irrigation water, but it occurs in an area where water is scarce in the summer. Nearly two-thirds of it has not been cultivated but is still under its natural cover of juniper, sagebrush, and grass. This acreage is used for range. The carrying capacity is low. About 20 percent of this soil has been cultivated but is now idle or in annual grasses or crested wheatgrass. The rest is irrigated and used for crops and pasture, or is used for farmsteads. The crops most commonly grown are small grains, potatoes, alsike clover for seed, vetch for seed, and other crops that do not need much irrigation late in summer.

Cropping practices and management needs for this soil are similar to those for Deschutes loamy sand, 0 to 3 percent slopes, but the need for water is greater. If irrigated, this soil is fair to good for crops; it is poorly suited to dry-farmed grains.

Deschutes loamy coarse sand, over gravelly material, 3 to 7 percent slopes (Dd).—This inextensive soil occupies a few small areas in association with Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent slopes. This more strongly sloping soil is more likely to erode if irrigated; the irrigation water should be applied in short runs and should be carefully controlled. Nearly three-fourths of this soil remains under its natural cover, and part of the rest is idle. The soil is fair to poor for irrigated crops. It is in management subgroup 1E.

Deschutes loamy sand

Much of Deschutes loamy sand is near Bend, in the extreme southern part of the Area. Other tracts are near Cloverdale, Tumalo, and Terrebonne. This soil is coarser textured than Deschutes sandy loam in both the surface soil and the subsoil; the light yellowish-brown, very pale brown, or yellow pumice particles are more conspicuous in the Deschutes loamy sand, and the proportion of coarser particles is higher. Furthermore, this soil is less fertile than Deschutes sandy loam; it is lower in water-holding capacity and requires more water for irrigation.

Like Deschutes sandy loam, this soil developed principally from light-colored, lightweight pumice sand derived from volcanic material that erupted south and southwest of this Area. The pumice sand was 2 or 3 feet deep, but it has been moved by wind and water and is now uneven in depth. It has weathered somewhat, and a little organic matter has accumulated in the surface soil.

Deschutes loamy sand is somewhat excessively drained. Drainage through the soil is rapid; through the substratum it is generally moderate to very rapid. Runoff is very slow.

Typical profile:

0 to 15 inches, grayish-brown or light brownish-gray to brown or pale-brown loamy sand; contains a large amount of light yellowish-brown or very pale brown pumice particles; most particles range from medium to very coarse sand in size but a few are as large as 3/16 inch in diameter; soft or very friable to nearly loose; single grain; noncalcareous and mostly neutral but ranges from slightly acid to mildly alkaline; when moist, dark grayish brown or very dark grayish brown; lower part may be slightly browner than the plow layer.

15 to 26 inches, similar in color or slightly browner than layer above; somewhat hard heavy loamy sand or light sandy loam; contains pumice particles like layer above; breaks into weak subangular blocky or rounded aggregates or nodules 1/4 to 3/4 inch in diameter; aggregates are very slightly firm and moderately fine porous; noncalcareous and mostly mildly alkaline; when moist, dark grayish brown to dark brown or olive brown.

26 to 33 inches, similar to layer above but slightly calcareous; in places the lime is segregated in small veins.

33 inches +, in most places substratum is basalt bedrock. Where the substratum is not basalt bedrock it may be (1) more or less cemented gravelly or sandy material or sedimentary material of the Dalles formation (*5*); (2) pumice or volcanic cinders; or (3) loose gravel, cobblestones, or coarse sand. Commonly the basalt and the cemented materials have thin coatings of lime on their surfaces or in cracks.

Because of the large quantity of light-colored pumice, this soil, when dry, is lighter colored than is typical of the loamy sand in the profile. Small angular or subangular fragments or rounded pebbles of basalt or other rock are scattered through the soil in many places.

This soil is low in organic matter and nitrogen. Salts or alkali rarely occur in harmful quantities. Included are some areas where the surface soil is light sandy loam, coarse sandy loam, or loamy coarse sand.

To show variations in slope, erosion, stoniness, and the nature of the substratum, 13 phases of this soil are mapped.

Deschutes loamy sand, 0 to 3 percent slopes (De).—This extensive soil occupies most of the level and nearly level nonstony irrigated areas near Bend. It also occurs east and northeast of Bend between low ridges or knolls of Scabland.

The natural vegetation consists of fairly open stands of juniper, big sagebrush, rabbitbrush, bunchgrasses, cheatgrass, other annual grasses, and associated herbs. South and southeast of Bend, pines are mixed with the juniper and bitterbrush is an important part of the understory. In the moister areas there is some snowbrush and manzanita. Bitterbrush occurs with the sagebrush in a 2- to 4-mile belt just below the lower edge of the pines. In the places where pine and bitterbrush grow, the soil differs from a typical Deschutes soil in that it is generally noncalcareous throughout the profile. Most of this soil receives 10 to 13 inches of precipitation a year, but it has a shorter frost-free season than most of the Deschutes sandy loam.

Use and management (subgroup 1B).—This soil is fair to good for crops. It is used in about the same way as Deschutes sandy loam, 0 to 3 percent slopes, except that a larger proportion of it is in native range and a larger proportion is used to grow wheat. The management

requirements of the two soils are similar, but this soil requires more water and more frequent irrigation. The head of water should be larger and the irrigation runs shorter. This soil also needs more fertilizer and organic matter than Deschutes sandy loam, 0 to 3 percent slopes. Crops on this soil are more likely to be damaged by frosts. Average yields are 25 to 40 percent less.

Deschutes loamy sand, 3 to 7 percent slopes (Dg).—This soil is like the associated Deschutes loamy sand, 0 to 3 percent slopes, except that, because of the gentle slopes, the erosion hazard under irrigation is moderate to somewhat high. Included in the mapping unit are about 40 acres that have been moderately sheet eroded. These areas are identified on the soil map by erosion symbols.

Use and management (subgroup 1E).—This soil is somewhat similar to Deschutes sandy loam, 3 to 7 percent slopes, in use and management, but a greater part is under natural cover and a greater part is used for wheat. Furthermore, this soil needs more water and more frequent irrigation than the sandy loam. The head of water should be larger and irrigation runs sho ter. This soil also needs large additions of organic matter and large annual applications of fertilizer. The eroded areas need slightly more organic matter and nitrogen than the uneroded soil.

This soil is poor to fair for crops. It is not suitable for dry-farmed grain. It should be kept in hay and pasture as much as possible. A straw mulch helps keep the soil from blowing and washing while new stands of hay or pasture are being established. Average yields are slightly less than on Deschutes sandy loam, 3 to 7 percent slopes.

Deschutes loamy sand, 7 to 12 percent slopes (Dh).—This soil is moderately sloping or rolling. It is highly erosive under irrigation.

Use and management (Subgroup 1H).—This soil is poorly suited to row crops. Much of it is in its natural vegetation. Irrigated areas should be kept in alfalfa-grass or clover-grass hay or in grass-legume pasture most of the time. The productivity is low. Grain can be seeded lightly when it is necessary to re-establish a pasture stand. A straw mulch should be used until the new stand is established, to keep the soil from blowing and washing.

Irrigation water should be carefully controlled. The head should be fairly large and runs should be short. This soil can be irrigated by the corrugation method or by flooding from contour laterals.

Deschutes loamy sand, eroded, 0 to 3 percent slopes (Df).—This soil occurs in scattered areas in Deschutes County. It is moderately eroded; 2 or more inches of the original topsoil has been removed by wind. This soil contains less organic matter and nitrogen and is slightly shallower than Deschutes loamy sand, 0 to 3 percent slopes.

Use and management (subgroup 1B).—Nearly all of this soil is in natural vegetation; only about 7 percent is cultivated. It is similar in management needs and crop suitability to Deschutes loamy sand, 0 to 3 percent slopes, but needs more organic matter and nitrogen.

Deschutes loamy sand, over cinders, 0 to 3 percent slopes (Dk).—Most of this inextensive soil occurs near Terrebonne. Its surface soil and subsoil are similar to those of Deschutes loamy sand, 0 to 3 percent slopes. At depths between 16 and 36 inches, however, this soil is underlain by cindery or pumicy material similar to that underlying Deschutes sandy loam, over cinders, 0 to 3 percent slopes. This substratum commonly is mantled with a very thin layer of lime, or it may contain lime in cracks or veins. In places the subsoil contains some cinders. The cinders and pumice are generally loose and very porous; water drains downward through them very rapidly. In places, however, the material is more or less cemented; in such places it impedes root penetration and probably retards the movement of water.

Use and management (subgroup 1B).—This soil is used and managed in about the same way as Deschutes loamy sand, 0 to 3 percent slopes, but because the substratum is generally more porous, it requires more irrigation water.

Deschutes loamy sand, over cinders, 3 to 7 percent slopes (Dl).—This soil occurs in several scattered areas near Terrebonne. It is similar to Deschutes loamy sand, over cinders, 0 to 3 percent slopes, but because of the stronger slopes it is more likely to erode under irrigation. The water-holding capacity is low.

Use and management (subgroup 1E).—About 90 percent of this soil is under the natural vegetation of sagebrush, grass, and juniper, which furnishes poor grazing. Most of the rest is irrigated for crops and pasture.

This soil is only fair to poor for irrigated crops. If possible, it should be kept in pasture or hay. A straw mulch helps to keep the soil from blowing and washing while a new stand is being established. Unless it is irrigated, this soil is not suited to small grains.

Because of runoff and the rapid movement of water through the soil, it is difficult to distribute water evenly and keep erosion at a minimum. Water should be applied frequently. The most suitable method of irrigation is flooding from contour laterals or the use of corrugations. A large head of water should be used.

Deschutes loamy sand, over cinders, eroded, 3 to 7 percent slopes (Dm).—This soil occurs in a few small scattered areas near Terrebonne. It is moderately eroded by water or wind.

Use and management (subgroup 1E).—Most of this soil is used for irrigated crops and pasture. Crop suitability and management needs are similar to those of Deschutes loamy sand, over cinders, 3 to 7 percent slopes.

Deschutes loamy sand, over cobbly material, 0 to 3 percent slopes (Dn).—This inextensive soil occurs on a few rather low, nearly level terraces along the Deschutes River in Deschutes County. The largest area is near Tumalo. Except that it contains a small to moderate number of rounded pebbles, the upper part of this soil is similar to the upper part of Deschutes loamy sand, 0 to 3 percent slopes. Instead of basalt bedrock, the substratum below depths of 2 to 3 feet consists of loose rounded pebbles and cobblestones, a few rounded boulders up to 4 feet in diameter, and very little fine material. The water-holding capacity of this soil is low. Drainage is rapid through the upper part of the profile and very rapid through the substratum.

Use and management (subgroup 1B).—This soil is fair for irrigated crops. It is used and managed in about the same way as Deschutes loamy sand, 0 to 3 percent slopes, but it needs more water and more frequent irrigation. Average yields are slightly less. A few acres are used for gravel pits.

Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes (Do).—This soil occurs on the outwash

plain in Deschutes County west of the Deschutes River. Most of it is near Plainview. Some areas are extensive.

The natural vegetation on most of this soil consists of juniper, big sagebrush, and grasses, but at the extreme western edge of the Area some ponderosa pines are mixed with junipers and some bitterbrush is mixed with sagebrush.

The upper part of this soil was derived mainly from pumice, but the substratum and the coarser particles throughout the soil apparently are outwash from the Cascade Mountains, perhaps glacial outwash. Included are areas that have a sandy loam surface soil. In places the subsoil is sandy loam, gravelly loam, or loam.

This soil is similar to Deschutes loamy sand, 0 to 3 percent slopes, except for the following: (1) In many places this soil is noncalcareous throughout; (2) instead of angular fragments of basalt, the surface soil contains scattered rounded pebbles, and the subsoil contains a few scattered pebbles or many pebbles and small cobblestones; (3) below depths of 25 to 40 inches, the subsoil grades into somewhat loose or very friable cobbly sandy loam or loamy sand. The pebbles and cobblestones, which are as much as 4 or 5 inches in diameter, are rounded or subangular. They were derived from dark-colored lava rock.

The water-holding capacity of this soil is rather low, but it is slightly higher than that of the associated Deschutes coarse sandy loam, over sandy material, and Deschutes loamy coarse sand, over gravelly material.

Use and management (subgroup 1B).—Between 35 and 50 percent of this soil is under natural cover, and 5 to 10 percent that was formerly cultivated is used for range. Under irrigation, this soil is good to fair for crops, but much of it is not irrigated, chiefly because of the scarcity of water in the Squaw Creek irrigation district during the summer.

This soil is used in about the same way as Deschutes loamy sand, 0 to 3 percent slopes. It has similar management requirements and produces about the same yields. Because the growing season is short, this soil is only moderately well suited to potatoes, and average yields of potatoes are rather low. Most of the grain is planted in spring. If enough water is available, this soil is well suited to alfalfa, clover for seed, and vetch for seed. A small acreage is used to grow rye without irrigation. Yields of rye are normally 7 to 10 bushels.

Deschutes loamy sand, over gravelly material, 3 to 7 percent slopes (Dp).—This soil is gently sloping or undulating. It is more likely to erode under irrigation than Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes.

Use and management (subgroup 1E).—About two-thirds of this soil is under natural vegetation. Most of the rest is used for irrigated crops and pasture. Some of this soil is irrigated by flooding from contour laterals. Yields are somewhat lower than on Deschutes loamy sand, over gravelly materials, 0 to 3 percent slopes.

This soil is fair for irrigated pasture, hay, and small grains. It should be kept in these crops as much of the time as possible. Irrigation water must be carefully applied to avoid causing erosion. This soil is not suited to row crops.

Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes (Dr).—This nearly level soil occurs in the outwash plains, in the west-central part of the mapped area of Deschutes County. Part of it occurs where irrigation water is scarce late in summer. Because of its coarser texture, this soil has lower water-holding capacity than Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes.

The surface soil and subsoil are similar to those of Deschutes loamy sand, 0 to 3 percent slopes, but they commonly contain somewhat larger quantities of rounded or subangular small pebbles. In some areas larger pebbles are numerous in the subsoil, and in some areas the entire subsoil is noncalcareous.

At depths of about 25 to 35 inches, the loamy sand or sandy loam subsoil is underlain by weakly to strongly cemented sandy material that is mixed in many places with pebbles or pebbles and cobblestones. This cemented layer commonly contains much lime. In places, however, it is noncalcareous and apparently is cemented by silica or siliceous material. This layer does not appear to be a continuous, strongly cemented, impermeable hardpan over wide areas. It apparently has fissures and also many weakly cemented spots that are more or less permeable. Although much of the layer can be broken with the hands, some of it cannot. The cemented layer ranges from 1 to 12 inches in thickness, and it may consist of two or more discontinuous strata.

Loose sand underlies the cemented layer. In many places the sand contains gravel and cobblestones. This material originated mainly from andesite and basalt. It seems to be water-spread outwash from the nearby mountains, probably glacial outwash.

Runoff is very slow, and the erosion hazard under irrigation is slight. Drainage through the soil to the cemented layer is rapid. Drainage is slow through the cemented layer and very rapid through the underlying sand and gravel.

Use and management (subgroup 1B).—About half of this soil is under its natural vegetation of juniper, sagebrush, rabbitbrush, grass, and associated herbs. Less than one-fourth is irrigated and used for crops and pasture. The rest was formerly cultivated, but it is now idle or in cheatgrass or crested wheatgrass. A few acres are used for gravel pits.

This soil is similar to Deschutes loamy sand, 0 to 3 percent slopes, in use suitability, productivity, and management needs, but its subsoil is less likely to become waterlogged from overirrigation.

Deschutes loamy sand, over semicemented sandy material, 3 to 7 percent slopes (Ds).—This soil is gently sloping or undulating. It is slightly difficult to irrigate without causing erosion. Erosion is negligible or slight in unirrigated areas.

Use and management (subgroup 1E).—About 70 percent of this soil is under its natural vegetation of juniper, sagebrush, and grass. Most of the rest is irrigated for crops and pasture, but some areas occur where irrigation water is scarce late in summer. The principal crops are alfalfa, oats, barley, wheat, alsike clover for seed, and potatoes. Average yields are lower than on Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes.

This soil can be irrigated satisfactorily either by flooding from contour laterals or by using corrugations. Water should be applied under careful control. Short runs and a large head should be used.

If cultivated, this soil needs heavy additions of organic matter and large annual applications of fertilizer. The soil is fair to poor for crops. If possible, it should be kept

in pasture or hay. While a stand is being reestablished, a straw mulch helps to keep the soil from blowing and washing. This soil is not suited to dry-farmed grain.

Deschutes loamy sand, over semicemented sandy material, 7 to 12 percent slopes (Dt).—This inextensive soil occupies a few scattered tracts near Tumalo. About 80 percent is in the natural vegetation, and only a few acres are irrigated. This soil is poorly suited to row crops. It is similar in use suitability and management needs to Deschutes loamy sand, 7 to 12 percent slopes. It is in management subgroup 1H.

Deschutes sandy loam

Deschutes sandy loam is the most extensive soil in the Area. It occupies a large part of the acreage south of the Crooked River. In the areas near Bend, the soil is coarser textured than is typical. Only a small acreage of this soil occurs north of the Crooked River.

Much of Deschutes sandy loam occurs in small swale-like areas that are nearly level or gently sloping. These areas lie between the mounds and ridges of outcropping lava (Scabland) which are characteristic of much of the upland plain in Deschutes County. Other areas lie on the nearly level outwash plain west of the Deschutes River. Some areas have slopes of as much as 20 percent gradient.

Most of this soil receives 8 to 11 inches of precipitation annually. In these semiarid areas the natural vegetation consists mainly of open stands of juniper with an understory of big sagebrush, bunchgrasses, annual grasses, rabbitbrush, and herbs. On small acreages in the extreme southern and western parts of the Area, which receive a little more precipitation, the natural vegetation includes some ponderosa pine and bitterbrush.

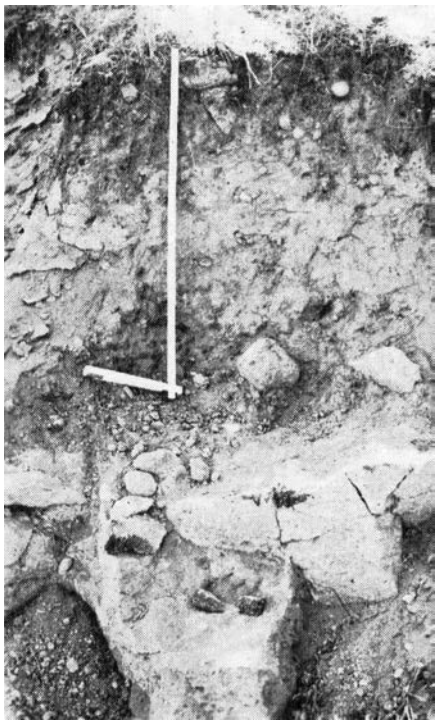

***Figure 2.*—Cut in Deschutes sandy loam, 0 to 3 percent slopes, just west of Redmond. The upper part of this soil was derived mainly from pumice, and it overlies lime-coated basalt. This is the most extensively irrigated soil in Deschutes County.**

This soil developed mainly from pumice sand, which apparently was weathered from material that erupted from now-extinct volcanoes south and southwest of the Area. The pumice sand, possibly mixed with a little fine volcanic dust, was carried northward by the wind. The deposits were reworked by wind and water, which moved material from the higher spots and redeposited it in low places, so that the layer of pumice sand is now of uneven thickness. In general, the layer becomes thicker and the texture of the material coarser toward the south and southwest; that is, in the direction of the extinct volcanoes. The lower part of this soil may be mixed with fragments of basalt, pebbles washed from nearby ridges of Scabland, or gravelly or sandy materials from other sources.

Deschutes sandy loam normally has a slightly developed profile; the subsoil is slightly finer textured and more compact than the surface soil and has only weakly developed structural aggregates. This soil differs from the associated Redmond soils in having a less developed and coarser textured subsoil. It is better drained than the Odin soils. It differs from the somewhat similar Era soils mainly in that it was derived from materials that contained more pumice. Figure 2 shows a profile of Deschutes sandy loam, 0 to 3 percent slopes.

Typical profile:

0 to 13 inches, grayish-brown or light brownish-gray to brown or pale-brown soft sandy loam; layer mainly light yellowish-brown or pale-brown pumice particles, most of them ranging in size from medium to very coarse sand; noncalcareous and mostly neutral in reaction but ranges from slightly acid to mildly alkaline; when moist, dark grayish brown or very dark grayish brown and very friable; lower part may be slightly browner than the plow layer.

13 to 22 inches, pale-brown or light yellowish-brown, grading toward light brownish-gray or grayish-brown, sandy loam or heavy sandy loam; slightly lighter in color and browner than layer above; hard and firm but breaks with moderate pressure of hands into weak subangular or rounded aggregates that range from ¼ to ¾ inch in diameter; slightly dense but somewhat porous; noncalcareous and mostly mildly alkaline; contains pumice sand ranging from the size of medium sand to that of coarse sand; when moist, dark grayish brown to dark brown or olive brown.

22 to 30 inches, material similar to that in layer above but slightly calcareous; in places lime is segregated in small veins.

30 inches +, in most places substratum consists of basalt bedrock.

In places, the texture is a fine sandy loam. Included in the mapping unit are some soils that are entirely noncalcareous.

In some places the substratum is (1) gravelly or sandy material or sedimentary material of the Dalles formation, more or less cemented with lime and silica (*5*); (2) volcanic pumice or cinders; or (3) in many of the areas west of the Deschutes River, loose gravel, coarse sand, or cobblestones. A thin coating of lime commonly overlies the basalt and the cemented materials.

This soil contains a considerable to a large quantity of light yellowish-brown, very pale brown, or yellow pumice the size of fine to very coarse sand. The pumice tends to accumulate in miniature depressions and imparts to the surface of the dry soil a color that is browner than is typical of the finer material in the surface layer. In

many places scattered small angular or subangular fragments or rounded pebbles of basalt or other igneous rock occur throughout the soil.

This soil is relatively low in organic matter and nitrogen. Salts or alkali do not normally occur in injurious quantities. This soil is well drained. Above the substratum it is moderately to rapidly permeable to water, roots, and air. The substratum varies greatly in permeability. Runoff generally is slow or very slow.

To show variations in slope, erosion, stoniness, depth to substratum, kind of substratum, and moisture relations, 26 phases of this soil are mapped.

Deschutes sandy loam, 0 to 3 percent slopes (Du).—This is the largest mapping unit of Deschutes sandy loam in the Area. It occurs in level or nearly level areas where erosion is negligible or slight. A few areas have been moderately eroded by water or wind. Most of this soil occurs in low areas between ridges or mounds of Scabland on the upland plain in Deschutes County, east of the Deschutes River and north of Bend.

The substratum varies from place to place. Typically, it is basalt, commonly more or less vesicular and fissured. In places, however, it consists of sedimentary material of the Dalles formation (*5*) or other water-transported materials, or of cemented or semiconsolidated sand, gravel, and agglomerate. In many places, the basalt or semiconsolidated material has a thin coating of lime. Some angular basalt fragments commonly lie above the basalt bedrock. In most places, movement of water through the substratum is somewhat slow but, unless too much irrigation water is applied, drainage is adequate. The penetration of roots, water, and air through the surface soil and subsoil is moderate to rapid. In a few swales, however, the substratum is impermeable or slowly permeable. In these places the subsoil and even the entire profile may become waterlogged by excess irrigation water or by runoff from higher areas. The depth to the substratum ranges from 16 to 36 inches.

This soil apparently is moderately fertile, but it is low in organic matter and nitrogen. It responds to good management, however, and it is very easily tilled. If water is available this soil is easy to irrigate. The erosion hazard under irrigation is slight.

Use and management (subgroup 1A).—Three-fourths or more of this soil is used for irrigated crops and pasture. Almost all of the rest is under the natural vegetation. Much of the nonirrigated soil lies in relatively small, unconnected areas in the eastern part of the Area south and east of Redmond. Smaller nonirrigated tracts occur on irrigated farms, in places that cannot conveniently be irrigated. Little of this soil is idle and practically none of it is dry-farmed. It is poorly suited to dry farming.

Systematic crop rotations are not practiced on most farms but some general crop sequences are common. Alfalfa, the principal crop, is grown for 5 to 7 years or until it becomes grassy or low in yield. On most farms potatoes follow alfalfa, clover, or pasture. Potatoes are often grown a second year, and then followed by oats, barley, wheat, or rye. Generally, alfalfa is seeded again in the grain stubble. If potatoes are not grown, grain commonly follows alfalfa, clover, or pasture. Typical irrigated pastures consist primarily of bluegrass and whiteclover. Rotation pastures are not common.

Clover grown for seed may be sown in the grain stubble in place of the alfalfa. Unless weeds become too dense, two seed crops are usually obtained from alsike clover and Ladino clover. Because it is difficult to keep Ladino clover free from other clovers and weeds, not much Ladino clover is grown for seed on this soil. Some red clover is grown for hay and seed. On a few farms vetch is grown for seed, often in a 2-year rotation with oats and barley.

Potatoes are usually fertilized with about 300 pounds of 6–10–4 fertilizer an acre the first year. If potatoes are grown a second year, a slightly larger application of fertilizer is generally used, but no fertilizer is used on oats, barley, wheat, or rye when they follow potatoes. All available manure is used on potatoes, other row crops, or grain. On most of the farms pastures are not fertilized.

If irrigated, this soil is moderately well suited to a wide range of crops and very well suited to potatoes. Potatoes are irrigated by the furrow method, and legumes, grain, and pasture by the strip-border method. No special practices for erosion control are generally used. The potatoes form well-shaped tubers in this moderately coarse textured soil. They are practically free of dirt when dug, and they need little or no brushing to make them bright and clean for market. Because this soil is only moderately deep, it has limited water-holding capacity and is not well suited to alfalfa and other deep-rooted crops.

This soil needs to be managed in such a way as to build up its supply of organic matter. Effective management practices are described in the section, Use and Management of Soils, and in several publications of the Oregon Agricultural Experiment Station (*10*) (*12*) (*11*) and other agencies (*14*).

Fertilizer trials on Deschutes sandy loam, 0 to 3 percent slopes, have shown that (1) sulfur is the element most needed for legumes; (2) potassium fertilizers help potatoes, legumes, and possibly other intensively grown crops; and (3) nitrogen is needed by many crops (*9*) (*10*). Much of the nitrogen can be supplied by plowing under a good growth of well-inoculated legumes. Ammonium sulfate or some other nitrogen fertilizer helps grains that do not follow a legume or fertilized crop. Phosphorus appears to benefit potatoes, pasture, and legumes, especially seed legumes. A little boron applied to potatoes seems to result in smoother, better shaped tubers.

Farmers who consistently obtain high yields apply from 30 to 50 pounds of sulfur, preferably in the form of gypsum, to alfalfa every year. For pasture and for most other legumes except hairy vetch, they apply gypsum every 2 years. Alfalfa and other legumes also receive treble phosphate or an equivalent quantity of phosphorus in superphosphate. Sulfur is not commonly used on vetch planted for seed, because it is likely to stimulate growth enough to make the crop difficult to harvest. Potatoes receive fairly heavy applications of a complete fertilizer. If potatoes are grown in 2 successive years, rye or some other green-manure crop is usually plowed under before the second crop, and manure or ammonium sulfate is added. Fertilizers are seldom used on grains that follow legumes or heavily fertilized potatoes, but grains that do not follow legumes or fertilized potatoes ordinarily are fertilized with nitrogen and phosphate.

Farmers who obtain high yields use good irrigation practices, including proper land leveling, the efficient layout of field ditches with checks and drops where needed, and the timely use of water.

Deschutes sandy loam, 3 to 7 percent slopes (Dv).—This soil is like Deschutes sandy loam, 0 to 3 percent

slopes, but because it is gently sloping it is more likely to erode if irrigated. Most of the irrigated areas are slightly eroded. Only a small acreage has lost more than one-fourth of the original surface soil. A few shallow gullies have formed. This soil is slightly shallower than Deschutes sandy loam, 0 to 3 percent slopes.

Use and management (subgroup 1D).—This soil is used in much the same way as Deschutes sandy loam, 0 to 3 percent slopes. Average yields are slightly less, however, and because of the erosion hazard, a somewhat smaller part of this soil is used for potatoes, and a larger part is used for alfalfa and pasture.

This soil is easy to till. It is somewhat less suitable than Deschutes sandy loam, 0 to 3 percent slopes, for potatoes and other row crops. It should be kept in alfalfa, clover, or pasture two-thirds to three-fourths of the time, if possible. Additions of organic matter would help to prevent erosion, increase the productivity of the soil, and improve the water-holding capacity. Smooth bromegrass, big bluegrass, or other grasses, grown with the alfalfa for hay, will also help to prevent erosion (*10*).

Irrigation water should be applied carefully. The gently sloping areas can be irrigated by the strip-border method. Unless the strips are carefully graded and leveled between the borders, the corrugation method may be more effective on the stronger slopes. The strips should be narrower and the runs shorter than on Deschutes sandy loam, 0 to 3 percent slopes. Flooding from contour laterals may be suitable in some areas.

Deschutes sandy loam, 7 to 12 percent slopes (Dw).—This inextensive soil occurs mostly in the northern part of Deschutes County. It is associated with other phases of Deschutes sandy loam. It is slightly more shallow than Deschutes sandy loam, 0 to .3 percent slopes.

Use and management (subgroup 1G).—About 80 percent of this soil is in its natural vegetation of sagebrush, juniper, and grass. The carrying capacity is very low. Approximately 10 percent was formerly cropped, but this acreage is now idle or is in grass and used for grazing. About 10 percent is irrigated.

This soil is poorly suited to row crops. It should be kept most of the time in alfalfa-grass or clover-grass hay or in grass-legume pasture. A light seeding of oats or barley should be used to reestablish a stand. Clover can be grown for seed. This soil is very poorly suited to dry-farmed grains, and practically none of it is used for these crops. It is less productive than more nearly level Deschutes sandy loams.

Under irrigation, this soil is used in somewhat the same way as Deschutes sandy loam, 0 to 3 percent slopes, but a larger part of its irrigated acreage is used for alfalfa and pasture. It is more difficult to work and much more difficult to irrigate than Deschutes sandy loam, 0 to 3 percent slopes.

Irrigation water should be very carefully controlled, and runs should be short. The corrugation method, with a small head of water, may be the best way of irrigating this soil. Flooding from contour laterals, however, may be effective.

Deschutes sandy loam, 12 to 20 percent slopes (Dy).—Except that this soil is more shallow and varies more from place to place, it is similar to Deschutes sandy loam, 0 to 3 percent slopes. Because of the strong or moderately steep slopes, water is very difficult to control and the erosion hazard is very high.

About one-third of this mapping unit consists of areas in which the surface soil is a loamy sand. Some of these areas have slopes of more than 20 percent. Almost one-third of this soil has enough stones on the surface and in the surface soil to interfere with cultivation. These areas are identified on the map by stone symbols. About one-fourth of this soil is moderately sheet eroded. In a few places gullies have formed; some cannot be crossed by farm machinery.

Use and management (subgroup 1I).—This soil is very poor for crops under irrigation; it is generally better suited to range grazing. A considerable part of it is under the natural vegetation. Under very careful management, some of the less steep areas can be used for irrigated grass-legume pasture. This soil is very poor for dry-farmed grains.

Grass-legume pasture can be irrigated by corrugations running down the steepest slopes. The water should be supplied in short runs under a well-controlled head.

Most of the areas used for range can be improved by seeding crested wheatgrass mixed with bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass. The range can be plowed or disked in the spring, left fallow in summer, and seeded with a drill in fall. New stands of grass should not be grazed the first year, and established stands should be protected from overgrazing.

Deschutes sandy loam, deep, 0 to 3 percent slopes (Dz).—This soil occurs in many scattered areas in Deschutes County. Many tracts are in low, level spots or shallow swales between ridges of Scabland or within broader tracts of shallower Deschutes soils. In some of the swales excessive irrigation and runoff from higher land may cause waterlogging of the subsoil and, eventually, some accumulation of soluble salts.

This soil is deeper than the associated Deschutes sandy loam, 0 to 3 percent slopes, and has better water-holding capacity. In most places it is 36 or more inches in depth to the basalt bedrock, semiconsolidated material, or other layer that is impermeable to roots.

Use and management (subgroup 1A).—This soil is somewhat similar in use suitability and management needs to Deschutes sandy loam, 0 to 3 percent slopes, but it is better suited to alfalfa and other deep-rooted crops. Yields, particularly of alfalfa, red clover, and alsike clover, tend to be higher on this soil. Irrigation water can be applied in larger quantities and less frequently on this soil, and deeper cuts can be made when leveling. This is one of the better soils of the Area for many crops.

Deschutes sandy loam, deep, 3 to 7 percent slopes (Dea).—This soil is similar to the associated Deschutes sandy loam, 3 to 7 percent slopes, except that it is 36 inches or more in depth to the basalt bedrock, semiconsolidated sedimentary material, or other material that roots cannot penetrate. Because it is deeper, this soil has better water-holding capacity. Small areas of moderately eroded soil are included; in a few places gullies occur.

Use and management (subgroup 1D).—Except that it is better suited to alfalfa and other deep-rooted crops, this soil is similar to Deschutes sandy loam, 3 to 7 percent slopes, in present use, suitability for use, and management needs. Average yields, particularly of alfalfa, red clover, and alsike clover, are higher on this deep soil. Irrigation water can be applied in larger quantities and at longer intervals. The eroded areas require larger additions of

organic matter than the noneroded areas and also need somewhat heavier applications of manure and fertilizer.

Deschutes sandy loam, deep over cinders, 0 to 3 percent slopes (Deb).—Most of this inextensive soil occurs west of Terrebonne. It overlies a substratum of volcanic cinders or pumicy material similar to those in the substratum of Deschutes sandy loam, over cinders, 0 to 3 percent slopes. In most places this soil is 36 inches or more in depth to the cindery substratum.

Use and management (subgroup 1A).—This soil is similar to Deschutes sandy loam, deep, 0 to 3 percent slopes, in use, management, and yields, but it probably needs slightly more water at slightly shorter intervals. This is one of the better soils of the Area for irrigated crops.

Deschutes sandy loam, eroded, 7 to 12 percent slopes (Dx).—This soil occurs in a few scattered tracts. It is moderately eroded; about one-fourth to three-fourths of the original topsoil, or plow layer, has been removed, mainly by sheet erosion. Gullies have formed in a few places. This soil is 2 to 5 inches shallower than Deschutes sandy loam, 7 to 12 percent slopes, and is also slightly lower in organic matter and nitrogen.

Use and management (subgroup 1G).—About 30 percent of this soil is irrigated and used for crops or pasture. The rest is under a cover of juniper, sagebrush, and grass. Use suitability and management needs are similar to those of Deschutes sandy loam, 7 to 12 percent slopes, except that the need for organic matter and nitrogen is greater.

Deschutes sandy loam, over cinders, 0 to 3 percent slopes (Dec).—Most of this soil occurs in the northern part of Deschutes County west of Terrebonne (fig. 3). It is similar to Deschutes sandy loam, 0 to 3 percent slopes, but instead of being underlain by basalt or semiconsolidated sedimentary material, it is underlain by a substratum of reddish-brown, red, dark-red, black, pale-gray, or yellow vesicular or spongelike volcanic cinders, pumice, or pumiceous materials. In many places the cindery substratum is porous; in other places it ranges from weakly cemented to strongly cemented. It is not practicable to delineate these variations on the soil map. Little or no lime may occur where the substratum is loose, but where the substratum is more or less cemented, the lower part of the subsoil commonly is calcareous, and the substratum is lime-coated or contains lime in fissures or veins. Where the underlying cinders are loose and excessively porous, drainage through the substratum is very rapid; consequently, these areas require more water for irrigation than Deschutes sandy loam, 0 to 3 percent slopes, which has a substratum of basalt or semiconsolidated material that retards internal drainage.

Included in this mapping unit are a few acres from which much of the surface soil has been removed by wind. A few acres have enough basaltic stones on the surface and in the surface soil to interfere with tillage; these areas are shown on the map by stone symbols. If the stones are removed from these areas, the soil is similar to the nonstony Deschutes sandy loam, over cinders, 0 to 3 percent slopes.

Use and management (subgroup 1A).—Except that somewhat more water is required and that water must be applied more frequently, this soil is similar to Deschutes sandy loam, 0 to 3 percent slopes, in present use, suitability for use, and management needs. Places where the underlying cinders are excessively loose and porous need heavier and more frequent irrigation. Average yields are slightly less than on Deschutes sandy loam, 0 to 3 percent slopes, but this soil seems to be better suited to alfalfa because it has better underdrainage. The eroded areas of this soil need large amounts of organic matter and fertilizer.

Deschutes sandy loam, over cinders, 3 to 7 percent slopes (Ded).—This soil occurs near Terrebonne. Except that it is gently sloping and is moderately erodible under irrigation, this soil is similar to Deschutes sandy loam, over cinders, 0 to 3 percent slopes.

Use and management (subgroup 1D).—In present use, suitability for use, and management needs this soil is similar to Deschutes sandy loam, 3 to 7 percent slopes, but apparently it needs more water and more frequent irrigation. It yields slightly less.

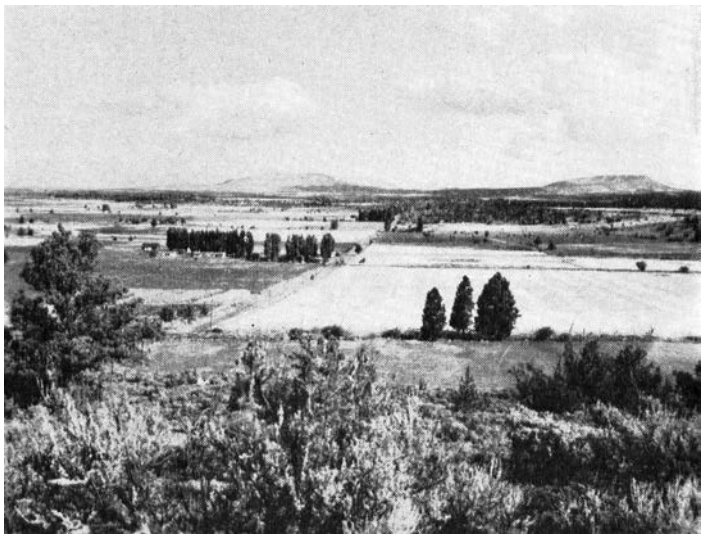

Figure 3.—**An area west of Terrebonne as seen looking northward from Tetherow Butte. Much of the irrigated crop area is Deschutes sandy loam, over cinders, 0 to 3 percent slopes. Big sagebrush and junipers on Rough stony land in foreground; Juniper Butte and Haystack Butte in distance.**

Deschutes sandy loam, over cinders, eroded, 3 to 7 percent slopes (Del).—This inextensive soil occurs in a few tracts near Terrebonne. It is moderately eroded. From 25 to 75 percent of the original topsoil has been removed from much of the area, and a few gullies have formed.

Use and management (subgroup 1D).—Most of this soil is irrigated and used for crops and pasture. It is similar in use suitability and management needs to Deschutes sandy loam, 3 to 7 percent slopes, but it is slightly less productive and apparently needs more water and more frequent applications of water. Organic matter is especially needed, and heavy applications of manure and fertilizer are suggested.

Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes (Deo).—This soil occurs extensively in the west-central part of the surveyed area of Deschutes County. It occurs in many areas on the nearly level to gently undulating outwash plains, particularly in the vicinity of Tumalo. It is farther west than most of Deschutes sandy loam, 0 to 3 percent slopes, and receives slightly more rain and may have a slightly shorter growing season.

The surface soil and subsoil are similar to those of Deschutes sandy loam, 0 to 3 percent slopes, but in some areas the subsoil is entirely noncalcareous or only slightly calcareous in the lower part. Furthermore, both the surface soil and subsoil in most places contain rounded or subangular pebbles that are scattered or grouped in small quantities. Most of the pebbles are less than 1 inch in diameter, but in some areas the pebbles in the subsoil are somewhat larger and fairly numerous.

At depths of about 28 to 35 inches, the subsoil is underlain by a weakly to strongly cemented layer consisting of sandy material mixed, in many places, with pebbles or pebbles and cobblestones. This layer is from 1 to 12 inches thick, and it may consist of two or more discontinuous cemented strata. In most places this layer, or hardpan, contains much lime, but in some places it is noncalcareous and apparently is cemented by silica or siliceous material. Much of this material can be broken in the hands, but some of it cannot. Where strongly cemented it has on the upper side a very thin, very dense or glazed coating that roots cannot penetrate. The hardpan, however, does not appear to be a continuous, strongly cemented, impermeable stratum. Apparently, there are fissures and also many places where the cementation is weak.

The cemented layer overlies coarse or very coarse loose sand, which in many places contains gravel and cobblestones. This underlying material was derived mostly from andesitic, basaltic, or other dark-colored, fine-grained, igneous rock. It appears to be waterspread outwash from the Cascade Mountains, probably glacial outwash.

Runoff from rainfall is low, and the erosion hazard under irrigation is slight. Drainage through the soil to the cemented layer is moderate to rapid; through the cemented layer it is slow; and through the underlying material it is very rapid. No drainage problem has developed under irrigation.

Use and management (subgroup 1A).—In present use, suitability for use, productivity, and management needs, this soil is similar to Deschutes sandy loam, 0 to 3 percent slopes. Its subsoil is less likely to become waterlogged. Oats are grown more extensively on this soil than on Deschutes sandy loam, 0 to 3 percent slopes. A few acres of this soil are used for gravel pits.

Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes (Des).—This soil occurs near Tumalo in the west-central part of the surveyed area of Deschutes County. It lies west of most areas of Deschutes sandy loam, 3 to 7 percent slopes, receives slightly more rainfall, and has a shorter growing season. It is similar to the associated Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes, but because it has stronger slopes it is more likely to erode under irrigation. The layer of semicemented material is at depths of 2 to 3 feet. It is similar to the hardpan that underlies Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes, but is generally somewhat less hard and more permeable.

Use and management (subgroup 1D).—About 58 percent of this soil remains under its natural vegetation of juniper, sagebrush, and grass, and is used for grazing. About 37 percent is used for irrigated crops or pasture. Oats is an important crop, but barley, wheat, alfalfa, potatoes, red clover, alsike clover, and vetch are also grown. This soil is similar in productivity, use suitability, and management needs to Deschutes sandy loam, 3 to 7 percent slopes.

Deschutes sandy loam, over semicemented sandy material, 7 to 12 percent slopes. (Dla).—This sloping or rolling soil occurs in several small scattered tracts near Tumalo. Its hardpan is somewhat less strongly cemented and more permeable than that of Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes. The erosion hazard under irrigation is high.

Use and management (subgroup 1G).—Nearly 85 percent of this soil is under the natural vegetation; a few acres have been planted to crested wheatgrass. A very small part is irrigated and used for crops and pasture. In use suitability and management needs this soil is similar to Deschutes sandy loam, 7 to 12 percent slopes.

Deschutes sandy loam, over semicemented sandy material, eroded, 12 to 20 percent slopes (Dlb).—This strongly sloping or hilly soil occurs in a few small tracts near Tumalo. About three-fourths of the acreage has lost 25 percent or more of the original topsoil through erosion, chiefly sheet erosion. In places, as much as 75 percent has been removed. The surface soil is thinner than that of Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes, and the hardpan is less strongly cemented and more permeable. It is very difficult to irrigate this soil without causing further erosion.

Use and management (subgroup 1I).—Nearly half of this soil is under a cover of juniper, sagebrush, and grass. Most of the rest is irrigated for pasture, hay, and grain. This soil is poorly suited to crops. The irrigated areas are best suited to permanent grass-legume pasture. Where water is scarce, crested wheatgrass could be grown. While a stand is being reestablished, a straw mulch helps prevent loss of soil through blowing and washing.

Deschutes sandy loam, shallow, 0 to 3 percent slopes (Dlc).—In many places this shallow soil lies between Deschutes sandy loam, 0 to 3 percent slopes, and Scabland. It is also associated with Deschutes sandy loam, stony, 0 to 3 percent slopes.

This soil is less than 16 inches deep over a layer of basalt, other lava bedrock, semiconsolidated sandy material, or other material that is impermeable to roots. The subsoil is thinner than that of Deschutes sandy loam, 0 to 3 percent slopes, and the surface soil is generally somewhat thinner. The water-holding capacity is low.

Fragments of basalt of various sizes are on the surface and in the surface soil, but they are not numerous enough to interfere materially with cultivation. In many places lime occurs in fissures in the substratum or as a thin coating over the substratum, but in a few places the lower part of the subsoil is not calcareous.

Use and management (subgroup 1C).—This soil generally appears to be better suited to irrigated grass-legume pasture than to crops. It is moderately well suited to potatoes, small grains, some of the clovers, and possibly vetch. It is poorly suited to alfalfa and other deep-rooted crops. Yields are much lower than on Deschutes sandy loam, 0 to 3 percent slopes.

This soil is used in much the same way as Deschutes sandy loam, 0 to 3 percent slopes, but a smaller part is used for alfalfa and a much larger part remains under natural cover and is used for range.

Where crops are to be harvested, a rotation consisting of a small grain, alsike clover, and potatoes is suggested. The alsike clover can be harvested for seed for a year or

two and then used for pasture for a few years. This practice can also be followed, using Ladino clover, on newly cleared land or on other areas where weeds and volunteer white and alsike clovers are not bothersome. A 2-year rotation of small grain and vetch may be suitable on some farms. Pastures should include Ladino clover, alta fescue, orchardgrass, and perennial wheatgrass.

The fertilization suggested for Deschutes sandy loam, 0 to 3 percent slopes, should be suitable for this soil.

This soil needs frequent, light irrigations. Because the root zone is shallow, little leveling can be done. The strip-border method is used in some areas. Where the surface is very gently undulating or somewhat uneven, corrugations may be more suitable than strip borders.

Deschutes sandy loam, shallow, 3 to 7 percent slopes (Dle).—This gently sloping shallow soil is more likely to erode under irrigation than Deschutes sandy loam, shallow, 0 to 3 percent slopes. Like the more nearly level soil, this soil has a shallow root zone and limited water-holding capacity. The erosion hazard is moderate.

Use and management (subgroup 1F).—Nearly 50 percent of this soil is covered with juniper, sagebrush, and grass, and 40 percent is irrigated and used for crops and pasture. The use suitability and management needs of this soil are similar to those of Deschutes sandy loam, shallow, 0 to 3 percent slopes, but irrigation water must be distributed more carefully. Irrigations must be frequent and light. Many of the areas probably can be irrigated more effectively by the corrugation method or by flooding from contour laterals than by the strip-border method. In most places, it is probably best to use this soil for irrigated grass-legume pasture.

Deschutes sandy loam, shallow over cinders, 0 to 3 percent slopes (Dlo).—This inextensive shallow soil occurs west of Terrebonne. It is associated with Deschutes sandy loam, over cinders, 0 to 3 percent slopes. It is like the associated soil except that, in most places, it is about 16 inches or less in depth to the substratum of volcanic cinders or pumicy materials. It differs from Deschutes sandy loam, shallow, 0 to 3 percent slopes, in that its substratum is rapidly permeable.

Use and management (subgroup 1C).—Slightly more than one-half of this soil is covered with sagebrush and grass; about one-third is irrigated for crops and pasture, and the rest is mostly idle. This soil is similar in use suitability, yields, and management needs to Deschutes sandy loam, shallow, 0 to 3 percent slopes, but it requires more water and more frequent applications of water. This soil is fair to poor for crops.

Deschutes sandy loam, shallow over cinders, eroded, 3 to 7 percent slopes (Dls).—This inextensive soil occurs mainly west of Terrebonne, in association with Deschutes sandy loam, over cinders, 0 to 3 percent slopes, and other soils underlain by cinders. It is like the associated soil, except that it is about 16 inches or less in depth to the substratum of volcanic cinders or pumicy material, and it is moderately eroded in most areas. From 25 to 75 percent of the original topsoil has been lost, mostly as a result of irrigation.

Use and management (subgroup 1F).—About 60 percent of this soil is irrigated and used for crops and pasture, and 20 percent has a sagebrush cover. The rest is idle or in crested wheatgrass. In use suitability, yields, and management needs, this soil is similar to Deschutes sandy loam, shallow, 3 to 7 percent slopes, but apparently it requires more water and more frequent irrigations. This soil is best suited to irrigated grass-legume pasture.

Deschutes sandy loam, stony, 0 to 3 percent slopes (Dsa).—A considerable part of this soil lies in the nonirrigated region south and east of Redmond. Smaller areas are in irrigated districts. Except that it contains angular and subangular stones, this soil is similar to Deschutes sandy loam, 0 to 3 percent slopes. The stones range from less than 1 inch to 2 feet or more in diameter. Most of them are fragments of basalt; a few are fragments of rhyolite, andesite, or other kinds of rock. In most areas there are enough stones to interfere with tillage but not to prevent it.

Most areas of this soil could be cleared of stones and in the last few years some areas have been cleared. If the stones are removed from the surface soil, this soil is very similar to Deschutes sandy loam, 0 to 3 percent slopes, except that it has a stonier subsoil and, in many areas, is shallower to bedrock. In places lava bedrock crops out.

Deschutes sandy loam, stony, 0 to 3 percent slopes, is associated with Scabland, 0 to 3 percent slopes, and Scabland, 3 to 12 percent slopes. Included are some areas that have a surface soil of loamy sand or loamy coarse sand.

Use and management (subgroup 1A).—A considerable part of this soil is not irrigated and remains in its natural vegetation of juniper, sagebrush, rabbitbrush, grass, and herbs. Most of the irrigated areas are used for permanent grass-legume pasture, but a few of the less stony areas are used for various crops.

Most areas that have not been cleared of stones seem to be best suited to irrigated permanent grass-legume pasture. The nonirrigated areas seem best suited to grazing. If cleared of most of the stones, this soil is similar to Deschutes sandy loam, 0 to 3 percent slopes, in use suitability, management needs, and productivity.

Deschutes sandy loam, stony, 3 to 7 percent slopes (Dsb).—This soil is more difficult to irrigate and more likely to erode under irrigation than Deschutes sandy loam, stony, 0 to 3 percent slopes.

Use and management (subgroup 1D).—Most of this soil remains under the natural vegetation, but a small part is used for irrigated grass-legume pasture, and a few of the less stony areas are used for irrigated crops. Areas from which the stones are not removed seem best suited to grass-legume pasture if irrigated and to range if not irrigated. Most tracts can be cleared of stones. If the stones are removed, this soil is almost the same in use suitability, management needs, and productivity as Deschutes sandy loam, 3 to 7 percent slopes.

Deschutes sandy loam, stony, 7 to 12 percent slopes (Dsc).—This soil resembles Deschutes sandy loam, stony, 0 to 3 percent slopes, but because of the stronger slopes it is more difficult to irrigate and more likely to erode under irrigation. It is similar to the more nearly level soil in stoniness. A few acres have been moderately eroded. These areas are shown on the map by erosion symbols.

Use and management (subgroup 1G).—Most of this soil remains under the natural vegetation and is used for range; a few areas are used for irrigated grass-legume pasture. Because of the erosion hazard under irrigation, the feasibility of removing the stones and growing crops is doubtful. In most places irrigated grass-legume pasture seems the best use. If this soil is cleared of stones, it is similar in use suitability, management needs, and productivity to Deschutes sandy loam, 7 to 12 percent slopes.

Deschutes sandy loam, stony, over cinders, 3 to 7 percent slopes (Dsd).—This inextensive soil is underlain by the same kind of cindery or pumicy substratum as Deschutes sandy loam, over cinders, 0 to 3 percent slopes. It is similar to Deschutes sandy loam, stony, 3 to 7 percent slopes, in stoniness, present use, suitability for use, productivity, and management needs, but it requires more water and more frequent irrigations. In places wind erosion has removed considerable surface soil. This soil is in management subgroup 1D.

Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes (Dse).—This soil occurs in the west-central part of the surveyed area of Deschutes County. It has a cemented layer in the lower subsoil or substratum at a depth of 2 or 3 feet. Apparently this cemented layer, or hardpan, is not a continuous impermeable layer, but contains fissures, weakly cemented places, or uncemented openings, through which water moves downward.

A considerable part of this soil has enough stones on the surface and in the surface soil to interfere with tillage. Most of the stones are subangular fragments of andesite and basalt. The degree of stoniness varies from place to place. If the stones are removed from the upper part, this soil is similar to Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes, except that its subsoil may be stonier.

Use and management (subgroup 1A).—All except a few small areas of this soil are covered with juniper, sagebrush, and grass. If the stones are removed, this soil is similar to Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes, in crop suitability and management needs. Areas that are not cleared of stones are best suited to grass-legume pasture if irrigated and to range if not irrigated.

Deschutes sandy loam, stony, over semicemented sandy material, 3 to 7 percent slopes (Dsl).—This soil is gently sloping or undulating and is more difficult to irrigate properly than Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes.

Use and management (subgroup 1D).—Most of this soil is in its natural vegetation; only small areas are irrigated. If most of the stones are removed, this soil is similar in use suitability and management needs to Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes.

Deschutes sandy loam, stony, over semicemented sandy material, 7 to 12 percent slopes (Dso).—This inextensive soil occurs near Tumalo. It is of little agricultural importance. A small area that has slopes of 12 to 20 percent is included.

Use and management (subgroup 1G).—Practically all of this soil is in its natural vegetation. Because of the strong slopes, the difficulty of irrigating, and the high erosion hazard under irrigation, clearing stones from this soil probably is not practicable. Under irrigation, this soil is probably best suited to grass-legume pasture.

Era sandy loam

All of the Era sandy loam in the Area is in Jefferson County. Most of this extensive soil lies on the nearly level and undulating upland plains. Some of it occurs in more strongly sloping areas where the plains are more dissected, and some on the lower slopes of buttes. Much of this soil will be irrigated under the Deschutes Irrigation Project.

The normal annual precipitation is 8.5 to 10 inches. The natural vegetation consisted of big sagebrush, rabbitbrush, bunchgrasses, annual grasses, scattered junipers, and associated herbs.

The upper part of this soil has developed mostly from material weathered from partly consolidated sandstone, agglomerate, and other sedimentary strata of the Dalles formation. This material was mainly of volcanic origin chiefly andesite, basalt, and rhyolite. The parent material of the upper part of the soil probably contained some pumice particles, volcanic ash, and wind-borne silt.

The lower part of the profile was affected by materials weathered from basalt or other lava rock. Basalt bedrock commonly underlies this soil at a moderate depth.

This soil is associated with the Agency soils. It has developed from parent materials similar to those of Agency soils, in a similar climate, and under a similar kind of vegetation. The subsoil of Era sandy loam, however, is coarser textured than the Agency subsoil. Era sandy loam is somewhat similar to the Deschutes soils, but it contains less pumice and its subsoil is more friable.

The soil profile is weakly or very weakly developed. The subsoil is only slightly, if at all, finer in texture and more compact than the surface soil. Some lime has accumulated in the lower subsoil.

Typical profile:

0 to 9 inches, grayish-brown sandy loam grading to light brownish gray or brown; noncalcareous; slightly hard or soft; single-grain or weak very fine granular structure; when moist, very dark grayish brown and very friable.

9 to 25 inches, brown to grayish-brown sandy loam or light loam; noncalcareous; slightly hard; single grain or massive; when moist, dark brown to dark grayish brown; contains pebbles, more in lower part.

25 to 33 inches, brown gravelly sandy loam or loam, grading to grayish brown or pale brown; slightly calcareous; slightly hard; weak subangular blocky structure; commonly contains lime-coated angular rock fragments.

33 inches +, lime-coated basalt.

Partly because of the diversity of the stratified underlying material, this soil differs from place to place. The underlying material may be andesitic or rhyolitic lava, caliche, or more or less consolidated sandstone, agglomerate, or other sedimentary rock. The permeability of these layers differs. Normally this soil is 2 to 3 feet deep to a layer that is impermeable to roots, but it may be 5 or more feet deep. Included are some areas where the subsoil is finer in texture and less permeable than is typical.

In most places the upper layers contain a few red rhyolitic and gray or dark-gray andesitic and basaltic pebbles or subangular rock fragments. These pebbles or fragments are more numerous in the lower part of the profile. The upper part of the soil also contains a small quantity of pumice the size of fine and medium sand. This pumice sand was either deposited from the air following a volcanic eruption, or was part of the sedimentary parent material.

Era sandy loam apparently is low in organic matter and nitrogen, but not so low as the Deschutes soils. The surface soil commonly is about neutral in reaction, and the subsoil is normally mildly alkaline.

Drainage through the surface soil and subsoil is moderate to rapid. The underlying basalt is relatively imperme-

able except in places where fissures or cracks occur. This soil is normally well drained, but in some swales or level tracts excessive irrigation may cause a perched water table. In these places soluble salts may accumulate. Normally, however, this soil is not saline or alkaline.

To show variations in slopes and erosion, eight phases of this soil are mapped.

Era sandy loam, 0 to 3 percent slopes (Ea).—This is one of the better soils that will be irrigated under the Deschutes Irrigation Project. All of it lies north of the Crooked River, mainly in the nearly level upland plains. This soil is moderately deep and the water-holding capacity is moderate to high. Runoff is slow. The organic-matter content is low. The erosion hazard under irrigation will be slight, but in some areas wind erosion may be a hazard.

Use and management (subgroup 2A).—When this soil was mapped, 80 percent was used for dry-farmed crops, chiefly wheat alternating with summer fallow. Yields have been low. Nearly 10 percent was in sagebrush and grass. Most of the rest has been cultivated but is now in annual grasses or crested wheatgrass.

This soil is moderately to poorly suited to dry farming.

Except for a section not easily reached by canals, most of this soil will be irrigated. It will be easy to level and to irrigate. About the same kind of crops probably will be grown on this soil as are now grown on Deschutes sandy loam, 0 to 3 percent slopes. These crops include alfalfa, potatoes, oats, barley, wheat; Ladino, alsike, and red clovers for hay and seed; and perhaps peas for seed.

After a few years of cropping, yields on Era sandy loam, 0 to 3 percent slopes, are expected to increase slightly. This soil appears to be better suited to alfalfa and clover than Deschutes sandy loam, 0 to 3 percent slopes. It should be well suited to Ladino clover grown for seed, at least until the stand is invaded by weeds and other clovers.

Management needs under irrigation will be similar to those of Agency loam, 0 to 3 percent slopes, but irrigation runs should be shorter on this soil and applications of fertilizer somewhat heavier.

Era sandy loam, 3 to 7 percent slopes (Ec).—All of this gently sloping or undulating soil lies north of the Crooked River. It occurs near the edges of the nearly level upland plains and where the terrain is slightly more dissected. Many areas lie on the lower slopes of buttes. Runoff from rainfall is slow.

Use and management (subgroup 2B).—Most of this soil has been cropped. Only about 10 percent is in sagebrush and grass. Nearly half of the acreage that has been cropped, however, is now in grass, chiefly cheatgrass or other annuals and crested wheatgrass. Much of the soil that had been cropped was put in grass under a Federal land utilization project. The nonirrigated soil is similar in use suitability, yields, and management needs to Era sandy loam, 0 to 3 percent slopes.

A considerable part of this soil will be irrigated under the Deschutes Irrigation Project, but many tracts cannot easily be reached by canals. Under irrigation, this soil will be suited to about the same kind of crops as Era sandy loam, 0 to 3 percent slopes. It will be less well suited to potatoes and other row crops because, under irrigation, it will be erosive. It should remain in alfalfa, clover, or pasture as much as possible, perhaps two-thirds of the time. A grass should be planted with the alfalfa. Additions of organic matter are suggested.

It will be difficult to irrigate this soil without causing moderate erosion. Careful control of water will be necessary to prevent excessive runoff and washing. Corrugations may be better suited to this soil than strip borders, but runs should be rather short. Flooding from contour laterals may be satisfactory. Other management needs are rather similar to those of Agency loam, 0 to 3 percent slopes.

Era sandy loam, 7 to 12 percent slopes (Ee).—This sloping or rolling soil lies in the more dissected parts of the upland plains and along the lower slopes of buttes.

Use and management (subgroup 2C).—About one-third of this soil is in sagebrush and grass. One-fourth is used for dry-farmed grain, and most of the rest has been cropped but is now in annual grasses or crested wheatgrass. Yields of grain have been low. Some of the soil that had been cropped was put in grass under a Federal land utilization project.

Some of this soil will probably be irrigated under the Deschutes Irrigation Project, but much of it lies in positions that are difficult to supply with water. This soil is poorly suited to irrigation. It will be difficult to distribute water evenly without causing considerable erosion. If corrugations are used or if the soil is flooded from contour laterals, short runs are essential. Irrigated areas should be kept in alfalfa, clover, or grass-legume pasture most of the time, and a grain crop should be grown only as preparation for reseeding the pasture.

Era sandy loam, 12 to 20 percent slopes (Eg).—This soil occurs in scattered tracts in the more dissected parts of the upland plains and in the rougher sections in Jefferson County.

Use and management (subgroup 2D).—Half of this soil is in sagebrush and grass, and only about 6 percent is dry farmed. Most of the rest has been cropped but is now in annual grasses or crested wheatgrass. Some of this soil that had been cropped was put in grass under a Federal land utilization project.

Because irrigation would be likely to cause serious erosion, probably little or none of this soil will be irrigated. If any is irrigated it should be kept in grass-legume pasture.

Era sandy loam, eroded, 0 to 3 percent slopes (Eb).—This soil has been moderately eroded, chiefly by the wind. Much of the acreage has lost one-fourth or more of the original topsoil.

Use and management (subgroup 2A).—This soil should be managed in about the same way as Era sandy loam, 0 to 3 percent slopes, but its needs for additions of organic matter and for nitrogen-supplying crops are greater. Wind erosion of unirrigated areas can be controlled by planting grain in narrow strips alternating with strips of fallow soil.

Era sandy loam, eroded, 3 to 7 percent slopes (Ed).—This soil occurs mainly near Round, Haystack, and Juniper Buttes. A considerable part of it has lost 25 percent of the topsoil through erosion by water or wind, or both. In a few spots as much as 75 percent has been removed, and in other spots a few gullies have formed.

Use and management (subgroup 2B).—Much of this soil probably will be irrigated. It should be managed in about the same way as Era sandy loam, 3 to 7 percent slopes, but it will need more organic matter and nitrogen.

Era sandy loam, eroded, 7 to 12 percent slopes (Ef).—Many tracts of this soil are in the sloping or rolling uplands east of Culver. This soil has been moderately eroded by

wind or water, or both. One-fourth or more of the original topsoil has been removed, and in spots a few gullies have formed.

This soil is in management subgroup 2C. It is managed in about the same way as Era sandy loam, 7 to 12 percent slopes, but yields are slightly lower.

Era sandy loam, eroded, 12 to 20 percent slopes (Eh).—This soil has been moderately eroded by water or wind, or both. Included are some areas on alluvial fans where the soil is deeper than normal and resembles Metolius sandy loam.

This soil is in management subgroup 2D. It needs about the same kind of management as Era sandy loam, 12 to 20 percent slopes.

Gem clay loam

Gem clay loam occurs in the southeastern part of the surveyed area of Jefferson County on the lower foot slopes of the nearby buttes. Except for the extreme southern and southwestern parts, this region receives more rainfall than the rest of the Area. The normal annual precipitation is probably about 11 or 12 inches. The natural vegetation consists mainly of big sagebrush and bunchgrasses, but it includes some junipers, bitterbrush, rabbitbrush, and associated herbs. Cheatgrass is common.

This soil was formed mainly from material weathered from basalt. Most of it is underlain by basalt bedrock. In some areas the parent material was probably old alluvial or colluvial material that collected on alluvial fans on the foot slopes of the nearby buttes. Andesite, rhyolite, and other material are mixed with the basalt. This soil contains little or no pumice.

This soil is darker colored than the Lamonta soils. The profile is moderately to strongly developed but less strongly developed than the profile of the Lamonta soils.

Typical profile:

0 to 8 inches, grayish-brown to dark grayish-brown or dark-gray noncalcareous hard clay loam; fine granular structure; when moist, very dark gray or very dark grayish brown and firm; when wet, plastic.

8 to 20 inches, noncalcareous clay or heavy clay loam, slightly lighter colored than layer above; very weak prismatic structure that breaks into very hard, dense, subangular blocky aggregates about ½ inch in diameter; shiny colloidal coating on the aggregates is darker colored than the soil material; when moist, dark grayish brown or dark brown and very firm or firm.

20 to 28 inches, similar to layer above but brown, slightly less hard, and not prismatic; contains many large white lime splotches.

28 to 38 inches, rather similar to layer above, but light yellowish brown or pale brown; slightly coarser texture and less distinct structure; contains many rock fragments.

38 inches +, lime-coated fragments of basalt over basalt bedrock.

In many places the upper few inches of this soil is platy. A few angular or subangular rock fragments occur in the surface soil; they are more numerous with increasing depth. These fragments are dark colored; in places some are red rhyolitic rocks.

The upper layer of this soil contains moderate amounts of organic matter and nitrogen and is about neutral in reaction. Drainage is moderate to slow through the surface soil, slow through the subsoil, and very slow through the substratum.

Because of the combination of more precipitation and a finer texture, Gem clay loam supports a denser stand of grasses and associated herbs than other soils in the Area. Consequently it is the darkest colored soil in the Area; it is also the most fertile and has the best supply of organic matter and nitrogen.

To show variations in slope, erosion, and depth to bedrock, four phases of this soil are mapped.

Gem clay loam, eroded, 3 to 12 percent slopes (Ga).—This soil occurs southeast of Haystack Butte, on upland plains or the foot slopes of buttes. It is gently sloping to moderately sloping, or undulating to rolling. This soil occurs in a region where rainfall is higher than it is in most of the Area. A considerable part of this soil has been moderately eroded by water or wind, or both. Runoff ranges from slow to moderate. When wet, this soil is sticky and difficult to till. Workability is only fair. This soil has better water-holding capacity than most of the soils in the Area, and also contains more organic matter and nitrogen.

Use and management (group 3).—Almost 40 percent of this soil is used for dry-farmed grain and left fallow every other summer. The rest has been cropped but is now in grasses, chiefly crested wheatgrass, and is used for grazing. Much of this area was put in grass under the Federal land utilization project.

This is one of the better soils for dry-farmed grain. It seems better suited to winter wheat than to spring wheat. Yields are normally 15 to 17 bushels an acre, but they range from 5 to 25 bushels, depending on the amount of rainfall.

This soil would be only fair for irrigated crops. Because of its location, probably none of it will be irrigated.

Gem clay loam, eroded, 12 to 20 percent slopes (Gb).—This soil occurs in a few tracts southeast of Haystack Butte. It is strongly sloping or rolling to hilly. Most of it has been moderately eroded, chiefly by water. In areas not protected by vegetation, runoff is moderate. Included are some areas in which the surface soil is loam instead of clay loam. These areas are more easily tilled than the typical soil.

Use and management (group 3).—About 40 percent of this soil is used for dry-farmed grain, 15 percent is under sagebrush and grass, and the rest is in grass and is used for grazing.

Because of strong slopes and erodibility, this soil is not well suited to dry-farmed grain. Farm machinery is difficult to use on the strong slopes. Yields are lower on this soil than on Gem clay loam, eroded, 3 to 12 percent slopes.

Probably none of this soil will be irrigated under the Deschutes Irrigation Project. It is poorly suited to irrigated crops, but it could be used for irrigated pasture.

Gem clay loam, shallow, 7 to 12 percent slopes (Gc).—This soil occurs east and northeast of Haystack Butte. It differs from Gem clay loam, 7 to 12 percent, in that (1) it is generally less than 16 inches deep over bedrock; (2) its surface soil and subsoil are coarser textured; (3) its surface soil is lighter colored; (4) it contains more pebbles and rock fragments; and (5) its subsoil contains less lime.

Use and management (subgroup 2I).—Little of this soil has been cleared of its native sagebrush and grass. Because it is shallow and low in water-holding capacity, it is poorly suited to dry-farmed grain. If it is not irrigated, it should be used for range. Probably none of

this soil will be irrigated. If any is irrigated, it should be used for permanent pasture.

Gem clay loam, shallow, eroded, 7 to 12 percent slopes (Gd).—This shallow or rolling soil occurs southeast of Haystack Butte. It has been moderately eroded. About 20 acres of a similar soil having 12 to 20 percent slopes and only slight erosion are included.

Use and management (subgroup 2I).—Nearly all of this soil is in sagebrush and grass. Because the soil is shallow and low in water-holding capacity, it is poorly suited to dry farming. Probably none will be irrigated. If it is irrigated, it would be suited to permanent pasture.

Gem loam

Except that it is coarser in texture, Gem loam is similar to Gem clay loam. In most places the surface soil is loam, silt loam, or heavy loam, and the subsoil is heavy clay loam. Drainage is moderate through the surface soil and slow through the subsoil.

To show variations in slope and erosion, three phases of this soil are mapped.

Gem loam, 3 to 7 percent slopes (Ge).—This soil occurs southeast and west of Haystack Butte, in spots where rainfall is greater than in most of the Area. This soil absorbs and holds water better than most soils of the Area, and also contains more organic matter and nitrogen. Runoff is rather low, and tilth is fairly good. Included are 18 acres where the slopes range from 0 to 3 percent, and a few acres where about one-fourth or more of the original surface soil has been removed by water or wind, or both.

Use and management (group 3).—About 75 percent of this soil is used for dry-farmed grain; the grain is alternated with summer fallow. About 6 percent is in sagebrush and grass. The rest of the soil has been cropped but is now chiefly in crested wheatgrass.

This is the best soil in the Area for dry-farmed grain. Dry-farming practices are similar to those on Gem clay loam, eroded, 3 to 12 percent slopes, but workability is better on this soil. Yields are about the same or slightly higher. Because of its location, probably none of this soil will be irrigated.

Gem loam, 7 to 12 percent slopes (Go).—This soil occurs in one tract northeast of Haystack Butte. Runoff is slow to moderate, but some erosion may occur during heavy rains or when snow melts. Workability is good.

Use and management (group 3).—This soil is slightly less well suited to dry-farmed grain than Gem loam, 3 to 7 percent slopes, but yields should be almost as high. Although this soil was formerly cultivated, all of it is now in grass, chiefly crested wheatgrass. The area is included in the Federal land utilization project. This soil is not likely to be irrigated soon. Under irrigation it would be only fair for crops, but it could be used for permanent pasture and hay.

Gem loam, eroded, 7 to 12 percent slopes (Gs).—This soil occurs east, northeast, and southeast of Haystack Butte. It has been moderately eroded. About one-fourth or more of the original surface soil has been removed by water or wind. A few shallow gullies have formed in places.

Use and management (group 3).—This soil was included in the Federal land utilization project. At present, 85 percent of it is in grass, chiefly crested wheatgrass. About 10 percent is in sagebrush and grass, and 5 percent is in dry-farmed grains. Because it is more strongly sloping and has more rapid runoff, this soil is less well suited to dry-farmed wheat than Gem loam, 3 to 7 percent slopes. Yields probably would be lower. This soil is not likely to be irrigated soon.

Laidlaw sandy loam

Laidlaw sandy loam occurs in rather small tracts in the undulating to rolling uplands of the southwestern parts of the Area, particularly southwest of Laidlaw Butte. The normal annual precipitation is about 11 to 13 inches. The frost-free season is usually short. Near Laidlaw Butte the native vegetation consists of big sagebrush, an open stand of juniper, and some rabbitbrush and bunchgrasses. Areas of this soil west of Bend support, in addition, some ponderosa pine and bitterbrush.

This soil developed in a 2- to 3-foot layer of pumice sand. Mixed with the pumice sand were small crystals of plagioclase, hypersthene, augite, and hornblende, and also some dark-gray or gray sand, coarse sand, or angular fragments of basalt or andesite, an inch or less in diameter. This material was carried by the wind from places south and southwest of the Area where volcanic eruptions had occurred. It was deposited over pumice that apparently erupted from Laidlaw Butte, and was subsequently somewhat reworked by wind and water.

The parent material is somewhat weathered. The subsoil is somewhat compacted, and weak structural aggregates have formed. In most places a hard cemented layer occurs at a depth of 2½ or 3 feet. The cementation may occur in the top part of the pumice flow material.

This soil differs from the typical Deschutes sandy loam in being entirely noncalcareous, probably because it receives more rainfall.

Typical profile:

0 to 7 inches, grayish-brown soft light sandy loam grading to brown or light brownish gray; single grain; contains much light yellowish-brown, pale-brown, or very pale brown pumice sand; some pumice particles are as large as ⅛ inch; when moist, very dark grayish brown and very friable.

7 to 17 inches, similar to layer above but slightly browner and lighter colored.

17 to 23 inches, pale-brown light sandy loam; breaks into weak, slightly hard or hard, rounded or subangular blocky aggregates ½ to ¾ inch in diameter; contains much pumice similar to that in surface layer; when moist, dark grayish brown and firm to friable.

23 to 30 inches, soft or slightly hard gravelly loamy sand that is similar to layer above in color; contains many rounded or subangular pumice pebbles as large as 1½ inches in diameter.

30 inches +, light gray splotched with yellowish brown, weakly to strongly cemented pumice flow material; material consists of fine sandy material among rounded to angular pumice pebbles and lumps as large as 10 inches in diameter; pebbles and lumps are light in weight and vesicular or spongelike; when wet, lumps are mainly yellowish brown on the inside; in most places layer is capped by an indurated film about ½₀ inch thick that is apparently cemented by siliceous material and can be broken only by a pick or heavy bar.

In places scattered basalt stones as large as 1 foot in diameter occur on or in this soil. The surface soil contains a little organic matter. This soil is about neutral; in places it grades from slightly acid in the surface soil to mildly alkaline in the subsoil. Drainage through the

surface soil and subsoil is rapid, but drainage appears to be very slow or slow through the underlying layer.

To show variations in slope and erosion, five phases of this soil are mapped.

Laidlaw sandy loam, 0 to 3 percent slopes (La).—This nearly level soil occurs southwest of Laidlaw Butte and west of Bend. In this region the frost-free season is normally about 96 days, but it ranges from 47 to 143 days.

Use and management (subgroup 1A).—About 57 percent of this soil is in its natural vegetation, 26 percent is irrigated for crops and pasture, and the rest is used for farmsteads, range, or other purposes.

In use and management this soil is somewhat similar to Deschutes sandy loam, 0 to 3 percent slopes, and Deschutes loamy sand, 0 to 3 percent slopes. The frost-free season may be too short for potatoes and for alfalfa. Under irrigation this soil is best suited to small grains, vetch for seed, alsike clover for seed and hay, and red clover. Possibly strawberries can be grown.

A few acres of this soil are sometimes used to grow dry-farmed rye for hay or grain, but yields are low.

Laidlaw sandy loam, 3 to 7 percent slopes (Lb).—This soil is gently sloping or undulating and therefore is more likely to erode under irrigation than Laidlaw sandy loam, 0 to 3 percent slopes. Runoff from rainfall is rather low.

Use and management (subgroup 1D).—About 82 percent of this soil is in natural vegetation, and only about 11 percent is used for crops and pasture. Most of the acreage used for crops and pasture is irrigated, but a little is used to grow dry-farmed rye for hay or grain.

In use and management this soil is similar to Laidlaw sandy loam, 0 to 3 percent slopes. It is suited to irrigated pasture. Irrigation runs should be short to prevent erosion.

Laidlaw sandy loam, 7 to 12 percent slopes (Lc).—This soil is sloping or rolling and consequently is difficult to irrigate effectively. The erosion hazard under irrigation is high.

Use and management (subgroup 1G).—About 82 percent of this soil is in its natural vegetation; most of the rest is irrigated for crops and pasture. A few acres may be used to grow dry-farmed rye for hay or grain.

This soil is poor for irrigated or dry-farmed crops. It is better suited to pasture.

Laidlaw sandy loam, eroded, 7 to 12 percent slopes (Ld).—This soil occurs southwest of Laidlaw Butte. It has been moderately eroded, chiefly by water.

Use and management (subgroup 1G).—About 65 percent of this soil is used for irrigated crops and pasture, and 20 percent is in its natural vegetation. A few acres is in dry-farmed rye or other small grain for hay or grain.

This soil is poorly suited to irrigated or dry-farmed crops. The irrigated areas can be used for permanent pasture. The nonirrigated areas can be seeded to crested wheatgrass.

Laidlaw sandy loam, eroded, 12 to 20 percent slopes (Le).—This inextensive soil is strongly sloping or hilly. The runoff from rainfall is not rapid, but the erosion hazard under irrigation is very high. Effective distribution of water is difficult.

Use and management (subgroup 1I).—About two-thirds of this soil is used for crops and grass pasture. Some of the pasture is irrigated. About one-third remains in its natural vegetation. On a few acres dry-farmed rye is grown for hay or grain. The irrigated areas can be used for grass-legume pasture. The nonirrigated soil can be seeded to crested wheatgrass.

Lamonta loam

Lamonta loam occurs extensively in Jefferson County, on nearly level or dissected upland plains and along the adjoining lower slopes of buttes. The annual precipitation ranges from about 8.5 to 11 inches. The natural vegetation consists of big sagebrush, bunchgrasses, annual grasses, rabbitbrush, scattered junipers, and associated herbs.

This soil was derived from mixed weathered materials that contained much rhyolitic and apparently some andesitic and basaltic materials. A considerable part of the soil material apparently was derived from the partly consolidated sandstone and agglomerate of the Dalles formation. In many places, however, the parent material may be old water-spread or colluvial materials that came from nearby buttes. The upper part of the soil may contain some wind-blown fine pumice and possibly some volcanic ash and windblown silt.

Lamonta loam is associated with Agency and Madras soils. Unlike these soils, it typically has a compact clay subsoil that is finer textured than the surface soil. The subsoil of the Agency and Madras soils is no finer in texture than clay loam.

Representative profile:

0 to 10 inches, grayish-brown, noncalcareous, slightly hard loam; fine granular structure; neutral reaction; when moist, very dark brown or very dark grayish brown and friable; in most places, layer grades into the layer below.

10 to 19 inches, dark-brown clay grading toward brown or dark grayish brown; noncalcareous; weak prismatic structure that breaks into very hard, dense, fine and medium-sized angular blocky aggregates; aggregates have glossy colloidal coating; neutral or mildly alkaline; sticky and plastic when wet.

19 to 26 inches, similar to layer above but lighter in color and moderately alkaline.

26 to 33 inches, very pale brown, pink, or light yellowish-brown very hard clay or clay loam; contains pebbles and small subangular rock fragments; fine angular blocky structure; very highly calcareous; veins and splotches of white lime; in places, soft caliche.

33 inches +, weathered, partly consolidated sandstone, agglomerate, or cobbly and stony fluvial deposits; generally calcareous in the upper part; in places, rhyolite, basalt, or other lava.

In many places a layer of hard subangular blocky clay loam, 2 to 8 inches thick, occurs in the upper subsoil between the surface soil and the dense clay layer. Included are areas where the subsoil is coarser and more permeable than typical.

Lamonta loam generally contains a small to moderate number of pebbles or subangular fragments of red rhyolite, some pebbles or fragments of gray or dark-gray andesite or basalt, and a few pebbles of quartz. Most of these pebbles and fragments are less than 1 inch in diameter, but a few are as large as 3 or 4 inches. They are generally more numerous in the lower subsoil.

Drainage is moderate through the surface soil, very slow or slow through the subsoil, and slow in most places through the underlying material. This soil is naturally nonsaline and nonalkaline. The organic-matter content is low to moderate.

To show variations in slope, depth, stoniness, and erosion, 15 phases of this soil are mapped.

Lamonta loam, 0 to 3 percent slopes (Lf).—This nearly level soil occurs in Jefferson County, near the outer edges of the Agency Plains and the plains south of Culver and near Opal City. It occurs elsewhere in Jefferson County in nearly level tracts on the more dissected upland.

Runoff is slow, but the soil may be damaged by wind erosion when it is not protected. The water-holding capacity is moderate to somewhat high. The erosion hazard under irrigation is slight.

Use and management (subgroup 2E).—Between two-thirds and three-fourths of this soil is used for dry-farmed small grains, chiefly winter wheat. Perhaps one-half of the rest of the soil is in sagebrush and grass. Some areas that have been cropped are in crested wheatgrass or other grasses and are grazed.

Yields of winter wheat are about 11 bushels an acre, but vary from year to year depending on rainfall. In the vicinity of Haystack Butte, precipitation is higher than in most of the Area; consequently, yields are slightly better.

Much of this soil will be irrigated under the Deschutes Irrigation Project. Some tracts, however, are located above the canal or in other locations that are difficult to supply with water. This soil should be fairly well suited to irrigated pasture and to several irrigated crops—oats, barley, wheat; and Ladino clover, peas, and vetch grown for seed. It is less well suited to alfalfa, red clover, alsike clover, and other deep-rooted crops. Because of the clay subsoil, it is not well suited to potatoes.

This soil should be easy to prepare for irrigation. Deep grading should be avoided, because it will expose the clayey subsoil, which takes water slowly and is difficult to work. On areas that are nearly level, irrigation runs can be longer than on most of the soil. This soil needs about the same fertilization as Agency loam, 0 to 3 percent slopes.

Lamonta loam, 3 to 7 percent slopes (Lh).—This soil occurs in Jefferson County in the somewhat dissected upland plains and along the lower foot slopes of Haystack, Juniper, and Round Buttes. It is gently sloping or undulating and therefore more likely to erode under irrigation than Lamonta loam, 0 to 3 percent slopes.

Use and management (subgroup 2F).—Nearly half of this soil is used for dry-farmed grain under management similar to that used on Lamonta loam, 0 to 3 percent slopes. Yields are slightly less. About one-fourth is in sagebrush and grass. Most of the rest has been cropped, but is now in crested wheatgrass or cheatgrass. Much of this acreage was seeded to grass under a Federal land utilization project.

Half or more of this soil probably will be irrigated under the Deschutes Irrigation Project. It should be managed in about the same way as Lamonta loam, 0 to 3 percent slopes, but it is not so well suited to irrigation. Sod or close-growing crops will help to control erosion. The corrugation method of irrigation is probably more suitable for this soil than the strip-border method.

Lamonta loam, 7 to 12 percent slopes (Lm).—This sloping or rolling soil occurs in Jefferson County on the dissected upland plains and along the lower slopes of buttes.

Use and management (subgroup 2G).—About 55 percent of this soil is in sagebrush and grass, and 20 percent is in dry-farmed crops. The rest has been cropped but is now in crested wheatgrass or cheatgrass. Some was seeded to grass under a Federal land utilization project. Yields of grain are a little lower on this soil than on the less strongly sloping Lamonta loams.

Under dry farming, runoff is rather slow, but this soil is somewhat erodible. Stubble should be left on the surface to protect the soil against erosion. Contour tillage will also retard erosion.

Some of this soil probably will be irrigated. It is rather poorly suited to irrigation. If water is not efficiently controlled, it may cause considerable erosion. Severe erosion is more damaging to this soil than to soils that have more permeable subsoils. Under irrigation this soil is better suited to permanent grass-legume pasture, oats, barley, and wheat than to most other crops.

Lamonta loam, 12 to 20 percent slopes (Lo).—This moderately steep or hilly soil occurs inextensively in Jefferson County in several widely scattered tracts. Some of this soil has a subsoil that is shallower, coarser textured, and less dense than the subsoil of Lamonta loam, 0 to 3 percent slopes.

Use and management (subgroup 2H).—Slightly more than half of this soil is in native vegetation. The rest has been cultivated but is now in annual grasses or crested wheatgrass and is used for range. Yields of dry-farmed crops were rather low. Because of the strong slopes, it is difficult to use large farming implements efficiently.

This soil would be poor for irrigated crops and should be kept in permanent grass-legume pasture.

Lamonta loam, eroded, 0 to 3 percent slopes (Lg).—This soil has been moderately eroded by water or wind, or both; about one-fourth or more of the original surface soil has been removed. In many places, deep plowing turns up some of the clay subsoil. This results in a more clayey surface soil, which impedes the infiltration of water. Consequently the suitability of this soil for crops, especially irrigated crops, is reduced.

Use and management (subgroup 2E).—This soil is in the same management subgroup as Lamonta loam, 0 to 3 percent slopes, but it is less well suited to agriculture and it needs more organic matter, nitrogen, and other fertilizer.

Lamonta loam, eroded, 3 to 7 percent slopes (Lk).—This soil has been moderately eroded; a large part of it has lost 25 percent or more of the original surface soil. Shallow gullies have formed in a few places. In many places, deep plowing will bring up some of the clay subsoil. The clay causes poorer tilth and makes the surface soil hard when dry and sticky and plastic when wet. Consequently the soil will be more difficult to work, and runoff probably will be increased. Thus the soil will be less suitable for crops, particularly irrigated crops.

Use and management (subgroup 2F).—This soil is in the same management subgroup as Lamonta loam, 3 to 7 percent slopes, but it needs more organic matter and nitrogen. Yields are lower on this soil.

Lamonta loam, eroded, 7 to 12 percent slopes (Ln).—This soil has been moderately eroded; much of it has lost from 25 to 75 percent of the original surface soil. Shallow gullies have formed in a few places. In many places, deep plowing turns up some of the clay subsoil and causes the plow layer to be harder when dry and more sticky and plastic when wet.

Use and management (subgroup 2G).—About 22 percent of this soil is in sagebrush and grass, and 34 percent is in dry-farmed small grains. Most of the rest has been

cultivated but is now in crested wheatgrass or cheatgrass and is used for range. This soil is less suitable for crops than Lamonta loam, 7 to 12 percent slopes, and produces lower yields. If irrigated, it is suited to grass-legume pasture.

Lamonta loam, eroded, 12 to 20 percent slopes (Lp).—This soil has lost from 25 to 75 percent of its original surface soil through erosion. Shallow gullies have formed in a few places. Deep plowing mixes some of the clay subsoil with the surface soil and causes the surface soil to become harder when dry and more sticky when wet. This soil is somewhat shallower than the more nearly level Lamonta loams and has a coarser, more permeable subsoil.

Use and management (subgroup 2H).—About 35 percent of this soil is in sagebrush and grass, and 7 percent is used for dry-farmed grains. Much of the rest has been cropped but is now in crested wheatgrass or cheatgrass and is grazed. Yields are low. This soil is poorly suited to irrigated crops. If irrigated, it should be kept in permanent grass-legume pasture.

Lamonta loam, shallow, 0 to 3 percent slopes (Lr).—This soil occurs north of Gateway and south of Juniper Butte. It is only about 16 inches or less in depth to the underlying sandstone, rhyolite, or basalt. The lower part of the subsoil may be noncalcareous or only slightly calcareous, but some lime commonly occurs in fissures in the underlying rock. Because this soil is shallow, its water-holding capacity is low. Included in the mapping unit is a small acreage that is moderately eroded.

Use and management (subgroup 2I).—About two-thirds of this soil is in sagebrush and grass. The rest has been cropped but is now in cheatgrass or crested wheatgrass and is used for grazing.

This soil is poorly suited to dry-farmed grains. It is better suited to crested wheatgrass that is grown for grazing. This soil is less well suited to irrigated crops than the deeper Lamonta loams, but oats, barley, wheat, peas, and vetch should do fairly well if water is applied when needed.

Lamonta loam, shallow, 3 to 7 percent slopes (Ls).—This soil is 16 inches or less in depth to the underlying sandstone, rhyolite, or basalt. Its water-holding capacity is low. It is difficult to irrigate this soil effectively without causing erosion.

Use and management (subgroup 2I).—About two-thirds of this soil is in natural vegetation. A few acres are used for dry-farmed grain, and a few acres are in cheatgrass or crested wheatgrass. This soil is poorly suited to dry-farmed grain. Irrigated oats, barley, wheat, and vetch should do fairly well if water is applied when needed.

Lamonta loam, shallow, eroded, 3 to 7 percent slopes (Lt).—This soil is moderately eroded. Clay in the subsoil has been exposed and tilth impaired.

Use and management (subgroup 2I).—Nearly half of this soil is in sagebrush and grasses. About 15 percent is used for dry-farmed crops. The rest has been planted to crested wheatgrass or is in cheatgrass. This soil is suitable for about the same uses as Lamonta loam, shallow, 3 to 7 percent slopes.

Lamonta loam, shallow, eroded, 7 to 12 percent slopes (Lu).—This soil is about 16 inches or less in depth to the underlying rock. Its water-holding capacity is low.

Use and management (subgroup 2I).—About 80 percent of this soil is under its natural vegetation; 10 percent is used for dry-farmed crops.

This soil is poorly suited to dry-farmed grain. Because it is difficult to distribute water evenly, this soil is also poorly suited to irrigated crops. If it is irrigated, it should be used for permanent grass-legume pasture.

Lamonta loam, stony, 0 to 3 percent slopes (Lv).—This soil occurs in Jefferson County, much of it around the edges of the nearly level Agency Plains. It contains many tones. Much of it is somewhat shallower than Lamonta loam, 0 to 3 percent slopes, and a considerable part apparently is underlain by basalt, rhyolite, or other lava rock instead of sandstone and agglomerate. Included are several eroded areas from which one-fourth or more of the original surface soil has been removed. These areas are shown on the soil map by erosion symbols.

Except in a few places, this soil is too stony to be tilled. Most of the stones are angular fragments of basalt, but in places red rhyolite or other kinds of stone predominate. The stones range from a few inches to 20 inches or more in diameter. In places, the bedrock outcrops at the surface.

Use and management (group 6).—About 90 percent of this soil is in sagebrush and grass and is used for grazing.

The stones make it difficult to prepare this soil for seeding grass. If the stones were removed, areas that could conveniently be irrigated would be suitable for permanent grass-legume pasture.

About 5 percent of this soil is used for dry-farmed grain. Only areas from which some of the stones have been removed are suitable for crops.

Lamonta loam, stony, 3 to 7 percent slopes (Lw).—This gently sloping or undulating soil is more difficult to irrigate evenly than Lamonta loam, stony, 0 to 3 percent slopes. The mapping unit includes several areas from which one-fourth or more of the original surface soil has been removed by erosion.

Use and management (group 6).—Almost all of this soil is under natural vegetation. In use and management this soil is similar to Lamonta loam, stony, 0 to 3 percent slopes, but it is less well suited to permanent irrigated grass-legume pasture.

Lamonta loam, stony, 7 to 12 percent slopes (Lx).—This soil occurs in large tracts near Round Butte. It is sloping or rolling and has more rapid runoff than Lamonta loam, stony, 0 to 3 percent slopes. Included are areas that are moderately eroded.

Use and management (group 6).—Nearly all of this soil is under natural vegetation. In use and management it is similar to Lamonta loam, stony, 0 to 3 percent slopes, but it is less well suited to permanent irrigated pasture.

Lamonta sandy clay loam

Lamonta sandy clay loam is similar to Lamonta loam except for its surface soil, which is somewhat harder when dry, more sticky and plastic when wet, more difficult to work, and slightly less permeable to water. Furthermore, it may hold more water than the surface soil of Lamonta loam and may contain slightly less organic matter and nitrogen. In places, the surface soil of Lamonta sandy clay loam is slightly darker colored than is typical. Included are some areas of clay loam and gritty loam.

To show variations in slope, erosion, depth, and stoniness, 15 phases of this soil are mapped.

Lamonta sandy clay loam, 0 to 3 percent slopes (Ly).—This soil occurs in Jefferson County in several widely

scattered areas. Runoff is rather slow, but unprotected areas may be damaged by wind erosion.

Use and management (subgroup 2E).—About 40 percent of this soil is in sagebrush and grass, and 35 percent is in dry-farmed grain. Much of the rest has been cultivated but is now in crested wheatgrass or cheatgrass and used for grazing. Yields of grain are low.

In use suitability and management this soil is similar to Lamonta loam, 0 to 3 percent slopes, but because it tends to be hard when dry and sticky when wet, it is less easily worked. It is too fine textured to be suitable for potatoes. It needs an increase of organic matter.

Much of this soil probably will be irrigated. Either the strip-border or the corrugation method of irrigation can be used. This soil should be leveled carefully so that the fine-textured subsoil will not be exposed.

Lamonta sandy clay loam, 3 to 7 percent slopes (Lea).—This gently sloping or undulating soil occurs in Jefferson County in several scattered areas. It occupies moderately dissected upland plains and the foot slopes of buttes. Runoff from rainfall is somewhat slow to moderate.

Use and management (subgroup 2F).—About 20 percent of this soil is in sagebrush and grass, and 10 percent is used for dry-farmed crops. Most of the rest has been cultivated but is now in crested wheatgrass or annual grasses. Yields of grain are rather low; near Haystack Butte they are slightly higher than in other areas.

A considerable part of this soil may be irrigated. Irrigation would be easy, and the erosion hazard under irrigation would be slight or moderate. This soil can be irrigated by the corrugation method or by flooding from contour laterals. Most of the time a sod or close-growing crop should be grown. Permanent grass-legume pasture should do well. This soil is not suited to potatoes.

Lamonta sandy clay loam, 7 to 12 percent slopes (Led).—This sloping or rolling soil occurs in the dissected parts of the uplands and along the lower slopes of buttes. Runoff from rainfall is moderate to slow. Under irrigation the erosion hazard is high to moderate.

Use and management (subgroup 2G).—About 10 percent of this soil is in sagebrush and grass, and about 25 percent is used for dry-farmed grain. Much of the rest has been cropped but has now been sown to crested wheatgrass under a Federal land utilization project.

In use and management this soil is similar to Lamonta loam, 7 to 12 percent slopes, but it is somewhat more difficult to work and is even more poorly suited to potatoes.

Lamonta sandy clay loam, eroded, 0 to 3 percent slopes (Lz).—This soil has been moderately eroded, chiefly by wind; much of the acreage has lost one-fourth or more of the original surface soil.

Use and management (subgroup 2E).—About 50 percent of this soil is used for dry-farmed grain, and 10 percent is in natural vegetation. Most of the rest has been cultivated but is now in crested wheatgrass or annual grasses and is used for grazing. Yields are rather low; they are somewhat higher in the areas near Haystack Butte than in other areas of this soil. In use and management this soil is similar to Lamonta sandy clay loam, 0 to 3 percent slopes.

Lamonta sandy clay loam, eroded, 3 to 7 percent slopes (Lec).—This soil has been moderately eroded by water or wind; about one-fourth or more of the surface soil has been lost. Deep plowing may turn up some of the clay subsoil and thus impair tilth.

Use and management (subgroup 2F).—About 20 percent of this soil is in sagebrush and grass, and about 25 percent is used for grazing. Much of the rest has been cultivated but is now in crested wheatgrass and is used for grazing. In use and management this soil is similar to Lamonta sandy clay loam, 3 to 7 percent slopes.

Lamonta sandy clay loam, eroded, 7 to 12 percent slopes (Leh).—This soil has been moderately eroded; from much of it, one-fourth to three-fourths of the original surface soil has been removed by wind or water, or both. In many places deep plowing turns up some of the finer textured subsoil. As a result, workability is impaired and infiltration of water is impeded. Runoff from rainfall is moderate, and the erosion hazard under irrigation is high to moderate. Because the topsoil is hard when dry and sticky when wet, workability of this soil is only fair.

Use and management (subgroup 2G).—About 10 percent of this soil is in sagebrush and grass. An equal acreage is used for dry-farmed grain. Much of the rest has been cropped but is now in crested wheatgrass or annual grasses and is used for grazing. Controlled grazing of crested wheatgrass is a suitable use for unirrigated areas of this soil. Stubble mulching helps to prevent erosion in cropped areas.

This soil is difficult to irrigate, but some of it probably will be irrigated. If irrigated, it will be better suited to permanent pasture than to crops.

Lamonta sandy clay loam, eroded, 12 to 20 percent slopes (Ler).—This strongly sloping or hilly soil has been moderately eroded; from much of it, one-fourth to three-fourths of the original surface soil has been removed by water or wind. Deep plowing will bring up some of the finer textured subsoil. Runoff is moderate. Workability is fair to poor. This soil is shallower than the typical Lamonta sandy clay loam and has a somewhat coarser and less dense subsoil.

Included are a few acres that are only slightly eroded and about 25 acres of soil that is only 16 inches deep or less.

Use and management (subgroup 2H).—Some of this soil is in sagebrush and grass, some is in crested wheatgrass, and some is used for dry-farmed grain. Yields are low. One of the best crops for this soil is crested wheatgrass. If this soil is cultivated, stubble mulching and contour tilling are needed to prevent erosion.

This soil is poorly suited to irrigation. If it is irrigated, it should be used for permanent grass-legume pasture.

Lamonta sandy clay loam, shallow, 0 to 3 percent slopes (Lev).—This soil occurs in two areas north of Juniper Butte. Unlike the typical Lamonta sandy clay loam, this soil is only about 16 inches or a little less in depth to partly consolidated sandstone, agglomerate, rhyolite, basalt, or other rock. In places the lower part of the subsoil is only slightly calcareous, but lime commonly occurs in fissures in the underlying rock. Nearly half of this soil has lost one-fourth of the original surface soil through wind or water erosion. Such areas are shown on the soil map by erosion symbols.

Use and management (subgroup 2I).—Nearly all of this soil is in sagebrush and grass. A little of it was once cropped. Because this soil is shallow and somewhat low in water-holding capacity, it is poorly suited to dry-farmed grain. It is better suited to crested wheatgrass grown for grazing. Under irrigation, this soil is less well

suited to crops than the deeper soils, but oats, barley, wheat, peas, and vetch should do fairly well.

Lamonta sandy clay loam, shallow, 3 to 7 percent slopes (Lsa).—This soil occurs in two areas east of Culver. Unlike the typical Lamonta sandy clay loam, this soil is only about 16 inches or a little less in depth to the underlying rock, and in places it is noncalcareous or only slightly calcareous. The water-holding capacity is somewhat low.

Use and management (subgroup 2I).—All of this soil is in sagebrush and grass. It is poorly suited to dry-farmed grains. Under irrigation, oats, barley, wheat, peas, and vetch should do fairly well.

Lamonta sandy clay loam, shallow, eroded, 3 to 7 percent slopes (Lsb).—This gently sloping or undulating soil occurs near Juniper Butte and Haystack Butte. From much of the acreage, one-fourth or more of the original surface soil has been removed by water or wind.

Use and management (subgroup 2I).—Most of this soil is in sagebrush and grass. A small acreage that was formerly cropped is in crested wheatgrass or annual grasses. In use suitability this soil is similar to Lamonta sandy clay loam, 0 to 3 percent slopes, but its need for additions of organic matter is greater.

Lamonta sandy clay loam, shallow, eroded, 7 to 12 percent slopes (Lsc).—This sloping or rolling soil occurs north of Juniper Butte and northeast and northwest of Haystack Butte. Runoff is slight to moderate. Much of this soil has lost one-fourth or more of the original surface soil through erosion. Unlike the typical Lamonta sandy clay loam, this soil is only about 16 inches or a little less in depth to the underlying rock, and in places it is noncalcareous or only slightly calcareous.

Use and management (subgroup 2I).—Much of this soil is in sagebrush and grass. A small acreage was once cropped but is now in crested wheatgrass or annual grasses. Because the water-holding capacity is somewhat low, this soil is poorly suited to dry-farmed grain. It is better suited to crested wheatgrass grown for grazing. Under irrigation, this soil would be fairly well suited to oats, barley, wheat, peas, and vetch. Because of the erosion hazard it would be better suited to grass-legume pasture than to crops.

Lamonta sandy clay loam, stony, 0 to 3 percent slopes (Lsd).—Except for its finer textured surface soil, this soil is similar to Lamonta loam, stony, 0 to 3 percent slopes. Most of it is too stony to be tilled. A few areas are less stony.

Use and management (group 6).—Almost all of this soil is in its natural vegetation. The less stony areas could be cleared of stones and made suitable for cultivation, preferably under irrigation. In use suitability and management needs this soil is similar to Lamonta loam, stony, 0 to 3 percent slopes. If not irrigated, it seems best suited to controlled grazing. If irrigated, it should be well suited to permanent grass-legume pasture.

Lamonta sandy clay loam, stony, 3 to 7 percent slopes (Lse).—This soil is gently sloping or undulating. It is more likely to erode under irrigation than Lamonta loam, stony, 0 to 3 percent slopes. Most of it is too stony to be tilled. Included are a few areas that are moderately eroded. Such areas are shown on the soil map by erosion symbols.

Use and management (group 6).—Most of this soil is in sagebrush and grass. In a few places, it would be practicable to remove the stones and cultivate this soil, if it could be irrigated. In use suitability and management needs this soil is similar to Lamonta loam, stony, 0 to 3 percent slopes.

Lamonta sandy clay loam, stony, 7 to 12 percent slopes (Lsl).—Because of its stronger slopes, this soil is more likely to erode under irrigation than Lamonta loam, stony, 0 to 3 percent slopes. Most of it is too stony to be tilled. Included are about 60 acres that are moderately eroded.

Use and management (group 6).—Most of this soil is in sagebrush and grass. In a few places, it might be practicable to remove the stones and cultivate this soil, preferably under irrigation. In use suitability and management needs, this soil is similar to Lamonta loam, stony, 0 to 3 percent slopes.

Lamonta sandy clay loam, stony, 12 to 20 percent slopes (Lso).—Enough stones occur on and in this moderately steep or hilly soil to prevent ordinary tillage. Included are about 130 acres where the surface soil is loam or heavy loam. Also included are 90 acres that are moderately eroded.

Use and management (group 6).—Almost all of this soil is under its natural cover. Because of the strong slopes, the difficulty of spreading water evenly, and the erosion hazard, it is not practicable to clear this soil of stones even if it were to be irrigated.

Madras loam

Madras loam generally occurs on level to somewhat rolling upland plains where the normal annual precipitation is 8.5 to 10 inches. The natural vegetation consisted mainly of big sagebrush, bunchgrasses, rabbitbrush, annual grasses, scattered junipers, and associated herbs.

Madras loam has developed from material weathered from partly consolidated sandstone, agglomerate, and other sedimentary or old water-laid materials of the Dalles formation. Most of this material is of volcanic origin. The sandstone and agglomerate are dominant. They are mixed with rhyolitic and other acidic igneous material as well as with andesitic and other more basic materials. The upper part of the soil may contain some fine pumice, volcanic ash, and windblown silt.

Madras loam is associated with Agency, Era, and Lamonta soils. It differs from Agency loam in having a limy siliceous hardpan or caliche layer in the lower subsoil. In texture and compactness the subsoil of Madras is intermediate between that of the Era and that of the Lamonta soils.

Typical profile (fig. 4):

0 to 9 inches, light brownish-gray to grayish-brown slightly hard loam; very fine granular structure; when moist, very dark grayish brown and friable; neutral.

9 to 12 inches, brown to grayish-brown, slightly hard heavy loam or light clay loam; weak fine granular to subangular blocky structure; when moist, dark grayish brown or slightly darker; neutral or mildly alkaline.

12 to 22 inches, brown noncalcareous clay loam grading to grayish-brown or pale brown; breaks into hard medium and fine subangular blocky aggregates that are somewhat coated with colloid; small to moderate number of fine pores; when moist, dark grayish brown to dark brown and firm; mildly to moderately alkaline.

22 to 25 inches, brown or pale-brown to light yellowish-brown hard clay loam or gravelly clay loam; calcareous in most places.

25 to 33 inches, white, pinkish-white, light-gray, or very pale brown, strongly cemented or indurated hardpan or caliche consisting, in most places, of tuffaceous or pumiceous sandstone or agglomerate cemented by lime and siliceous material; normally consists of two or more plates; plates have a very dense or glazed film on top, and may have miniature stalactites on their lower sides; inside of plates may be either calcareous or noncalcareous; commonly much lime between plates and in cracks; may or may not be broken in hands.

33 inches +, partly consolidated tuffaceous or pumiceous sandstone or agglomerate.

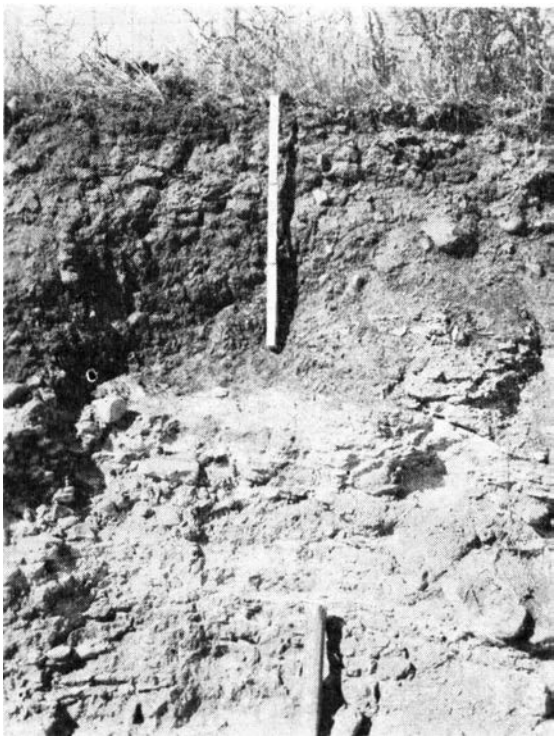

***Figure 4.*—Madras loam east of Culver, showing moderately developed subsoil over a limy hardpan. This soil has developed mainly from material weathered from partly consolidated tuffaceous sandstone and agglomerate and small quantities of fine pumice and wind-borne silt.**

Small quantities of light yellowish-brown or very pale brown pumice particles are common. These particles are the size of fine and medium sand. In most places, there are a few red and reddish-brown subangular pebbles of rhyolite on the surface and in the upper part of the soil. Most of the pebbles are less than 1 inch in diameter. Pebbles are generally more numerous and larger in the lower subsoil. In places, there are brown, light yellowish-brown, and olive-brown pebbles and a few pebbles of quartz. In the undisturbed soil, the upper ¾ inch may be vesicular and the next lower 3 inches may be platy. The surface soil is rather low in organic matter and nitrogen.

Drainage is moderate through the surface soil, moderate to somewhat slow through the upper subsoil, and very slow through the hardpan. The hardpan commonly is almost impermeable to water and roots, but some water passes through fissures, cracks, discontinuous plates, or holes. In some flats or swales the pan may be nearly impermeable over wide areas. Excessive irrigation or runoff from higher areas may cause the subsoil in such places to become waterlogged. These areas may become saline, although this soil normally is nonsaline and nonalkali.

Madras loam, 0 to 3 percent slopes (Ma).—This soil occurs in Jefferson County in relatively undissected upland plains and in the more level parts of dissected plains. It occupies much of the Agency Plains. Runoff is slow, and water erosion is slight. If the soil is not protected by vegetation, some wind erosion may occur.

In some flats or swales, sizable areas are underlain by the nearly impermeable hardpan. In these places, excessive irrigation and runoff from higher areas may result in waterlogging of the subsoil and eventually in the accumulation of salts.

Use and management (subgroup 2A).—Almost all of this soil is used for dry-farmed small grain. A small acreage is under natural vegetation and is grazed. About 42 percent is used for wheat, 1 percent for barley, and 5 percent for small grains cut for hay. An area equal to the cultivated area is summer fallowed.

Because it is somewhat shallow and receives little rainfall, this soil is only moderately to poorly suited to dry-farmed grain. The normal yield of winter wheat is about 11 bushels an acre, but yields range from about 4 to 16 bushels, depending mainly on the amount and distribution of rainfall. Average yields of spring wheat are a little less.

Much of this soil will be irrigated under the Deschutes Irrigation Project. The principal crops probably will be alfalfa, potatoes, oats, barley, and wheat; Ladino, alsike, and red clovers for hay and seed; and perhaps peas and vetch for seed. Because the subsoil is clay loam, this soil is not well suited to potatoes. Alfalfa, red clover, alsike clover, and other deep-rooted crops should do fairly well, but the hardpan will limit the growth of their roots. This soil should be well suited to Ladino clover grown for seed, at least until weeds and volunteer clovers spread.

Madras loam, 3 to 7 percent slopes (Mc).—This gently sloping or undulating soil occurs in the somewhat dissected upland of Jefferson County. Large areas lie northeast of Madras. Runoff from rainfall is rather slow, but runoff from irrigation would be more rapid. The erosion hazard under irrigation is moderate. The workability is very good.

Use and management (subgroup 2B).—About 75 to 85 percent of this soil is used for dry-farmed small grains, mostly wheat, and a small part is in sagebrush and grass. A few tracts that have been cropped are now in crested wheatgrass and cheatgrass. Average yields are slightly less than those on Madras loam, 0 to 3 percent slopes.

Much of this soil will be irrigated under the Deschutes Irrigation Project. Irrigating will present little or no difficulty. This soil is in the same management subgroup as Agency loam, 3 to 7 percent slopes.

Madras loam, 7 to 12 percent slopes (Me).—This sloping or rolling soil occurs in Jefferson County in several widely scattered tracts. Runoff from rainfall is moderate to low, but the erosion hazard under irrigation would be high. The workability is good.

The hardpan in this soil is generally less strongly cemented than that in the more nearly level Madras loams. Included in this mapping unit is a tract of about 35 acres that has a surface soil of heavy loam or light clay loam. This tract lies south of Haystack Butte.

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Use and management (subgroup 2C).—About 36 percent of this soil is under sagebrush and grass, and about 27 percent is used for dry-farmed grains, chiefly wheat. Most of the rest has been cropped but is now in crested wheatgrass or cheatgrass. Yields are slightly lower than on the more nearly level Madras loams.

A considerable part of this soil probably will be irrigated. It will be difficult to control water and distribute it evenly, particularly on row crops. This soil is poorly suited to potatoes and other row crops. It is fairly well suited to sod and close-growing crops. If possible, this soil should be kept in grass-legume pasture.

Madras loam, eroded, 0 to 3 percent slopes (Mb).—This soil has been moderately eroded, chiefly by wind; much of it has lost one-fourth or more of the original surface soil. In places, deep plowing may turn up some of the subsurface layer or upper subsoil. The surface layer is 2 to 4 inches thinner than that of Madras loam, 0 to 3 percent slopes, and the soil is slightly less fertile.

Use and management (subgroup 2A).—Almost all of this soil is used for dry-farmed wheat. Yields are low.

A large part of this soil will be irrigated under the Deschutes Irrigation Project. In use suitability and management needs this soil is similar to Madras loam, 0 to 3 percent slopes, but it needs larger additions of organic matter and, for potatoes and other row crops, a little more nitrogen.

Madras loam, eroded, 3 to 7 percent slopes (Md).—This gently sloping or undulating soil has been moderately eroded by water or wind, or both. Much of it has lost one-fourth or more of the original surface soil. In places, deep plowing may turn up some of the subsurface layer or upper subsoil. The surface layer is 2 to 4 inches thinner than that of Madras loam, 3 to 7 percent slopes, and the soil is slightly less fertile. The workability is good.

Use and management (subgroup 2B).—In use and management this soil is similar to Madras loam, 3 to 7 percent slopes, but it needs more organic matter and more nitrogen fertilizer.

Much of this soil will be irrigated. It will be slightly difficult to irrigate. The erosion hazard under irrigation will be moderate.

Madras loam, eroded, 7 to 12 percent slopes (Mf).—This sloping or rolling soil occurs in the upland plains northeast of Madras. It has been moderately eroded by water or wind; from much of it one-fourth or more of the original surface soil has been removed. Its surface layer is 2 to 5 inches thinner than that of Madras loam, 7 to 12 percent slopes, and its fertility is slightly lower. The workability is good.

Use and management (subgroup 2C).—Nearly one-fourth of this soil is in sagebrush and grass. About 70 percent is used for dry-farmed grain, chiefly wheat. Yields are low.

Much of this soil probably will be irrigated. It will be difficult to irrigate, and the erosion hazard will be high. It should be kept in grass-legume pasture much of the time. In use suitability and management needs this soil is similar to Madras loam, 7 to 12 percent slopes, but it needs more organic matter and nitrogen.

Madras loam, over sandstone, 0 to 3 percent slopes (Mg).—This soil occurs in Jefferson County in nearly level upland plains. Large tracts lie southwest of Juniper Butte. This soil is much like typical Madras loam, but it does not have a hardpan in the subsoil. Instead, it has a layer of partly consolidated sandstone or agglomerate, in most places very weakly cemented by lime. Here and there the layer is cemented by siliceous material, and is noncalcareous or only slightly calcareous. In many places the subsoil is light clay loam or heavy loam. It contains a little more light-colored pumice sand than the subsoil of the typical Madras loam and, in most places, is more permeable to roots and water.

Use and management (subgroup 2A).—About 30 percent of this soil is under sagebrush and grass and about 15 percent is used for dry-farmed grain. Most of the rest has been cropped, but is now in crested wheatgrass or annual grasses. Yields are low.

Much of this soil will be irrigated. In use suitability and management needs it is similar to Madras loam, 0 to 3 percent slopes, but its subsoil is less likely to be waterlogged, and it is better suited to alfalfa, red clover, alsike clover, and other deep-rooted crops.

Madras loam, over sandstone, 3 to 7 percent slopes (Mk).—This soil differs from Madras loam, over sandstone, 0 to 3 percent slopes, in being gently sloping or undulating. The workability is very good.

Use and management (subgroup 2B).—About 43 percent of this soil is used for dry-farmed grain and 10 percent is in sagebrush and grass. Most of the rest has been cropped but is now in crested wheatgrass or annual grasses. Yields are low.

Much of this soil will be irrigated. It will be slightly difficult to irrigate, and the erosion hazard in cultivated areas will be moderate. This soil is suited to the same uses as Agency loam, 0 to 3 percent slopes, and has similar management needs.

Madras loam, over sandstone, eroded, 0 to 3 percent slopes (Mh).—This soil is moderately eroded; about one-fourth of the original surface soil has been removed, chiefly by wind.

This soil is in management subgroup 2A. Almost all of it is used for dry-farmed grain, chiefly wheat. Yields are low. In use suitability and management needs this soil is similar to Madras loam, over sandstone, 0 to 3 percent slopes, but it needs slightly larger additions of organic matter.

Madras loam, over sandstone, eroded, 3 to 7 percent slopes (Ml).—This soil has lost one-fourth or more of the original surface soil through water and wind erosion. It is slightly difficult to irrigate without causing erosion. Included is a tract of 35 acres that has slopes of 7 to 12 percent, and is uneroded or only slightly eroded.

Use and management (subgroup 2B).—About 45 percent of this soil is used for dry-farmed grain and 20 percent is in sagebrush and grass. The rest is in cheatgrass or crested wheatgrass. In use suitability and management needs this soil is similar to Agency loam, 3 to 7 percent slopes.

Madras loam, stony, 0 to 3 percent slopes (Mm).—Most of this soil is too stony to be tilled. Most of the stones are angular fragments of basalt or other lava rock. They range from a few to 20 inches or more in diameter. Bedrock crops out in places. About 40 percent of this mapping unit has been eroded; such areas are shown on the soil map by erosion symbols.

Use and management (group 6).—Almost all of this soil is in sagebrush and grass and is grazed. The grazing capacity is low; about 10 acres are needed to graze a cow for 1 month.

Because of the stones, this soil is not suitable for crops. Some areas than can conveniently be irrigated should be suited to grass-legume pasture. The carrying capacity of pastures could be increased by applying sulfur and nitrogen and by grazing in rotation.

Madras loam, stony, 3 to 7 percent slopes (Mn).—All of this sloping or undulating soil is in Jefferson County. It is too stony to be tilled. It has somewhat more rapid runoff than Madras loam, stony, 0 to 3 percent slopes, and is erodible unless protected by vegetation. About 42 percent of this mapping unit is moderately eroded.

This soil is in management group 6. In use and management it is similar to Madras loam, stony, 0 to 3 percent slopes, but it is more difficult to irrigate for permanent pasture.

Madras loam, stony, 7 to 12 percent slopes (Mo).—All of this sloping or rolling soil occurs in Jefferson County. It is too stony to be tilled. It has more rapid runoff than Madras loam, stony, 0 to 3 percent slopes, and is more likely to erode if not protected by vegetation. About 45 percent of this mapping unit has been moderately eroded.

This soil is in management group 6. In use and management it is similar to Madras loam, stony, 0 to 3 percent slopes, but it is more difficult to irrigate for permanent pasture. Some areas of this soil may not be suitable for irrigated pasture.

Madras loamy sand

This soil occurs on the upland plains in the southern part of Jefferson County and the northern part of Deschutes County. It is coarser textured than Madras loam, and in some areas the surface soil contains a larger percentage of light-colored pumice particles the size of fine and medium sand. The cemented layer is less limy, thinner, and in most places more weakly cemented. This soil is less fertile than Madras loam and lower in water-holding capacity. Junipers are more prominent in the natural vegetation, particularly south of the Crooked River.

Representative profile:

0 to 9 inches, light brownish-gray to grayish-brown soft loamy sand; single grain; when moist, very dark grayish brown and very friable; about neutral in reaction.
9 to 13 inches, brown to grayish-brown soft sandy loam; single-grain structure; mildly alkaline.
13 to 21 inches, brown hard sandy clay loam or heavy loam; subangular blocky structure; mildly or moderately alkaline and noncalcareous.
21 to 25 inches, weakly to strongly cemented, tuffaceous or pumiceous sandstone or agglomerate; much white lime, particularly as coatings above and below the layer and in cracks.
25 inches+, partly consolidated tuffaceous or pumiceous sandstone or agglomerate.

In most places, a few red and reddish-brown subangular pebbles of rhyolite are on the surface and in the soil; commonly they are more numerous and larger in the lower subsoil. Drainage is rapid through the surface soil, moderate through the upper subsoil, very slow or slow through the cemented layer, and slow through the substratum. In places, the subsoil is coarser textured than typical.

Two phases of this soil are mapped.

Madras loamy sand, over sandstone, 3 to 7 percent slopes (Mp).—This soil is gently sloping or undulating. Runoff from rainfall is low, but the erosion hazard under irrigation is moderate. This soil is slightly difficult to irrigate. The water-holding capacity is low. The workability is very good. Included are 11 acres that have slopes of 0 to 3 percent. This acreage is easier to irrigate and better suited to crops than the rest of this mapping unit.

Use and management (subgroup 2B).—Sagebrush and grass, with junipers in places, cover almost half of this soil. About one-third is used for crops and pasture. Most of the rest has been cropped but is now in grass. Dry-farmed grain is grown north of the Crooked River, and the areas south of the river are irrigated.

This soil is only fair for crops. It is not well suited to dry-farmed grain. It is poorly suited to irrigated row crops. The irrigated areas should be kept in pasture, hay, or close-growing crops as much of the time as possible. Additions of manure and other organic matter are beneficial.

Madras loamy sand, over sandstone, eroded, 3 to 7 percent slopes (Mr).—This soil has been moderately eroded by water and wind. It is in management subgroup 2B. About 85 percent of it is used for dry-farmed grain, chiefly wheat. A few acres are in natural vegetation. Yields are low. In use suitability and management needs, this soil is similar to Madras loamy sand, over sandstone, 3 to 7 percent slopes.

Madras sandy loam

Almost all of the Madras sandy loam in the Area occurs in Jefferson County; a small acreage lies in the northern part of Deschutes County. This soil is similar to Madras loam except that it is sandier and a little less fertile and has more rapid drainage through the surface soil. In places, this soil contains more light-colored pumice sand than Madras loam.

Representative profile:

0 to 9 inches, light brownish-gray to grayish-brown soft or slightly hard sandy loam; noncalcareous; single grain; when moist, very dark grayish brown and very friable; neutral reaction.
9 to 13 inches, brown to grayish-brown, slightly hard, noncalcareous heavy sandy loam, loam, or light sandy clay loam; weak fine granular or indistinct fine subangular blocky structure; when moist, dark grayish brown or slightly darker; neutral or mildly alkaline reaction.
13 to 24 inches, brown sandy clay loam, clay loam, or light clay loam, grading to pale brown; noncalcareous; breaks into hard medium and fine subangular blocky aggregates that are thinly coated with colloid; lower 2 or 3 inches may be pale brown or light yellowish brown and calcareous.
24 to 31 inches, white, pinkish white, light gray, or very pale brown strongly cemented or indurated hardpan or caliche, in most places consisting of tuffaceous or pumiceous sandstone or agglomerate cemented by lime and siliceous material; layer usually consists of plates or lenses that have a very dense or glazed film on top and, in places, miniature stalactites on the lower side; plates may be either calcareous or noncalcareous on the inside but lime occurs commonly between plates and in cracks; may or may not be broken in hands.
31 inches +, partly consolidated tuffaceous or pumiceous sandstone or agglomerate.

This soil contains a few red and reddish-brown subangular pebbles of rhyolite, most of them less than 1 inch in diameter. They are normally more numerous and larger in the lower subsoil. In places there are brown, light yellowish-brown, and olive-brown pebbles and a few

pebbles of quartz. This soil is low in organic matter and nitrogen.

Drainage is moderate to rapid through the surface soil, moderate through the upper subsoil, and very slow through the hardpan. The hardpan typically is practically impermeable to water and roots, but water passes through fissures, cracks, discontinuous plates, or holes. The soil is naturally nonsaline and nonalkali.

To show variations in slope, depth, stoniness, underlying material, and erosion, 26 phases of this soil are mapped.

Madras sandy loam, 0 to 3 percent slopes (Ms).—This soil occurs in Jefferson County, chiefly on the nearly level upland plains. Runoff is slow. Water erosion is negligible or only slight in nonirrigated areas, but wind erosion may occur in places.

Use and management (subgroup 2A).—Most of this soil is used for dry-farmed wheat. A small part remains in its natural cover and is grazed. A few areas are in crested wheatgrass. In use and management this soil is similar to Madras loam, 0 to 3 percent slopes, but yields are slightly lower.

Most of this soil will be irrigated. The irrigated areas should be used and managed like Madras loam, 0 to 3 percent slopes, but this soil apparently will need larger additions of organic matter, nitrogen, and phosphorus. Yields of potatoes may be the same on this soil, but yields of other crops are expected to be slightly lower. This soil requires lighter and more frequent irrigations; the head of water should be larger and the irrigation runs shorter. Excessive irrigation may waterlog the subsoil.

Madras sandy loam, 3 to 7 percent slopes (Mu).—This gently sloping or undulating soil occurs in Jefferson County, mainly in the somewhat dissected upland plains. Runoff from rainfall is rather slow. Under irrigation, runoff would be more rapid and the erosion hazard would be moderate. The workability is very good.

Use and management (subgroup 2B).—Much of this soil is used for dry-farmed grain, chiefly wheat. Yields are low. A few areas are still in sagebrush and grass and a few have been seeded to crested wheatgrass. This soil is only fair for irrigated crops, but much of it will be irrigated. It is in the same management subgroup as Agency loam, 3 to 7 percent slopes, but it needs more organic matter, nitrogen, and phosphorus.

Madras sandy loam, 7 to 12 percent slopes (My).—This sloping or rolling soil occurs in the dissected upland plains in Jefferson County. It is slightly shallower than the more nearly level Madras sandy loams, and in most places the hardpan is only weakly to strongly cemented. Runoff from rainfall is low to moderate.

Use and management (subgroup 2C).—About 55 percent of this soil is in sagebrush and grass, and 20 percent is used for dry-farmed grain. Much of the rest has been seeded to crested wheatgrass, to which this soil is well suited.

A considerable part of this soil probably will be irrigated. In use and management it is similar to Madras loam, 7 to 12 percent slopes, but irrigation runs should be shorter on this soil and water should be applied more often and in smaller amounts.

Madras sandy loam, deep over sandstone, 0 to 3 percent slopes (Mea).—This soil differs from Madras sandy loam, 0 to 3 percent slopes, in having in the lower subsoil, normally at depths of 3 to 4 feet, a layer that is only weakly cemented. This layer is more permeable to water and roots than the cemented layer of Madras sandy loam, 0 to 3 percent slopes. Furthermore, this soil may contain more pumice sand, and the subsoil may be slightly lighter in texture and may contain some lime a few inches above the cemented layer.

Runoff is very low and water erosion is negligible, but this soil may be eroded by wind. This soil is normally well drained, but excessive irrigation and runoff from higher areas may cause an accumulation of water. Such an area occurs near Terrebonne; it is shown on the soil map by marsh symbols. Excessive soluble salts may accumulate in these inadequately drained areas.

Use and management (subgroup 2A).—About 85 percent of this soil is used for crops. North of the Crooked River this soil is used for dry-farmed crops, and south of the river it is used for irrigated crops and pasture. About 10 percent is in sagebrush and grass.

If irrigated properly, this is one of the better soils of the Area for crops and pasture. It is deep enough for alfalfa and clover roots. The water-holding capacity is somewhat high. Areas that are adequately drained produce high yields.

Madras sandy loam, deep over sandstone, 3 to 7 percent slopes (Meb).—This soil occurs in Jefferson County and in the northern part of Deschutes County. It is gently sloping or undulating. It has slightly higher runoff than Madras sandy loam, deep over sandstone, 0 to 3 percent slopes, particularly under irrigation. This soil is easy to slightly difficult to irrigate. The erosion hazard under irrigation is moderate. This soil is well drained, and ponding is not likely to occur.

Use and management (subgroup 2B).—About 20 percent of this soil is used for irrigated and dry-farmed crops. Most of the rest is in sagebrush and grass. This uncultivated area lies on high benches below the main upland plains in the Deschutes River canyon, where irrigation may not be feasible.

This soil is in the same management subgroup as Madras sandy loam, 3 to 7 percent slopes, but it is better suited to alfalfa and clover.

Madras sandy loam, deep over sandstone, eroded, 3 to 7 percent slopes (Mec).—Most of this soil occurs in Jefferson County; a small acreage is in Deschutes County near Terrebonne. This soil has been moderately eroded by water and wind.

Use and management (subgroup 2B).—About 15 percent of this soil is in sagebrush and grass. Nearly 50 percent is used for crops. The rest is idle or is in annual grasses. The area in Jefferson County is used for dry-farmed grain and that near Terrebonne has been irrigated.

This soil is in the same management subgroup as Madras sandy loam, 3 to 7 percent slopes, but it is better suited to alfalfa and clover. This soil, however, needs slightly more organic matter and nitrogen.

Madras sandy loam, eroded, 0 to 3 percent slopes (Mt).—All of this soil is in Jefferson County. Much of it has lost one-fourth or more of the original surface soil through erosion, chiefly wind erosion.

Use and management (subgroup 2A).—In use and management, under both dry farming and irrigated farming, this soil is similar to Madras sandy loam, 0 to 3 percent slopes, but it needs larger additions of organic matter and nitrogen.

Most of this soil probably will be irrigated. Yields should be almost as high as those on Madras sandy loam, 0 to 3 percent slopes.

Madras sandy loam, eroded, 3 to 7 percent slopes (Mv).—From most of this soil, erosion has removed about one-fourth or more of the original surface soil. This soil is in the same management subgroup as Madras sandy loam, 3 to 7 percent slopes, but it needs more organic matter and nitrogen. Yields are slightly lower.

Madras sandy loam, eroded, 7 to 12 percent slopes (Mz).—This soil is moderately eroded; 25 to 75 percent of the original surface soil has been removed.

Use and management (subgroup 2C).—About one-fourth of this soil is in sagebrush and grass. The rest is used for dry-farmed grain. Yields are low. In use and management this soil is similar to Madras sandy loam, 7 to 12 percent slopes, but it needs larger additions of organic matter and nitrogen.

Madras sandy loam, over sandstone, 0 to 3 percent slopes (Med).—This nearly level soil is widely distributed, mostly in Jefferson County; a few tracts lie near Terrebonne. This soil differs from Madras sandy loam, 0 to 3 percent slopes, mainly in having a less strongly cemented, more permeable lower subsoil. This soil contains less white lime. The weakly cemented lower subsoil normally can be broken with the hands. The upper subsoil may be slightly coarser in texture and less compact. The upper part of this soil contains considerably more pumice. Ponding is less likely than on Madras sandy loam, 0 to 3 percent slopes.

Included are some areas in which the cemented layer is partly consolidated sandstone or agglomerate that has some lime in seams or fissures.

Use and management (subgroup 2A).—Much of this soil is used for crops, a small part is in natural vegetation, and a small part is used for crested wheatgrass. North of the Crooked River this soil is dry-farmed; south of the river the cropland and pasture are irrigated.

In use and management this soil is similar to Madras sandy loam, 0 to 3 percent slopes, but it is slightly better suited to alfalfa. If potatoes are grown, additions of fertilizer and organic matter are needed.

Madras sandy loam, over sandstone, 3 to 7 percent slopes (Meh).—Most of this soil occurs in Jefferson County; a few scattered tracts lie near Terrebonne. This gently sloping or undulating soil is similar to Madras sandy loam, over sandstone, 0 to 3 percent slopes, but runoff is slightly more rapid, and the erosion hazard under irrigation is moderate. This soil is slightly difficult to irrigate.

Use and management (subgroup 2B).—Most of this soil is used for crops. The acreage north of the Crooked River is used for dry-farmed grain; that south of the river is used for irrigated crops and pasture.

Much of the area north of the Crooked River will be irrigated under the Deschutes Irrigation Project. In use and management this soil is similar to Madras sandy loam, 3 to 7 percent slopes, but it is better suited to potatoes and alfalfa.

Madras sandy loam, over sandstone, 7 to 12 percent slopes (Meo).—Most of this soil occurs in Jefferson County; a small acreage lies in the northern part of Deschutes County. This soil is similar to Madras sandy loam, over sandstone, 0 to 3 percent slopes, but, because it is sloping or rolling, runoff is more rapid and the erosion hazard under irrigation is higher. This soil is difficult to irrigate. The workability is good. Included are about 15 acres in which the surface soil is a loamy sand.

Use and management (subgroup 2C).—About 35 percent of this soil is in sagebrush and grass and 10 percent is used for dry-farmed grain, chiefly wheat. Most of the rest has been cropped but is now in crested wheatgrass.

A considerable part of this soil probably will be irrigated. It should be used and managed in about the same way as Madras loam, 7 to 12 percent slopes.

Madras sandy loam, over sandstone, 12 to 20 percent slopes (Mla).—This moderately steep or hilly soil occurs in Jefferson County. In most places the lower subsoil is less strongly cemented, contains less lime, and is more permeable to roots and water than the subsoil of Madras sandy loam, over sandstone, 0 to 3 percent slopes. In places this soil may be noncalcareous throughout the profile. In many places the upper subsoil is loam or light sandy clay loam and is only slightly hard. Included are about 25 acres where the surface soil is loam.

Runoff from rainfall is moderate to slight, but the erosion hazard under irrigation is very high. This soil is very difficult to irrigate. Its workability is fair.

Use and management (subgroup 2D).—About 20 percent of this soil is in sagebrush and grass. Nearly 40 percent is used for dry-farmed grain, mainly wheat. A little is in crested wheatgrass. This soil is poor for dry-farmed grain. It is better suited to crested wheatgrass for grazing.

This soil is poorly suited to irrigated row crops. If irrigated, it should remain in permanent grass-legume pasture and should be plowed only to renew a stand.

Madras sandy loam, over sandstone, eroded, 0 to 3 percent slopes (Mef).—This soil occurs in Jefferson County. It is moderately eroded; about one-fourth or more of the original surface soil has been removed, chiefly by wind.

Use and management (subgroup 2A).—About 9 percent of this soil is in sagebrush and grass. Nearly all the rest is used for dry-farmed grain, chiefly wheat. Yields of grain are low. A few acres are in crested wheatgrass.

In use and management this soil is similar to Madras loam, over sandstone, 0 to 3 percent slopes, except that it needs somewhat larger additions of organic matter and nitrogen. Most of this soil will be irrigated.

Madras sandy loam, over sandstone, eroded, 3 to 7 percent slopes (Mel).—Almost all of this soil occurs in Jefferson County; a few small tracts are in the northern part of Deschutes County. This soil has been moderately eroded; from much of it water and wind erosion have removed one-fourth or more of the original surface soil.

Use and management (subgroup 2B).—About one-fourth of this soil is under its natural cover. Nearly all the rest is used for crops. The cultivated areas north of the Crooked River are used for dry-farmed grain, mostly wheat; those south of the river are used for irrigated crops and pasture. This soil is suitable for the same uses as Madras sandy loam, over sandstone, 3 to 7 percent slopes, and has similar management needs.

Madras sandy loam, over sandstone, eroded, 7 to 12 percent slopes (Mes).—Almost all of this soil occurs in Jefferson County in the dissected upland plains. This soil has been moderately eroded; from much of its area 25 to 75 percent of the original surface soil has been removed. A few shallow gullies have formed. In some

places deep plowing will turn up some of the subsoil. The workability is good. Included are about 25 acres in which the surface soil is a loamy sand.

Use and management (subgroup 2C).—About one-third of this soil has a cover of sagebrush and grass. Nearly one-third is used for dry-farmed grain. Part of the rest has been sown to crested wheatgrass. Yields of grain are low.

In use suitability and management needs this soil is similar to Madras loam, 7 to 12 percent slopes. It should be irrigated by the corrugation method or by flooding from contour laterals. The irrigation runs should be short and the head of water moderate.

Madras sandy loam, over sandstone, eroded, 12 to 20 percent slopes (MIc).—This moderately steep or hilly soil occurs in the dissected plains of Jefferson County. It has lost 25 to 75 percent of its original surface soil through erosion. A few acres of this mapping unit have slopes of 20 to 25 percent. Also included are 40 acres of loam that has higher fertility and water-holding capacity than the typical soil.

Use and management (subgroup 2D).—Most of this soil has its natural vegetation. About 9 percent is used for dry-farmed grains and 15 percent has been sown to crested wheatgrass.

In use and management this soil is similar to Madras sandy loam, over sandstone, 12 to 20 percent slopes. It is well suited to crested wheatgrass.

Madras sandy loam, shallow over sandstone, 0 to 3 percent slopes (MId).—This soil occurs in Jefferson County and in the northern part of Deschutes County. It differs from Madras sandy loam, 0 to 3 percent slopes, chiefly in being shallower to the cemented layer, which in most places occurs at a depth of about 16 inches or less. In this soil the layer is weakly to strongly cemented. In places there is little or no lime. The water-holding capacity is low and the root zone shallow. Included are a few acres in Jefferson County that have been moderately eroded by wind.

Use and management (subgroup 2I).—About 50 percent of this soil is used for crops, and slightly more than 30 percent is in sagebrush and grass. Some of the rest has been sown to crested wheatgrass. The cropped areas in Deschutes County are irrigated; those in Jefferson County are dry-farmed.

This shallow soil is poorly suited to dry-farmed grain. Yields are very low. One of the best uses for this soil is controlled grazing of crested wheatgrass.

Much of this soil probably will be irrigated. It is only fair to poor for irrigated crops, but it is fairly well suited to permanent grass-legume pasture. This soil is poorly suited to alfalfa, alsike clover, red clover, and other deep-rooted crops, even though roots may penetrate the cemented layer in places. It is fairly well suited to potatoes, small grains, and probably peas, vetch, and Ladino clover. It is well suited to permanent pasture.

Deep cuts should be avoided when this soil is graded and leveled. To avoid waterlogging the subsoil, irrigations should be light and frequent.

Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes (MIe).—Most of this soil occurs in the southern part of Jefferson County; a small part lies in the northern part of Deschutes County. This soil differs from Madras sandy loam, over sandstone, 3 to 7 percent slopes, in being only about 16 inches or less to the cemented layer of the subsoil. In places there is little or no lime. The water-holding capacity of this soil is low and the root zone shallow.

Use and management (subgroup 2I).—Nearly 60 percent of this soil is used for crops, mostly dry-farmed grain; about 20 percent is in sagebrush and grass. Much of the rest has been seeded to crested wheatgrass—a good use. Yields are very low.

Because of its position, probably little of this soil will be irrigated. It is a poor soil for irrigated crops and should be kept in grass-legume pasture much of the time. This soil is better suited to potatoes, small grains, Ladino clover, peas, and vetch than to deep-rooted crops.

Irrigating this soil would be difficult. Deep cuts should be avoided while leveling. It should be irrigated by the corrugation method or by flooding from contour laterals. Small amounts of water should be applied at short intervals.

Madras sandy loam, shallow over sandstone, 12 to 20 percent slopes (Moc).—This soil occurs in Jefferson County. It differs from Madras sandy loam, over sandstone, 12 to 20 percent slopes, mainly in being only about 16 inches or less in depth to the cemented subsoil layer. In places there is little or no lime. The water-holding capacity is low. It is very difficult to irrigate this soil without causing erosion.

Use and management (group 5).—Much of this soil has been cropped but is now in crested wheatgrass. About one-third is in natural vegetation. A small acreage is used for dry-farmed grain. Yields of grain are low.

This soil is very poorly suited to crops. It can be seeded to crested wheatgrass and used for grazing. Grazing should be carefully controlled.

Madras sandy loam, shallow over sandstone, eroded, 3 to 7 percent slopes (MIo).—This soil occurs in Jefferson County. It has been moderately eroded.

Use and management (subgroup 2I).—About half of this soil is in sagebrush and grass; nearly one-fourth is used for dry-farmed grain. Most of the rest has a growth of crested wheatgrass.

Possibly some of this soil will be irrigated. In use suitability and management needs this soil is similar to Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes, but it needs more organic matter and nitrogen.

Madras sandy loam, shallow over sandstone, eroded, 7 to 12 percent slopes (MIs).—This sloping or rolling soil occurs in Jefferson County. Much of it has lost from 25 to 75 percent of the surface soil through erosion. Because it is 16 inches or less in depth to the cemented subsoil layer, the water-holding capacity is low and the root zone is limited.

Use and management (subgroup 2I).—Almost all of this soil is in sagebrush and grass. This soil is very poorly suited to crops. It does not hold enough moisture to be suitable for dry-farmed grain. Irrigation would be difficult to very difficult because little or no grading is feasible. If irrigated, this soil should be kept in grass-legume pasture.

Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes (Mod).—Most of this soil occurs in Jefferson County, but several tracts lie in the northern part of Deschutes County. This soil differs from Madras sandy loam, over sandstone, 0 to 3 percent slopes, chiefly in

containing more stones. Most of these stones are angular fragments of basalt, rhyolite, or other lava. They range from a few to 20 inches or more in diameter. In places bedrock outcrops. In most places the stones are numerous enough to prevent ordinary tillage; in a few places they are less numerous.

Use and management (group 6).—Almost all of this soil is in its natural vegetation. A small acreage has been partly cleared of stones and the soil was cropped, but this acreage was later sown to crested wheatgrass. The carrying capacity of the natural vegetation is low. The stones interfere with preparing the soil for seeding grass.

This soil is not suitable for crops. If it could be irrigated conveniently, it would be suited to permanent grass-legume pasture. The carrying capacity could be increased by applying sulfur and nitrogen, and by dividing the pasture into 3 or 4 tracts to be grazed in rotation.

Madras sandy loam, stony, over sandstone, 3 to 7 percent slopes (Moe).—This soil occurs in Jefferson County and in the northern part of Deschutes County. Except that it is gently sloping or undulating, this soil is very similar to Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes. In most areas this soil contains enough stones to prevent ordinary tillage. Included are about 85 acres from which erosion has removed one-fourth or more of the original surface soil. Such areas are shown on the soil map by erosion symbols.

Use and management (group 6).—Almost all of this soil is in its natural vegetation. In use suitability and management needs this soil is similar to Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes, except that it is more difficult to irrigate evenly.

Madras sandy loam, stony, over sandstone, 7 to 12 percent slopes (Mol).—This soil is similar to Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes, except that it is sloping or rolling and therefore has more rapid runoff. About three-fourths of this mapping unit is moderately eroded.

Use and management (group 6).—Almost all of this soil is in its natural vegetation. About 25 acres is used for dry-farmed grain, and a few areas are in crested wheatgrass. Some of the stones have been removed from these cultivated areas, or the areas may have been originally less stony than the rest of this soil. In use suitability and management needs this soil is similar to Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes, but, because of the stronger slopes, the distribution of water is more difficult. Many areas may not be suitable for irrigated pasture.

Madras sandy loam, stony, over sandstone, 12 to 20 percent slopes (Mos).—This moderately steep or hilly soil occurs in Jefferson County. It is somewhat similar to Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes, but runoff is more rapid. Also, the compact layer may be less cemented, and in places the soil contains little or no lime. About 90 percent of this mapping unit is moderately eroded. Also included are about 40 acres that have 20 to 35 percent slopes.

Use and management (group 6).—Almost all of this soil is in its natural vegetation. A few acres have a growth of crested wheatgrass. This soil is best suited to grazing. Because of the steep slopes, water for irrigated pasture is very difficult to control.

Metolius sandy loam

Almost all of the Metolius sandy loam in the Area occurs in Jefferson County. It occupies nearly level to undulating basins, elongated swales, bottom lands of intermittent streams, and sloping alluvial fans. This soil is normally well drained; it is seldom, if ever, flooded.

The normal annual precipitation is about 8 or 10 inches, except in a few areas southeast of Haystack Butte where the precipitation is slightly higher. The native vegetation consisted chiefly of big sagebrush, bunchgrasses, rabbitbrush, annual grasses, associated herbs, and a few scattered junipers.

This soil apparently has developed from somewhat stratified sandy and loamy alluvial material that contained much light-colored pumice sand of various sizes. Some of the parent material possibly was windblown fine pumice, volcanic ash, and windblown silt.

Representative profile:

0 to 7 inches, light brownish-gray to grayish-brown noncalcareous soft to slightly hard sandy loam; single grain or very weak very fine granular structure; contains moderate to large quantity of light yellowish-brown or very pale brown pumice sand; when moist, very dark grayish brown and very friable; neutral or mildly alkaline.

7 to 14 inches, similar to layer above but grades to pale brown or light yellowish brown.

14 to 23 inches, pale-brown to light brownish-gray noncalcareous slightly hard sandy loam; single grain or very weak coarse subangular blocky structure; contains pumice sand similar to that in surface layer; moderately porous; when moist, dark grayish brown to dark brown and very friable; in places, contains a few hard rounded aggregates as large as 1 inch in diameter; mildly to moderately alkaline.

23 to 47 inches, similar in color to layer above; slightly calcareous, soft or slightly hard, very friable sandy loam; single grain; contains much pumice sand.

47 inches +, similar in color to layer above; stratified, very friable sandy loam, loamy sand, or gravelly sandy material; commonly calcareous.

This soil varies from place to place. In the typical soil no layer that impedes the downward penetration of roots and water occurs above a depth of about 5 feet. Such typical soils occur mainly in the valleys of Mud Spring Creek, Willow Creek, and other intermittent creeks; but even in these valleys this soil has, in places, a thin cemented layer of lime or hardpan at a depth of about 3 feet. In other areas, particularly on alluvial fans and in the basins or swales of the more nearly level upland plains, a layer of less permeable material occurs at a depth of about 3 to 3½ feet. This laver may be a hardpan, or it may consist of partly consolidated sandstone or agglomerate, alluvial loam and silt loam, or, in a few places, clay loam or clay.

This soil is low in organic matter and nitrogen. It is deep and moderately permeable or rapidly permeable. It is normally nonsaline.

To show variations in slope and erosion, seven phases of this soil are mapped.

Metolius sandy loam, 0 to 3 percent slopes (Mta).—This nearly level soil occurs in Jefferson County. Runoff is slow. Excessive irrigation and runoff from higher irrigated soil may cause some areas of this soil to become waterlogged. This is likely to occur where a slowly permeable layer occurs at a depth of 4 or 5 feet or less. A perched water table may form above the slowly permeable layer. Artificial drains may be needed to remove the excess water. Soluble salts may eventually

accumulate in these areas. This soil is low in organic matter.

Use and management (subgroup 4A).—Three-fourths or more of this soil is used for dry-farmed grain, chiefly wheat. A small part is in sagebrush and grass. Several areas are in crested wheatgrass or annual grasses. Yields of grain are low. The average yield of winter wheat is about 10 bushels an acre. Yields are slightly higher near Haystack Butte where there is more precipitation.

Most of this soil will be irrigated under the Deschutes Irrigation Project. This should be one of the best soils in the Area for many irrigated crops. About the same kind of crops probably will be grown on this soil as are now grown on Deschutes sandy loam, 0 to 3 percent slopes. These crops include alfalfa, potatoes, oats, barley, wheat; alsike, Ladino, and red clovers for hay and seed; and perhaps vetch and peas for seed.

This soil should be used and managed like Deschutes sandy loam, deep, 0 to 3 percent slopes. The tracts that do not have a hard layer within 5 feet of the surface would be the best irrigated soil in the Area for alfalfa and deep-rooted clover.

In grading and leveling this soil for irrigation, deep cuts can be made. Irrigations can be heavier than on shallower soils and somewhat less frequent.

Metolius sandy loam, 3 to 7 percent slopes (Mtd).—This soil occurs in Jefferson County on gently sloping alluvial fans and in undulating areas of bottom lands. Runoff from rainfall is slow.

Use and management (subgroup 4B).—Much of this soil is used for dry-farmed grain. A small part is in sagebrush and grass. A few areas that were formerly cropped now have a growth of crested wheatgrass or annual grasses. Yields are about the same or a little less than those on Metolius sandy loam, 0 to 3 percent slopes.

A considerable part of this soil will be irrigated. It will be easy or slightly difficult to irrigate, and the erosion hazard will be moderate. In use suitability and management needs this soil will be somewhat similar to Metolius sandy loam, 0 to 3 percent slopes, but yields are expected to be slightly lower. This soil will be somewhat less well suited to potatoes and other row crops.

If this soil is leveled crosswise between strips, the strip-border method of irrigation can be used on the more gentle slopes. On the stronger slopes, the corrugation method or flooding from contour laterials is suitable.

Metolius sandy loam, 7 to 12 percent slopes (Mts).—This soil occurs in several tracts in Jefferson County on rolling alluvial fans, in colluvial areas, or on bottom lands. Runoff from rainfall is rather slow. Included are 55 acres that are moderately eroded; such areas are shown on the soil map by erosion symbols. Also included are about 15 acres in which the surface soil is a loamy sand.

Use and management (subgroup 4C).—About one-third of this soil is used for dry-farmed grain, chiefly wheat. One-fourth is in sagebrush and grass. Much of the rest was formerly cropped but is now in crested wheatgrass or annual grasses. Some of this acreage was seeded under a Federal land utilization project. Yields of grain have been low.

Much of this soil probably will be irrigated. It will be difficult to irrigate, and the erosion hazard will be high. This soil is poorly suited to row crops. It should be kept in alfalfa-grass hay, clover-grass hay, or grass-legume pasture most of the time. This soil apparently is suited to clover grown for seed.

Metolius sandy loam, eroded, 0 to 3 percent slopes (Mtc).—This soil has lost about one-fourth or more of the original surface soil, chiefly through wind erosion. Included are about 120 acres in which the surface soil is a light loam, and about 15 acres in which the surface soil is a loamy sand.

Use and management (subgroup 4A).—In use suitability and management needs this soil is similar to Metolius sandy loam, 0 to 3 percent slopes, but it needs more organic matter and nitrogen.

Metolius sandy loam, eroded, 3 to 7 percent slopes (Mte).—This soil has lost about one-fourth or more of the original surface soil through water and wind erosion. Included are about 20 acres in which the surface soil is a loam and 10 acres in which the surface soil is a loamy sand.

Use and management (subgroup 4B).—In use suitability and management needs this soil is similar to Metolius sandy loam, 3 to 7 percent slopes, but it needs more organic matter and nitrogen.

Metolius sandy loam, terrace position, 0 to 3 percent slopes (Mtl).—This soil occurs in Jefferson County and in the northern part of Deschutes County. It lies in the canyon of the Deschutes River, on terraces and high bottom lands that are 10 to 25 feet higher than the river. Although most areas of this soil adjoin the river, they are not flooded. In places the subsoil is slightly finer textured and more compact than in the typical soil.

Use and management (subgroup 4A).—About 50 percent of this soil is used for crops, 40 percent is in sagebrush and grass, and the rest is used for farmsteads or other purposes. Most of the cropped areas are in dry-farmed grain. A few areas adjoining the river are used for orchards, chiefly peach orchards. To irrigate the orchards, water is pumped from the river and distributed by sprinklers. Peaches can be grown here only because at the bottom of the Deschutes River canyon the growing season is longer than elsewhere in the Area, and the risk of frost damage is less. Some other low-lying tracts could possibly be irrigated by water pumped from the river. It is not likely that any of this soil will be irrigated by gravity under the Deschutes Irrigation Project.

Metolius sandy loam, terrace position, 3 to 7 percent slopes (Mto).—This soil is similar to Metolius sandy loam, terrace position, 0 to 3 percent slopes, except that it is gently sloping or undulating and, therefore, runoff is more rapid and the erosion hazard under irrigation higher.

Use and management (subgroup 4B).—About 70 percent of this soil is in sagebrush and grass; the rest is used for crops and farmsteads. In use and management this soil is similar to Metolius sandy loam, terrace position, 0 to 3 percent slopes, except that it is more likely to erode under irrigation.

Odin clay loam

Odin clay loam occurs in Jefferson County and in the northern part of Deschutes County. It lies in depressions and small basins that do not have natural outlets. It is imperfectly or poorly drained. Most areas of this soil, particularly those in the northern part of Deschutes County, occupy the lower part of extensive undissected

plains. Other areas are in small pockets or depressions in lava flows. Most areas have practically no runoff. Most areas have at least a fairly high water table some of the time. A few places may be flooded for short periods. Doubtless some of these areas are imperfectly drained as the result of long periods of irrigation, but many, such as the nonirrigated areas in Jefferson County, probably are naturally inadequately drained.

The natural vegetation probably consisted of grasses, big sagebrush, rabbitbrush, associated herbs, and possibly junipers. Now some areas have a growth of water-loving grasses, sedges, and reeds; a few places have cattails. The normal annual precipitation ranges from 8 to 10 inches.

This soil has formed principally from pumice, which was probably mixed with local alluvium that washed from nearby areas underlain by weathered partly consolidated sandstone or with other waterlaid materials. This material is mixed, but it is mostly from extrusive acid igneous rock sources.

Typical profile:

0 to 7 inches, light brownish-gray or gray hard noncalcareous clay loam; contains some pumice sand; when wet, very dark grayish brown, sticky, and plastic; about neutral in reaction.
7 to 45 inches, light brownish-gray, light-gray, or gray noncalcareous heavy clay loam; contains some pumice sand; massive to indistinct subangular blocky structure; when wet, dark grayish brown, plastic, and sticky; mildly to moderately alkaline; in places a few streaks or mottles of light yellowish brown and very dark gray stains of iron and manganese.
45 inches +, partly consolidated pumiceous or tuffaceous sandstone.

Included are areas that have a loam surface soil and a subsoil of heavy loam or clay loam. In some places the subsoil is clay.

Some of this soil has small pebbles scattered throughout the profile. Here and there a few light yellowish-brown mottles occur in the surface soil as well as in the subsoil. In places a little lime occurs in the lower subsoil or underlying sandstone. This soil is apparently low in organic matter.

Drainage through the soil is generally slow, except where a high water table prevents the downward movement of water. This soil is normally nonsaline, but a slight accumulation of soluble salts occurs in a few places.

Two phases of this soil are mapped.

Odin clay loam, 0 to 3 percent slopes (Oa).—Most of this soil occurs in the northern part of Deschutes County; a few tracts lie in Jefferson County in the western part of the Area. This soil occupies low flats, slight depressions, or small shallow basins in the uplands. Most of these areas have no outlets for surface drainage. In a few places intermittent ponds occur. Some areas have been drained by drilling to the porous layer.

Use and management (subgroup 1K).—About 75 percent of this soil is used for crops or grass-legume pasture. About 8 percent is in natural vegetation. The rest is in cheatgrass or sedges, or it is ponded. In Deschutes County this soil is irrigated, if irrigation is needed, and used for oats, barley, wheat, alsike clover, vetch, and grass-legume pasture. In Jefferson County dry-farmed grain is grown.

This soil is poorly suited to irrigated row crops, especially deep-rooted crops. Unless the soil is adequately drained, it is not suited to alfalfa and red clover. Because of its fine texture, this soil is not suited to potatoes. In most areas oats, wheat, barley, vetch, and alsike clover and Ladino clover grown for hay should do fairly well. This soil is well suited to grass-legume pasture.

Odin clay loam, 3 to 7 percent slopes (Ob).—This soil occurs in one tract, which borders the Deschutes River in the northwestern corner of the area. The tract is part of the alluvial fans and colluvial slopes at the base of the high canyon wall.

On the face of the canyon wall, sandstone, agglomerate, and lava are exposed and, below these, strata of the John Day formation, which consists of volcanic ash and tuff and some clay. The parent material of this soil was a mixture derived from the materials in the canyon wall. Possibly some river sediments were added to the mixture.

This soil differs somewhat from the typical Odin soil but it is included with the Odin series because its total area is small. Drainage is adequate, but apparently water that seeped from the canyon wall has affected this soil. This soil is not flooded. In places the surface soil is grayish brown and contains a moderate amount of organic matter and the lower subsoil is calcareous. The lower subsoil may be moderately or strongly alkaline. The underlying material normally is stratified. It may consist of loam, fine sand, sand, or gravelly material.

Use and management (subgroup 1K).—All of this soil is used for range grazing. Most of it has a growth of sagebrush or cheatgrass. This soil is suited to dry-farmed grain and to irrigated small grains, hay, and pasture. Water for irrigation could be pumped from the river. Yields should be fairly high.

Odin sandy loam

This soil occurs in the irrigated region of Deschutes County in level, slightly concave, or small basinlike areas. Drainage is imperfect to poor.

Typical profile:

0 to 11 inches, light brownish-gray to light-gray noncalcareous sandy loam or light gritty loam; single-grain structure; friable or very friable, when moist, very dark grayish brown or dark gray; about neutral in reaction; contains much pumice sand.
11 to 37 inches, light brownish-gray sandy clay loam or clay loam, grading to light gray or pale brown; noncalcareous; firm to friable; subangular blocky structure; contains some firm rounded nodules; contains considerable pumice sand; neutral or mildly alkaline; moderate fine pores; in many places, a few very dark gray stains of iron and manganese on aggregates, and a very few, small, very dark gray, hard concretions of iron and manganese; when wet, dark grayish brown.
37 inches+, light brownish-gray to pale-brown weakly to strongly cemented sandstone over stratified sandstone and sandy material; mildly to moderately alkaline.

In places a few small mottles of light gray, light yellowish brown, or pale brown are in the surface soil and subsoil. In some areas the lower subsoil or the cemented sandstone substratum is slightly calcareous. A few pebbles or cobblestones of basalt or red rhyolite may occur in the soil or underlying material. Soluble salts accumulate slightly in a few places.

Odin sandy loam, 0 to 3 percent slopes (Oc).—This soil is similar to Odin clay loam, 0 to 3 percent slopes, except for its coarser texture.

Use and management (subgroup 1L).—Almost three-fourths of this soil is under irrigation and is used for

crops or pasture. About 15 acres are intermittent ponds. A small acreage is in sagebrush, juniper, and grass. The main crops are oats, barley, wheat, alsike clover, vetch, and potatoes.

Because drainage is inadequate, this soil is not well suited to alfalfa. The better drained areas are fairly well suited to potatoes. This soil is very well suited to grass-legume pasture. Many areas cannot feasibly be drained by ditches, and require wells that are drilled to a pervious layer.

Pits and dumps

Pits and dumps (GP).—Open excavations and piles of rock or soil material that have been removed from the excavations are mapped as pits and dumps. They are shown on the soil map by the conventional sign for gravel pits or by the symbol GP. Many of the pits are sources of gravel used as concrete aggregate or for road surfacing. The soil material that overlaid the gravel is generally near the pits. Along the highways are borrow pits from which the soil and, in places, some of the underlying material has been removed to be used as fill. Most of the borrow pits are shallow. Other pits are sources of rock, pumice for building blocks, or volcanic cinders.

Pits and dumps have no agricultural value for growing plants. A few may hold water and serve as reservoirs for watering livestock.

Redmond clay loam

All of the Redmond clay loam in the Area occurs in the northern part of Deschutes County. This soil is somewhat similar to Odin clay loam, but drainage is moderately good. It has a surface soil of light clay loam or sandy clay loam and a subsoil of clay loam or sandy clay loam. In places the surface soil is a heavy loam.

One phase of this soil is mapped.

Redmond clay loam, 0 to 3 percent slopes (Ra).—This soil is similar to Redmond sandy loam, 0 to 3 percent slopes, except that it is finer in texture and drainage is slower. Runoff is slow and the erosion hazard negligible

Use and management (subgroup 1J).—Almost all of this soil is used for irrigated crops and pasture. Because of its fine texture, it is not well suited to potatoes. Inadequately drained areas are not well suited to alfalfa. Areas that are moderately well drained are suited to oats, wheat, clover, and vetch, and to grass-legume pasture.

Redmond loam

Redmond loam occurs in Deschutes County and in the southern part of Jefferson County. It is similar to Redmond sandy loam except that its surface soil is loam and its subsoil may be slightly finer textured clay loam.

One phase of this soil is mapped.

Redmond loam, 0 to 3 percent slopes (Rb).—This soil is more fertile than Redmond sandy loam, 0 to 3 percent slopes, and higher in water-holding capacity.

Use and management (subgroup 1A).—Most of this soil is used for irrigated crops and pasture. A few areas are in natural vegetation. In use and management this soil is similar to Redmond sandy loam, 0 to 3 percent slopes, but yields are slightly higher.

Redmond sandy loam

Redmond sandy loam occurs extensively in the northern part of Deschutes County; a few tracts are in Jefferson County. It occurs on nearly level or gently sloping plains, generally between ridges of Scabland. The natural vegetation consists of big sagebrush, juniper, rabbitbrush, bunchgrass, annual grasses, and associated herbs.

The upper 20 inches or more of this soil was developed mainly from pumice, in some places mixed with waterlaid material weathered from basalt, rhyolite, andesite, and sandstone. In many places, the lower part of this soil has been affected by material weathered from basalt or partly consolidated pumiceous or tuffaceous sandstone.

This soil is associated with Deschutes sandy loam and Odin sandy loam; in characteristics it is intermediate between these two soils. It is moderately well drained to imperfectly drained; most areas, especially the irrigated areas, are moderately well drained. It has a finer textured, more compact subsoil than Deschutes sandy loam, and is somewhat less well drained.

Representative profile:

0 to 8 inches, light brownish-gray to grayish-brown noncalcareous soft sandy loam grading to pale brown; contains much very pale brown and light yellowish-brown pumice sand; when moist, very dark grayish brown and very friable; about neutral in reaction.

8 to 14 inches, pale-brown to light brownish-gray or light yellowish-brown noncalcareous heavy sandy loam or light loam; slightly hard; weak subangular blocky structure; when moist, dark grayish brown and very friable or friable; contains much very pale brown and light yellowish-brown pumice sand; neutral to mildly alkaline.

14 to 27 inches, pale-brown or light yellowish-brown heavy loam or light clay loam grading to light brownish gray; hard; subangular blocky structure; noncalcareous; when moist, dark grayish brown to dark brown or olive brown and firm; contains much pumice sand; mildly or moderately alkaline.

27 to 34 inches, very pale brown slightly calcareous hard sandy loam; grading to light yellowish brown, pale brown, or light brownish gray; generally weakly or very weakly cemented; in places contains very hard lumps or nodules; contains some pumice.

34 inches +, basalt bedrock or, in places, partly consolidated sandstone or agglomerate.

This soil commonly contains a few small pebbles or fragments of basalt. In places the lower subsoil contains a small to moderate number of angular fragments of basalt as large as 10 inches in diameter. In places a layer in the lower subsoil is weakly cemented; the top of this layer is covered with a very dense, pale-brown or pinkish-gray film about $\frac{1}{20}$-inch thick. This film is cemented by lime and silica and is impenetrable to roots. This soil is low in organic matter and nitrogen.

Drainage is somewhat rapid through the upper part of this soil, moderate through the subsoil, and very slow through the underlying material. This soil is normally nonsaline and nonalkali, but a few spots are somewhat saline.

To show variations in slope and depth, two phases of this soil are mapped.

Redmond sandy loam, 0 to 3 percent slopes (Rc).—This soil lies between ridges of Scabland in nearly level and level areas and in shallow depressions. Many tracts

occur in the lower parts of upland plains in association with the higher Deschutes sandy loam. Runoff is slow and the erosion hazard negligible or slight. In some depressions, excessive irrigation and runoff from higher areas may cause waterlogging of the subsoil or a perched water table. This soil is moderate to somewhat high in water-holding capacity. It is very easy to irrigate. The workability is very good. This soil is generally 2½ to 3 feet in depth to basalt bedrock or a cemented layer that is impenetrable to roots. In many places this depth is 4 or 5 feet.

Use and management (subgroup 1A).—A very large part of this soil is irrigated for crops and pasture (fig. 5). The common crops of the region are grown. In use suitability and management needs, this soil is similar to Deschutes sandy loam, 0 to 3 percent slopes, but it is better suited to oats, wheat, barley, hay crops, and pasture. Inadequately drained tracts are not very well suited to alfalfa.

In inadequately drained areas, it may be feasible to improve the drainage by digging ditches or drilling wells to the pervious layer. Irrigation should be carefully controlled so that no excess water will be applied.

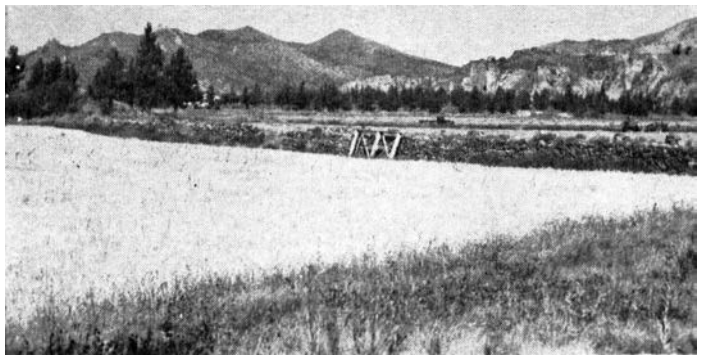

***Figure 5.*—Barley and alfalfa growing on Redmond sandy loam, 0 to 3 percent slopes. The alfalfa is beyond the stone fence. The grass and weeds in the foreground and the junipers to the left are on Scabland.**

Redmond sandy loam, 3 to 7 percent slopes (Rd).—Most of this soil occurs in Deschutes County; a few tracts lie northeast of Madras. This soil is gently sloping or undulating. Runoff is slightly more rapid than it is on Redmond sandy loam, 0 to 3 percent slopes, and irrigation is more difficult. The erosion hazard under irrigation is moderate.

Included with this soil are about 28 acres that have a loam surface soil. Also included are about 24 acres that have slopes of slightly more than 7 percent and 19 acres that are moderately eroded.

Use and management (subgroup 1D).—The acreage of this soil in Deschutes County is irrigated for crops and pasture; that in Jefferson County is used for dry-farmed grain. Some of the areas in Jefferson County may be irrigated under the Deschutes Irrigation Project. In use suitability and management needs this soil is similar to Deschutes sandy loam, 3 to 7 percent slopes, but it is higher in water-holding capacity and fertility.

Redmond sandy loam, deep, 0 to 3 percent slopes (Re).—This soil occurs in the northern part of Deschutes County and in several tracts in Jefferson County east of Madras. It is like Redmond sandy loam, 0 to 3 percent slopes, except that it is deeper to bedrock or a cemented layer and is a little less likely to be waterlogged.

Use and management (subgroup 1A).—This soil is used for dry-farmed grain. It may be irrigated under the Deschutes Irrigation Project. In use suitability and management needs this soil is similar to Deschutes sandy loam, 0 to 3 percent slopes, but where adequately drained it is better suited to alfalfa.

Riverwash

Most areas of Riverwash lie along the Deschutes and Crooked Rivers. One area is along Willow Creek. Most Riverwash is nearly barren, but in places a little sagebrush and grass grow, and in other areas there are a few trees.

Riverwash (Rk) consists of loose sand, gravel, cobblestones, and stones that occur in or near stream beds, overflow channels, or on islands or bars. It normally contains a little silt and clay. It may be covered by floods that shift the material. Hardly anything will grow on it. This mapping unit is in management group 6.

Rough broken land

Rough broken land consists of moderately steep, hilly, and steep land that is broken by many intermittent drainage channels. This miscellaneous land type is not excessively stony. It can be tilled enough to prepare for seeding grass. The natural vegetation consists of big sagebrush, rabbitbrush, bunchgrass, scattered junipers, annual grasses, and associated herbs.

Rough broken land, Era and Deschutes soil materials, 12 to 50 percent slopes (Ro).—This mapping unit consists of several undifferentiated soils. Some areas that are covered with pumiceous materials resemble Deschutes soils. In other areas the soils are less pumiceous and were derived mainly from weathered partly consolidated sandstone, agglomerate, and other rocks of the Dalles formation. In many areas the soils are somewhat similar to Era soils; in other places they are similar to Agency, Madras, Lamonta, and other soils. In a few places the parent material was derived mainly from weathered basalt, and the soils resemble a shallow Gem soil. The soils are generally shallow and low in water-holding capacity.

About 80 percent of this mapping unit has slopes that range from 20 to 35 percent. Runoff varies from place to place but normally ranges from moderate to somewhat high. Many areas are moderately eroded. Natural geologic erosion is active in much of the area.

Use and management (group 5).—This mapping unit is not suitable for irrigation. Its principal use is spring and fall grazing. The carrying capacity is low but can be increased by improved range management.

Rough stony land

Rough stony land consists of moderately steep, hilly, steep, very steep, and precipitous land that has enough stones, boulders, and rock outcrops to prevent ordinary tillage. The natural vegetation consists mainly of big

sagebrush, bunchgrasses, rabbitbrush, annual grasses, scattered junipers, and associated herbs. Junipers are larger and more numerous in the southern part of the Area. Ponderosa pine and bitterbrush also grow in small areas in the extreme southern and southwestern parts of the Area.

Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes (Rs).—The soils and soil materials included in this mapping unit are not differentiated. The soils are commonly shallow. Many areas are 90 percent stones and rock outcrops. Such areas include many rimrocks and vertical canyon walls of basalt or other lava (fig. 6). These areas are shown on the map by rock-cliff symbols. They are impassable by livestock.

***Figure 6.*—Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes, in lower Deschutes River valley near the northwest corner of the Area. The rimrock—a basaltic lava flow—terminates in the nearly level Agency Plains higher above it and protects the plains against dissection. The river, however, has cut through the lava strata of the Dalles and the John Day formations.**

Several kinds of soil are intricately associated in this mapping unit. In many areas the soils were derived from weathered sandstone or agglomerate and basalt and somewhat resemble a stony or shallow Agency soil. In other places the soils resemble a stony or shallow Era soil. To the southward many of the areas are mantled with pumiceous sandy materials, and the soils are similar to Deschutes soils.

About 62 percent of this mapping unit has slopes of more than 35 percent, and 30 percent has slopes of 20 to 25 percent. Runoff is moderate to high. Many areas have been moderately eroded. Natural geologic erosion is active in most places.

Use and management (group 6).—This land type is used mainly for spring and fall grazing. It is not suited to irrigation or dry farming. It is similar to Rough broken land in management needs, but in most places plowing or disking to prepare for seeding grass is not feasible. The carrying capacity is about the same as or a little lower than that of Rough broken land.

Scabland

Scabland occurs mostly in Deschutes County. It consists of level and undulating upland plains where blisterlike outcrops of basalt occur. Many ridges, low knolls, swales, and pockets were formed when the lava cooled and hardened. Later a mantle of pumice particles settled from the air on these uneven surfaces. Water and wind moved much of the pumice from the higher, more exposed places to the lower areas where Deschutes, Redmond, and Odin soils developed. In many places on the upland plain, basalt or other lava rock now crops out or is within a few inches of the surface. In cavities and small pockets in the lava the covering of pumice particles or other soil material is deeper. Scabland consists of areas in which the bedrock predominates; areas in which stony shallow soil and soil-forming material predominate are recognized as Rough stony land.

The natural vegetation of Scabland consists mainly of big sagebrush, open stands of juniper, rabbitbrush, bunchgrass, annual grasses, and associated herbs. In some areas in the extreme southern and southwestern part ponderosa pine and bitterbrush grow.

Because some nearly level areas of Scabland are suitable for irrigated pastures, two phases are mapped.

Scabland, 0 to 3 percent slopes (Sa).—Most of this mapping unit occurs in Deschutes County. It is in management group 6. Most of it is used for range grazing, mainly in spring and fall. The carrying capacity is low. Management needs for range are similar to those of Rough stony land. A few tracts where the soil is deepest are irrigated for grass-legume pasture. The grazing capacity of the irrigated tracts is higher than that of the native range.

Scabland, 3 to 12 percent slopes (Sb).—Extensive tracts of this miscellaneous land type occur in the southeastern part of the Area. It is associated with Deschutes and Redmond soils in swales and shallow basins. About 84 percent is gently sloping or undulating; the rest is moderately sloping or rolling.

This mapping unit is in management group 6. In use suitability and management needs it is similar to Scabland, 0 to 3 percent slopes, but it is less suitable for irrigated pasture.

Volcanic ash

Volcanic ash consists of inextensive areas of relatively unmodified deposits of white or light-gray fine volcanic ejecta, mixed with some soil material that washed from adjoining higher land. The sparse vegetation consists mostly of rabbitbrush.

Volcanic ash, 0 to 3 percent slopes (Vo).—This miscellaneous land type occupies nearly level, low, concave slopes in draws, basinlike areas, or the beds of former ponds. It consists of glassy or pumiceous loose sand, loamy sand, or finer material that shows little evidence of soil development. Below a depth of 4 feet the material is pale-brown fine sandy loam that contains weakly cemented nodules of soil material. Diatomaceous material possibly is included.

This land type is in management subgroup 1B. It is poor for grazing.

Use and Management of Soils

The soils and miscellaneous land types of the Area are placed in management groups and subgroups on the basis of characteristics that determine their similarity in use suitability and management needs. For each subgroup

suitable uses are given and, if applicable, suitable rotations, suggested fertilization, irrigation methods, and other management. The suggested fertilization is given in general terms only. Advice on specific amounts of fertilizer can be obtained from the county agricultural agent, from qualified advisers in the Agricultural Experiment Station and the Soil Conservation Service, and from others who may have adequate knowledge of soil conditions in the Area. Soil tests help to show how much fertilizer is needed. The suitable rotations, unless otherwise specified, are for irrigated soils.

Management Group 1

Management group 1 consists of soils of the uplands and terraces. These soils were derived mainly from pumice. They are placed in 12 subgroups, generally on the basis of drainage, texture, depth, and slope.

Management subgroup 1A

Subgroup 1A consists of the following moderately deep or deep soils that range from moderately well drained to somewhat excessively drained:

Deschutes coarse sandy loam, over sandy material, 0 to 3 percent slopes.
Deschutes loam, stony, 0 to 3 percent slopes.
Deschutes sandy loam, 0 to 3 percent slopes.
Deschutes sandy loam, deep, 0 to 3 percent slopes.
Deschutes sandy loam, deep over cinders, 0 to 3 percent slopes.
Deschutes sandy loam, over cinders, 0 to 3 percent slopes.
Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes.
Deschutes sandy loam, stony, 0 to 3 percent slopes.
Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes.
Laidlaw sandy loam, 0 to 3 percent slopes.
Redmond loam, 0 to 3 percent slopes.
Redmond sandy loam, 0 to 3 percent slopes.
Redmond sandy loam, deep, 0 to 3 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, barley, wheat, and peas; alsike clover, Ladino clover, and red clover for seed or hay; vetch for seed.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain; alfalfa for 5 years; potatoes for 2 years; grain in which red clover or alsike clover is seeded; then a crop of clover seed or clover hay.

Oats or barley with alsike clover or Ladino clover seeded in the stubble in August; 2 years of clover for seed; potatoes for 1 year.

Oats, barley, or wheat; hairy vetch or peas; potatoes.

Barley or oats followed by vetch.

Suggested fertilization

Fertilize alfalfa and clover grown for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with phosphoric acid, potash (K_2O), and borax. Use additional nitrogen if potatoes are grown for a second year.

Fertilize vetch with phosphoric acid.

Fertilize peas with nitrogen, in addition to gypsum and phosphoric acid.

Except when it follows potatoes, alfalfa, or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with gypsum, phosphoric acid, and, where needed, nitrogen.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture in strip. borders.

Other management

Apply manure to potatoes, other row crops, and grains; use all crop residues; remove stones from stony soils.

Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and use for potatoes or other crops, and reseed to pasture when necessary.

Management subgroup 1B

Subgroup 1B consists of the following moderately deep, somewhat excessively drained soils:

Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent slopes.
Deschutes loamy sand, 0 to 3 percent slopes.
Deschutes loamy sand, eroded, 0 to 3 percent slopes.
Deschutes loamy sand, over cinders, 0 to 3 percent slopes.
Deschutes loamy sand, over cobbly material, 0 to 3 percent slopes.
Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes.
Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes.
Volcanic ash, 0 to 3 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, barley, and wheat; alsike clover, Ladino clover, and red clover for seed or hay; vetch for seed; peas.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain; alfalfa for 5 or more years; potatoes for 1 year; grain in which red clover or alsike clover is seeded; then 1 year of clover for seed or hay.

Oats or barley, with alsike clover or Ladino clover seeded in the stubble in August; 2 years of clover for seed; 1 year of potatoes.

Oats, barley, or wheat; hairy vetch or peas; then potatoes.

Barley or oats, followed by vetch.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes following alfalfa or clover with nitrogen, phosphoric acid, potash (K_2O), and borax. Increase nitrogen for potatoes grown the second year.

Fertilize vetch with phosphoric acid.

Fertilize peas with nitrogen in addition to gypsum and phosphoric acid.

Except when it follows potatoes, alfalfa, or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with gypsum and phosphoric acid; where needed, apply nitrogen.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture in strip borders. Apply water in smaller quantities, from larger heads, and more often than for subgroup 1A.

Other management

For crops, apply manure and turn under green manure and crop residues.

Divide pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings. Plow pasture and use for potatoes or other crops, and reseed to pasture when necessary.

Management subgroup 1C

Subgroup 1C consists of the following well-drained soils:

Deschutes sandy loam, shallow, 0 to 3 percent slopes.
Deschutes sandy loam, shallow over cinders, 0 to 3 percent slopes.

Suitable uses

Irrigated crops: Potatoes, Ladino clover for seed or hay, oats, barley, wheat, vetch for seed, and peas.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain, followed by vetch or peas, then potatoes.

Oats or barley, followed by vetch.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, potash (K_2O), and borax. Apply more nitrogen if potatoes are grown a second year.

Fertilize vetch with phosphoric acid.

Fertilize peas with nitrogen, in addition to gypsum and phosphoric acid.

Fertilize grain, if it does not follow potatoes, alfalfa, or clover, with nitrogen and phosphoric acid.

Fertilize pastures with nitrogen.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture in strip borders. The soils of this subgroup also can be irrigated by corrugations.

Other management

For crops, apply manure and turn under green manure and crop residues.

Divide pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings.

Management subgroup 1D

Subgroup 1D consists of the following well drained or moderately well drained soils that are moderately deep or deep:

Deschutes sandy loam, 3 to 7 percent slopes.
Deschutes sandy loam, deep, 3 to 7 percent slopes.
Deschutes sandy loam, over cinders, 3 to 7 percent slopes.
Deschutes sandy loam, over cinders, eroded, 3 to 7 percent slopes.
Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes.
Deschutes sandy loam, stony, 3 to 7 percent slopes.
Deschutes sandy loam, stony, over cinders, 3 to 7 percent slopes.
Deschutes sandy loam, stony, over semicemented sandy material, 3 to 7 percent slopes.
Laidlaw sandy loam, 3 to 7 percent slopes.
Redmond sandy loam, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, barley, and wheat; alsike clover, Ladino clover, or red clover for seed or hay; vetch for seed; peas.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain; alfalfa for 5 years; potatoes for 1 year; grain seeded to red clover or alsike clover; then 1 year of clover for seed or hay.

Oats or barley with alsike clover or Ladino clover seeded in stubble in August; 2 years of clover for seed; then potatoes.

Oats, barley, or wheat; 1 year of hairy vetch or peas; then potatoes.

Barley or oats, followed by 1 year of vetch.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, potash (K_2O), and borax. Apply additional nitrogen if potatoes are grown a second year.

Fertilize vetch with phosphoric acid.

Fertilize peas with nitrogen, in addition to gypsum and phosphoric acid.

Except when it follows potatoes, alfalfa, or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with nitrogen.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture by corrugations or by flooding from contour laterals.

Other management

For crops, apply manure and turn under green manure and crop residues.

Divide pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings. Plow pasture and use for potatoes or other row crops, and reseed when needed.

Management subgroup 1E

Subgroup 1E consists of the following somewhat excessively drained soils that are moderately deep:

Deschutes loamy coarse sand, over gravelly material, 3 to 7 percent slopes.
Deschutes loamy sand, 3 to 7 percent slopes.
Deschutes loamy sand, over cinders, 3 to 7 percent slopes.
Deschutes loamy sand, over cinders, eroded, 3 to 7 percent slopes.
Deschutes loamy sand, over gravelly material, 3 to 7 percent slopes.
Deschutes loamy sand, over semicemented sandy material, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, barley, and wheat; alsike, Ladino, and red clovers for seed or hay; vetch for seed; peas.

Irrigated pasture: Grass-legume mixture; for example, orchardgrass, alta fescue, smooth bromegrass, and Ladino clover or alsike clover, or both.

Suitable rotations

Grain; alfalfa for 5 years; potatoes for 1 year; grain seeded to red clover or alsike clover for 1 year; clover for seed or hay for 1 year.

Oats or barley, with clover seeded in stubble in August; 2 years of alsike clover or Ladino clover for seed; potatoes.

Oats, barley, or wheat; hairy vetch or peas; potatoes.

Barley or oats, followed by vetch.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, potash (K_2O), and borax. Apply more nitrogen if potatoes are grown a second year.

Fertilize vetch with phosphoric acid.

Fertilize peas with nitrogen, in addition to gypsum and phosphoric acid.

Except when it follows potatoes, alfalfa, or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with gypsum, phosphoric acid, and, where needed, nitrogen.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture by corrugations or by flooding from contour laterals. Control irrigation water carefully to prevent erosion.

Other management

For crops, apply manure and turn under green manure and crop residues.

Divide pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings. Plow pasture and use for potatoes or other crops, and reseed when needed.

Management subgroup 1F

Subgroup 1F consists of the following shallow, well-drained sandy loams:

Deschutes sandy loam, shallow, 3 to 7 percent slopes.
Deschutes sandy loam, shallow over cinders, eroded, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Potatoes, Ladino clover for seed and hay, oats, barley, wheat, vetch for seed, and peas.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain; vetch or peas; potatoes.

Oats or barley, followed by vetch.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, potash (K_2O), and borax. Apply more nitrogen if potatoes are grown a second year.

Fertilize vetch with nitrogen, in addition to gypsum and phosphoric acid.

Except when it follows potatoes, alfalfa, or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with nitrogen.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture by corrugations or by flooding from contour laterals.

Other management

For crops, apply manure and turn under green manure and crop residues.

Divide pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings. Plow pasture and use for potatoes or other row crops, and reseed when needed.

Management subgroup 1G

Subgroup 1G consists of the following well-drained sandy loams:

Deschutes sandy loam, 7 to 12 percent slopes.
Deschutes sandy loam, eroded, 7 to 12 percent slopes.
Deschutes sandy loam, over semicemented sandy material, 7 to 12 percent slopes.
Deschutes sandy loam, stony, 7 to 12 percent slopes.
Deschutes sandy loam, stony, over semicemented sandy material, 7 to 12 percent slopes.
Laidlaw sandy loam, 7 to 12 percent slopes.
Laidlaw sandy loam, eroded, 7 to 12 percent slopes.

Suitable uses

Irrigated crops: Alfalfa, alsike clover, Ladino clover, red clover, oats, barley, and wheat.

Irrigated pasture: Grass-legume mixture; for example, orchardgrass, alta fescue, smooth bromegrass, and Ladino clover or alsike clover, or both.

Range grazing.

Suitable rotations

Grain, followed by 5 or 6 years of alfalfa.

Grain, followed by 2 or 3 years of clover.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Except when it follows alfalfa or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with phosphoric acid and, where needed, nitrogen.

Irrigation methods

Irrigate by corrugations or by flooding from contour laterals.

Other management

Apply manure to grains; use all crop residues; remove stones from stony soils.

Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow to scatter droppings. Plow, sow to grain, and reseed when necessary.

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation; provide adequate winter feed. Keep stock distributed by fences or by the location of water and salt.

Management subgroup 1H

Subgroup 1H consists of the following somewhat excessively drained soils:

Deschutes loamy sand, 7 to 12 percent slopes.
Deschutes loamy sand, over semicemented sandy material, 7 to 12 percent slopes.

Suitable uses

Irrigated crops: Alfalfa, alsike clover, Ladino clover, red clover, oats, barley, and wheat.

Irrigated pasture: Grass-legume mixture.

Range grazing.

Suitable rotations

Grain; alfalfa for 5 or 6 years.

Grain; clover for 2 or 3 years.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Except when it follows alfalfa or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pastures with phosphoric acid and, where needed, nitrogen.

Irrigation methods

Irrigate by corrugations or by flooding from contour laterals.

Other management

Apply manure to grains; use all crop residues; remove stones from stony soils.

Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow to scatter droppings. Plow, sow to grain, and reseed when necessary; use straw mulch when reseeding.

Regulate stocking of range; defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation; provide adequate winter feed. Keep stock distributed by fencing and by location of water and salt.

Management subgroup 1I

Subgroup 1I consists of the following well-drained sandy loams:

Deschutes sandy loam, 12 to 20 percent slopes.
Deschutes sandy loam, over semicemented sandy material, eroded, 12 to 20 percent slopes.
Laidlaw sandy loam, eroded, 12 to 20 percent slopes.

Suitable use

The soils of this subgroup are suitable only for range grazing.

Management

Regulate stocking of range; defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation; provide adequate winter feed. Keep stock distributed by fencing and by location of water and salt. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass and perhaps some beardless wheatgrass and bluebunch wheatgrass.

Management subgroup 1J

Redmond clay loam, 0 to 3 percent slopes, is the only soil in subgroup 1J. It is moderately well drained.

Suitable uses

Irrigated crops: Alfalfa, oats, barley, and wheat; alsike, Ladino, and red clovers for seed or hay; vetch for seed; peas.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain; alfalfa for 5 years; grain seeded to red clover or alsike clover; clover for seed or hay.

Oats or barley with alsike clover or Ladino clover seeded in stubble in August; 2 years of clover for seed; potatoes for 1 year.

Oats, barley, or wheat; hairy vetch or peas; then potatoes.

Barley or oats, followed by vetch.

Suggested fertilization

Fertilize vetch with phosphoric acid (P_2O_5).

Fertilize peas with nitrogen, gypsum, and phosphoric acid.

Except where it follows alfalfa or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pasture with gypsum, phosphoric acid, and, where needed, nitrogen.

Irrigation methods

Irrigate by strip borders.

Other management

Apply manure to grains; use all crop residues.

Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and use for crops, and reseed when needed.

Management subgroup 1K

Subgroup 1K consists of the following imperfectly drained and poorly drained soils:

Odin clay loam, 0 to 3 percent slopes.
Odin clay loam, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Oats, barley, wheat, Ladino clover, alsike clover, and vetch.

Irrigated pasture: Grass-legume mixture.

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Suitable rotations

For irrigated areas, suitable rotations include the following: Grain, followed by vetch; and grain followed by 2 or 3 years of clover.

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover grown for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize vetch with phosphoric acid.

Fertilize peas with nitrogen, in addition to gypsum and phosphoric acid.

Fertilize pasture with gypsum, phosphoric acid, and, where needed, nitrogen.

Irrigation methods

Irrigate by strip borders. Do not overirrigate.

Other management

Provide artificial drainage by ditches and drainage wells that extend into a pervious layer, or by pumping for irrigation. Flush and flood saline areas.

Fallow dry-farmed areas to conserve moisture. While soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it.

Management subgroup 1L

Odin sandy loam, 0 to 3 percent slopes, is the only soil in subgroup 1L. It is imperfectly drained.

Suitable uses

Irrigated crops: Potatoes, oats, barley, wheat, Ladino clover, alsike clover, and vetch.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

Grain, followed by vetch.

Grain, followed by clover for 2 or 3 years.

Grain; vetch; potatoes.

Suggested fertilization

Fertilize alfalfa and clover for seed with gypsum and phosphoric acid (P_2O_5).

Fertilize potatoes following alfalfa or clover with nitrogen, phosphoric acid, potash (K_2O), and borax. Increase nitrogen for potatoes grown a second year.

Fertilize vetch with phosphoric acid.

Except when it follows potatoes, alfalfa, or clover, fertilize grain with nitrogen and phosphoric acid.

Fertilize pasture with gypsum, phosphoric acid, and, where needed, nitrogen.

Irrigation methods

Irrigate potatoes by furrow runs. Irrigate grains, hay, and pasture with strip borders. Do not overirrigate.

Other management

Provide artificial drainage by ditches, by drainage wells that extend into a pervious layer, or by pumping for irrigation. Flush and flood saline areas. Fallow dry-farmed areas to conserve moisture. While soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it.

Management Group 2

Management group 2 consists of soils of the uplands that were derived from weathered sandstones, agglomerates, and mixed materials. They are placed in 9 subgroups, generally on the basis of texture of the subsoil, depth, and slope.

Management subgroup 2A

Subgroup 2A consists of the following soils that have sandy loam, loam, or clay loam subsoils.

Agency gravelly loam, 0 to 3 percent slopes.
Agency loam, 0 to 3 percent slopes.
Agency loam, eroded, 0 to 3 percent slopes.
Agency sandy loam, 0 to 3 percent slopes.
Agency sandy loam, eroded, 0 to 3 percent slopes.
Era sandy loam, 0 to 3 percent slopes.
Era sandy loam, eroded, 0 to 3 percent slopes.
Madras loam, 0 to 3 percent slopes.
Madras loam, eroded, 0 to 3 percent slopes.
Madras loam, over sandstone, 0 to 3 percent slopes.
Madras loam, over sandstone, eroded, 0 to 3 percent slopes.
Madras sandy loam, 0 to 3 percent slopes.
Madras sandy loam, deep over sandstone, 0 to 3 percent slopes.
Madras sandy loam, eroded, 0 to 3 percent slopes.
Madras sandy loam, over sandstone, 0 to 3 percent slopes.
Madras sandy loam, over sandstone, eroded, 0 to 3 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, barley, and wheat; alsike clover, Ladino clover, and red clover for seed or hay; vetch for seed; peas.

Irrigated pasture: Grass-legume mixture.

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Suitable rotations

The following rotations are suitable for irrigated areas:

Grain; alfalfa for 5 years; potatoes for 2 years; grain; red clover or alsike clover, seeded in preceding grain crop and harvested for seed and hay.

Oats or barley, with alsike clover or Ladino clover seeded in the stubble in August; 2 years of clover for seed; potatoes.

Oats, barley, or wheat; hairy vetch or peas; potatoes.

Barley or oats, followed by vetch.

A suitable rotation for dry-farmed areas consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, and potash (K_2O).

Fertilize grain and peas with ammonium sulfate.

Fertilize pasture with ammonium sulfate.

Irrigation methods

Irrigate row crops on gravelly loams and sandy loams by furrows. Irrigate grains, hay, and pasture on gravelly loams and sandy loams in strip borders. On loam soils irrigation runs can be longer than on the sandy loams.

Other management

Apply manure to potatoes, other row crops, and grains; use all crop residues; remove stones from stony soils.

Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and use for potatoes or other crops, and reseed when necessary.

Fallow dry-farmed areas to conserve moisture. While the soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it.

Management subgroup 2B

Subgroup 2B consists of the following soils that have sandy loam, loam, or clay loam subsoils and slopes of 3 to 7 percent.

Agency gravelly loam, 3 to 7 percent slopes.
Agency gravelly loam, eroded, 3 to 7 percent slopes.
Agency loam, 3 to 7 percent slopes.
Agency loam, eroded, 3 to 7 percent slopes.
Agency sandy loam, 3 to 7 percent slopes.
Agency sandy loam, eroded, 3 to 7 percent slopes.
Era sandy loam, 3 to 7 percent slopes.
Era sandy loam, eroded, 3 to 7 percent slopes.
Madras loam, 3 to 7 percent slopes.
Madras loam, eroded, 3 to 7 percent slopes.
Madras loam, over sandstone, 3 to 7 percent slopes.
Madras loam, over sandstone, eroded, 3 to 7 percent slopes.
Madras loamy sand, over sandstone, 3 to 7 percent slopes.
Madras loamy sand, over sandstone, eroded, 3 to 7 percent slopes.
Madras sandy loam, 3 to 7 percent slopes.
Madras sandy loam, deep over sandstone, 3 to 7 percent slopes.
Madras sandy loam, deep over sandstone, eroded, 3 to 7 percent slopes.
Madras sandy loam, eroded, 3 to 7 percent slopes.
Madras sandy loam, over sandstone, 3 to 7 percent slopes.
Madras sandy loam, over sandstone, eroded, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Potatoes, oats, barley, and wheat; alsike clover, Ladino clover, and red clover for seed or hay; vetch for seed; peas.

Irrigated pasture: Grass-legume mixture.

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Suitable rotations

The following rotations are suitable for irrigated areas:

Grain; alfalfa for 5 years; potatoes for 2 years; grain; red clover or alsike clover, seeded in the preceding grain crop and harvested for seed or hay.

Oats or barley, with alsike clover or Ladino clover seeded in the stubble in August; 2 years of clover for seed; potatoes.

Oats, barley, or wheat; hairy vetch or peas; potatoes.

Barley or oats, followed by vetch.

A suitable rotation for dry-farmed areas consists of grain alternating with summer fallow for 10 years, and followed by 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, and potash (K_2O).

Fertilize grain and peas with ammonium sulfate.

Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate row crops on gravelly loams and sandy loams by furrows. Irrigate grains, hay, and pasture on gravelly loams and sandy loams by corrugations or by flooding from contour laterals. Runs can be somewhat longer on loams than on sandy loams.

Other management

Apply manure to potatoes, other row crops, and grains; use all crop residues; remove stones from stony soils. Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and use for potatoes or other row crops, and reseed when needed. Fallow dry-farmed areas to conserve moisture. While the soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it.

Management subgroup 2C

Subgroup 2C consists of the following soils that have sandy loam, loam, or clay loam subsoils.

Agency gravelly loam, 7 to 12 percent slopes.
Agency gravelly loam, eroded, 7 to 12 percent slopes.
Agency loam, 7 to 12 percent slopes.
Era sandy loam, 7 to 12 percent slopes.
Era sandy loam, eroded, 7 to 12 percent slopes.
Madras loam, 7 to 12 percent slopes.
Madras loam, eroded, 7 to 12 percent slopes.
Madras sandy loam, 7 to 12 percent slopes.
Madras sandy loam, eroded, 7 to 12 percent slopes.
Madras sandy loam, over sandstone, 7 to 12 percent slopes.
Madras sandy loam, over sandstone, eroded, 7 to 12 percent slopes.

Suitable uses

Irrigated crops: Alfalfa, alsike clover, Ladino clover, red clover, oats, barley, or wheat.

Irrigated pasture: Grass-legume mixture.

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Range grazing.

Suitable rotations

For irrigated areas, suitable rotations include the following: Grain, followed by 5 or 6 years of alfalfa; and grain followed by 2 or 3 years of clover.

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 to 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.
Fertilize clover grown for seed with phosphoric acid (P_2O_5).
Fertilize grain with ammonium sulfate.
Fertilize irrigated pasture with gypsum and phosphoric acid; where needed, use nitrogen.

Irrigation methods

For crops and pasture, irrigate by corrugations or by flooding from contour laterals.

Other management

Apply manure to grains; use all crop residues; remove stones from stony soils. Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and reseed when needed.

Fallow dry-farmed areas to conserve moisture. While soil is fallow, cultivate to control weeds. Maintain stubble mulch. Spread straw and do not burn it; plow on the contour where possible.

Regulate stocking of range; defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation. Keep stock distributed over the range by fencing or by location of water and salt. Provide adequate winter feed. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass and perhaps some beardless wheatgrass and bluebunch wheatgrass.

Management subgroup 2D

Subgroup 2D consists of the following loams and sandy loams that have sandy loam, loam, or clay subsoils:

Agency loam, 12 to 20 percent slopes.
Era sandy loam, 12 to 20 percent slopes.
Era sandy loam, eroded, 12 to 20 percent slopes.
Madras sandy loam, over sandstone, 12 to 20 percent slopes.
Madras sandy loam, over sandstone, eroded, 12 to 20 percent slopes.

Suitable uses

Dry-farmed crops: Wheat for grain; rye or barley for hay.
Range grazing.
Irrigated pasture: Grass-legume mixture.

Suitable rotation

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate pastures by corrugations or by flooding from contour laterals.

Other management

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Spread straw and do not burn it. Maintain stubble mulch. Plow on contour where possible.

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short in fall; graze tracts in rotation; provide adequate feed in winter. Keep stock distributed by fencing and by location of water and salt. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Divide irrigated pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings.

Management subgroup 2E

Subgroup 2E consists of the following moderately deep loams and sandy loams that have clay subsoils:

Lamonta loam, 0 to 3 percent slopes.
Lamonta loam, eroded, 0 to 3 percent slopes.
Lamonta sandy clay loam, 0 to 3 percent slopes.
Lamonta sandy clay loam, eroded, 0 to 3 percent slopes.

Suitable uses

Irrigated crops: Alfalfa, oats, barley, wheat, Ladino clover for seed, peas, and vetch.

Dry-farmed crops: Wheat for grain; rye or barley for hay.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

For irrigated areas, suitable rotations include the following: Grain, followed by 2 years of Ladino clover; and grain followed by peas or vetch.

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.
Fertilize clover grown for seed with phosphoric acid (P_2O_5).
Fertilize grain and peas with ammonium sulfate.
Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate crops in strip borders or corrugations. Use a small head of water. Irrigate pasture in strip borders.

Other management

Apply manure to irrigated grains; use all crop residues; keep grading and leveling to a minimum. Fallow dry-farmed areas to conserve moisture; and while soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it.

Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and use for crops, and reseed when necessary.

Management subgroup 2F

Subgroup 2F consists of the following moderately deep loams and sandy clay loams that have a clay subsoil:

Lamonta loam, 3 to 7 percent slopes.
Lamonta loam, eroded, 3 to 7 percent slopes.
Lamonta sandy clay loam, 3 to 7 percent slopes.
Lamonta sandy clay loam, eroded, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Alfalfa, oats, barley, wheat, Ladino clover for seed, peas, and vetch.

Dry-farmed crops: Wheat for grain; rye or barley for hay.

Irrigated pasture: Grass-legume mixture.

Suitable rotations

For irrigated areas, suitable rotations include the following: Grain, followed by 2 years of Ladino clover; and grain followed by peas or vetch.

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize grain and peas with ammonium sulfate.

Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate by corrugations. Use a very small head of water.

Other management

Apply manure to irrigated grains; use all crop residues.

Divide irrigated pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings. Plow pasture, sow to grain, and reseed when necessary.

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it; till on contour where possible.

Management subgroup 2G

Subgroup 2G consists of the following moderately deep loams and sandy clay loams that have a clay subsoil:

Lamonta loam, 7 to 12 percent slopes.
Lamonta loam, eroded, 7 to 12 percent slopes.
Lamonta sandy clay loam, 7 to 12 percent slopes.
Lamonta sandy clay loam, eroded, 7 to 12 percent slopes.

Suitable uses

Irrigated crops: Alfalfa, oats, barley, wheat, Ladino clover for seed, peas, and vetch.

Dry-farmed crops: Wheat for grain; rye or barley for hay.

Irrigated pasture.

Suitable rotations

For irrigated areas, suitable rotations include the following; Grain, followed by 2 years of Ladino clover; and grain followed by peas or vetch.

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize grain and peas with ammonium sulfate.

Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate with a very small head of water delivered by corrugations.

Other management

Apply manure to irrigated grains; use all crop residues.

Divide irrigated pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings. Plow pasture, sow to grain, and reseed pasture mixture when necessary.

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it; till on contour where possible.

Management subgroup 2H

Subgroup 2H consists of the following moderately deep loams and sandy clay loams that have a clay subsoil:

Lamonta loam, 12 to 20 percent slopes.
Lamonta loam, eroded, 12 to 20 percent slopes.
Lamonta sandy clay loam, eroded, 12 to 20 percent slopes.

Suitable uses

Dry-farmed crops: Wheat for grain; rye or barley for hay.

Irrigated grass-legume pasture.

Range grazing.

Suitable rotations

For dry-farmed areas, a suitable rotation is grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate pasture with a very small head of water delivered by corrugations.

Other management

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it; cultivate on contour where possible.

Divide pasture into three or four units and rotate grazing; defer grazing of new stands until they are well established; clip to control weeds; harrow to scatter droppings.

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation; provide adequate feed in winter. Keep stock distributed by fences and by location of water and salt. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Management subgroup 2I

Subgroup 2I consists of the following shallow soils that have a clay and clay loam subsoil:

Gem clay loam, shallow, 7 to 12 percent slopes.
Gem clay loam, shallow, eroded, 7 to 12 percent slopes.
Lamonta loam, shallow, 0 to 3 percent slopes.
Lamonta loam, shallow, 3 to 7 percent slopes.
Lamonta loam, shallow, eroded, 3 to 7 percent slopes.
Lamonta loam, shallow, eroded, 7 to 12 percent slopes.
Lamonta sandy clay loam, shallow, 0 to 3 percent slopes.
Lamonta sandy clay loam, shallow, 3 to 7 percent slopes.
Lamonta sandy clay loam, shallow, eroded, 3 to 7 percent slopes.
Lamonta sandy clay loam, shallow, eroded, 7 to 12 percent slopes.
Madras sandy loam, shallow over sandstone, 0 to 3 percent slopes.
Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes.
Madras sandy loam, shallow over sandstone, eroded, 3 to 7 percent slopes.
Madras sandy loam, shallow over sandstone, eroded, 7 to 12 percent slopes.

Suitable uses

Range grazing.

Irrigated grass-legume pasture.

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Suitable rotations

For dry-farmed areas, a suitable rotation is grain alternating with summer fallow for 10 years, followed by 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize irrigated pasture with ammonium sulfate.

Irrigation methods

Irrigate with a small head of water delivered in strip borders or corrugations.

Other management

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation. Keep stock distributed by fences and by location of water and salt. Provide adequate feed in winter. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Divide irrigated pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture, use for crops, and reseed pasture when necessary.

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it; plow on contour where possible.

Management Group 3

Management group 3 is not subdivided. It consists of the following soils of the uplands that were derived principally from basalt:

Gem clay loam, eroded, 3 to 12 percent slopes.
Gem clay loam, eroded, 12 to 20 percent slopes.
Gem loam, 3 to 7 percent slopes.
Gem loam, 7 to 12 percent slopes.
Gem loam, eroded, 7 to 12 percent slopes.

Suitable uses

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Range grazing.

Suitable rotations

Grain alternating with summer fallow for 10 years, followed by 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Other management

Use manure and all crop residues; cultivate to control weeds; maintain stubble mulch; spread straw and do not burn it; cultivate on contour where possible.

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation; provide adequate winter feed. Keep stock distributed by fences and by location of water and salt. Seed burned or cleared areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Management Group 4

Management group 4 consists of soils of the bottom lands and alluvial fans. The soils in this group are of one type—Metolius sandy loam. They are placed in 3 subgroups on the basis of slope.

Management subgroup 4A

Subgroup 4A consists of the following soils:

Metolius sandy loam, 0 to 3 percent slopes.
Metolius sandy loam, eroded, 0 to 3 percent slopes.
Metolius sandy loam, terrace position, 0 to 3 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, wheat, barley, peas, and vetch; alsike clover, Ladino clover, and red clover for seed or hay.

Dry-farmed crops: Wheat; rye and barley for hay.

Suitable rotations

The following rotations are suitable for irrigated areas:

Grain; alfalfa for 5 years; potatoes for 2 years; red clover or alsike clover, seeded in preceding grain crop and harvested for seed or hay.

Oats or barley, with clover seeded in stubble in August; 2 years of alsike clover or Ladino clover for seed; potatoes.

Oats, barley, or wheat; hairy vetch or peas; potatoes.

Barley or oats, followed by vetch.

A suitable rotation for dry-farmed land consists of grain alternating with summer fallow for 10 years, followed by 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, or ammonium sulfate.

Fertilize grain and peas with ammonium sulfate.

Irrigation methods

Irrigate row crops by furrows. Irrigate grains, hay, and pasture in strip borders.

Other management

Apply manure to potatoes, other row crops, and grains; use all crop residues. Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Spread straw and do not burn it; maintain stubble mulch.

Management subgroup 4B

Subgroup 4B consists of the following soils:

Metolius sandy loam, 3 to 7 percent slopes.
Metolius sandy loam, eroded, 3 to 7 percent slopes.
Metolius sandy loam, terrace position, 3 to 7 percent slopes.

Suitable uses

Irrigated crops: Potatoes, alfalfa, oats, wheat, barley, peas, and vetch; alsike clover, Ladino clover, and red clover for seed and hay.

Dry-farmed crops: Wheat or rye and barley for hay.

Suitable rotations

The following rotations are suitable for irrigated areas:

Grain; alfalfa for 5 years; potatoes for 2 years; grain; red clover or alsike clover seeded in preceeding grain crop and harvested for seed or hay.

Oats or barley, with alsike clover or Ladino clover seeded in stubble in August; 2 years of clover for seed; potatoes.

Oats, barley, or wheat; hairy vetch or peas; potatoes.

Barley or oats followed by vetch.

A suitable rotation for dry-farmed areas consists of grain alternating with summer fallow for 10 years, followed by 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize potatoes that follow alfalfa or clover with nitrogen, phosphoric acid, and ammonium sulfate.

Fertilize grain and peas with ammonium sulfate.

Irrigation methods

Irrigate row crops by furrows. Irrigate grain, hay, and pasture by corrugations or by flooding from contour laterals.

Other management

For irrigated crops, apply manure and turn under green-manure crops and crop residues.

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Maintain stubble mulch; spread straw and do not burn it.

Management subgroup 4C

Metolius sandy loam, 7 to 12 percent slopes, is the only soil in subgroup 4C.

Suitable uses

Irrigated crops: Alfalfa, alsike clover, Ladino clover, red clover, oats, barley, or wheat.

Irrigated pasture: Grass-legume mixture.

Dry-farmed crops: Wheat for grain; rye and barley for hay.

Range grazing.

Suitable rotations

For irrigated areas, suitable rotations include the following: Grain followed by 5 or 6 years of alfalfa; and grain followed by 2 or 3 years of clover.

For dry-farmed areas, a suitable rotation consists of grain alternating with summer fallow for 10 years, then 5 or 6 years of crested wheatgrass and bulbous bluegrass.

Suggested fertilization

Fertilize alfalfa and clover with gypsum.

Fertilize clover grown for seed with phosphoric acid (P_2O_5).

Fertilize grain with ammonium sulfate.

Fertilize irrigated pasture with sulfur and phosphoric acid and, where needed, nitrogen.

Irrigation methods

For either crops or pasture, irrigate by corrugations or by flooding from contour laterals.

Other management

Apply manure to grains; use all crop residues. Divide pasture into three or four units and rotate grazing; do not graze new stands until they are well established; clip pasture to control weeds; harrow pasture to scatter droppings. Plow pasture and use for crops, and reseed when necessary.

Fallow dry-farmed areas to conserve moisture; while soil is fallow, cultivate to control weeds. Maintain stubble mulch. Spread straw and do not burn it. Plow on contour where possible. Seed cleared areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation. Keep stock distributed by fences and by location of water and salt; provide adequate feed in winter. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Management Group 5

Management group 5 consists of rough broken land and steep and shallow soils, most of which are not arable. This group is not subdivided.

Agency loam, eroded, 20 to 35 percent slopes.
Madras sandy loam, shallow over sandstone, 12 to 20 percent slopes.
Rough broken land, Era and Deschutes soil materials, 12 to 50 percent slopes.

Suitable use

Range grazing.

Management

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation. Keep stock distributed by fences and by location of water and salt; provide adequate feed in winter; reseed where feasible. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, bluegrass, and bluebunch wheatgrass.

Management Group 6

Management group 6 consists of the following nonarable stony soils and miscellaneous land types:

Agency loam, stony, 0 to 3 percent slopes.
Agency loam, stony, 3 to 7 percent slopes.
Agency loam, stony, 7 to 12 percent slopes.
Agency loam, stony, 12 to 20 percent slopes.
Agency loam, stony, 20 to 35 percent slopes.
Lamonta loam, stony, 0 to 3 percent slopes.
Lamonta loam, stony, 3 to 7 percent slopes.
Lamonta loam, stony, 7 to 12 percent slopes.
Lamonta sandy clay loam, stony, 0 to 3 percent slopes.
Lamonta sandy clay loam, stony, 3 to 7 percent slopes.
Lamonta sandy clay loam, stony, 7 to 12 percent slopes.
Lamonta sandy clay loam, stony, 12 to 20 percent slopes.
Madras loam, stony, 0 to 3 percent slopes.
Madras loam, stony, 3 to 7 percent slopes.
Madras loam, stony, 7 to 12 percent slopes.
Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes.
Madras sandy loam, stony, over sandstone, 3 to 7 percent slopes.
Madras sandy loam, stony, over sandstone, 7 to 12 percent slopes.
Madras sandy loam, stony, over sandstone, 12 to 20 percent slopes.
Riverwash.
Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes.
Scabland, 0 to 3 percent slopes.
Scabland, 3 to 12 percent slopes.

Suitable use

Range grazing.

Management

Regulate stocking of range. Defer grazing until new growth is 3 to 5 inches high; do not graze too short late in fall; graze tracts in rotation. Keep stock distributed by fences and by location of water and salt; provide adequate winter feed. Seed cleared or burned areas to crested wheatgrass mixed with a little bulbous bluegrass, beardless wheatgrass, and bluebunch wheatgrass.

Estimated Yields

Table 3, on estimated yields, was compiled from data obtained at the time of the survey. It gives, for each soil and miscellaneous land type mapped in the Deschutes Area, estimated average yields of the principal crops under ordinary management and improved management. The figures in table 3 are estimates of the average yields that can be expected over a period of several years. Yields on any given soil will be higher than the estimated average in some years and lower in others, depending on weather and management.

The estimates are based on observations of growing crops, on information obtained through interviews with farmers in the Area and with the county agricultural agent, on agricultural planning reports prepared by committees of farmers, on data from the agricultural conservation program, and on data from the Federal census.

That part of the Area that is in Jefferson County will be brought under irrigation for the first time when the facilities of the Deschutes Irrigation Project are finished. It has been assumed that, after 4 or 5 years of irrigation, the soils in this part of the Area will produce about as much as similar soils already under irrigation in Deschutes County and elsewhere.

The A columns in table 3 give average yields under ordinary management, that is, the level of management practiced by most farmers in the Area. The B columns give the average yields that can be expected under the type of management practiced by those farmers of the Area who consistently obtain high yields.

After a farmer has determined from the soil map the kinds of soil on his farm, he can use table 3 to find out whether he is getting as much as he can reasonably expect from his soils. If yields are consistently less than those listed in the B columns, it is likely that better yields could be obtained by improved management. Under the best possible management, yields would be even higher that those in the B columns if the weather were favorable.

The table of estimated yields cannot be used to calculate total production of a crop, because it does not show what proportion of the acreage of a particular soil is used for a specified crop. Neither should the estimates of average yields be considered an indication of land value, which depends on prices, distance to markets, and other economic factors.

TABLE 3.—*Estimated average acre yields of*

[Yields in columns A are to be expected under ordinary management; those in columns B, under improved management.[1] Absence of

Soil or land type	Map symbol	Irrigated					
		Potatoes		Alfalfa		Alsike clover seed	
		A	B	A	B	A	B
		100-lb. bags	*100-lb. bags*	*Tons*	*Tons*	*Bu.*	*Bu.*
Agency gravelly loam, 0 to 3 percent slopes [3]	Aa	120	190	2. 9	4. 3	5. 5	10
Agency gravelly loam, 3 to 7 percent slopes [3]	Ab	110	180	2. 8	4. 2	5	9
Agency gravelly loam, 7 to 12 percent slopes [3]	Ad	90	150	2. 3	3. 3	4	7
Agency gravelly loam, eroded, 3 to 7 percent slopes [3]	Ac	90	150	2. 3	3. 4	4	7
Agency gravelly loam, eroded, 7 to 12 percent slopes [3]	Ae	75	130	2. 0	3. 0	3. 5	6
Agency loam, 0 to 3 percent slopes	Af	140	210	3	4. 5	6	11
Agency loam, 3 to 7 percent slopes	Ah	130	200	3	4. 5	5. 5	10
Agency loam, 7 to 12 percent slopes	Al	100	160	2. 5	3. 5	5	9
Agency loam, 12 to 20 percent slopes	Am						
Agency loam, eroded, 0 to 3 percent slopes	Ag	130	200	3	4. 5	5. 5	10
Agency loam, eroded, 3 to 7 percent slopes	Ak	120	190	2. 8	4. 2	5	9
Agency loam, eroded, 20 to 35 percent slopes	An						
Agency loam, stony, 0 to 3 percent slopes	Ao						
Agency loam, stony, 3 to 7 percent slopes	Ap						
Agency loam, stony, 7 to 12 percent slopes	Ar						
Agency loam, stony, 12 to 20 percent slopes	As						
Agency loam, stony, 20 to 35 percent slopes	At						
Agency sandy loam, 0 to 3 percent slopes [3]	Au	125	195	2. 9	4. 3	5. 5	10
Agency sandy loam, 3 to 7 percent slopes [3]	Aw	115	185	2. 8	4. 2	5	9
Agency sandy loam, eroded, 0 to 3 percent slopes [3]	Av	110	170	2. 8	4. 2	5	9
Agency sandy loam, eroded, 3 to 7 percent slopes [3]	Ax	100	160	2. 6	4. 0	4	7
Deschutes coarse sandy loam, over sandy material, 0 to 3 percent slopes.	Da	100	170	2. 1	3. 0	3. 5	6
Deschutes loam, stony, 0 to 3 percent slopes	Db			2. 7	4. 0	5	8
Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent slopes.	Dc	80	135	2. 3	3. 2	4	7
Deschutes loamy coarse sand, over gravelly material, 3 to 7 percent slopes.	Dd	70	125	2. 2	3. 0	3. 5	6
Deschutes loamy sand, 0 to 3 percent slopes	De	90	150	2. 3	3. 2	4	7
Deschutes loamy sand, 3 to 7 percent slopes	Dg	80	135	2. 2	3. 0	3. 5	6
Deschutes loamy sand, 7 to 12 percent slopes	Dh	50	100	2. 0	2. 8	3	5
Deschutes loamy sand, eroded, 0 to 3 percent slopes	Df	85	150	2. 3	3. 2	4	7
Deschutes loamy sand, over cinders, 0 to 3 percent slopes	Dk	80	145	2. 1	3. 1	3. 5	6
Deschutes loamy sand, over cinders, 3 to 7 percent slopes	Dl	70	130	2. 0	2. 9	3	5
Deschutes loamy sand, over cinders, eroded, 3 to 7 percent slopes	Dm	60	125	1. 9	2. 9	3	5
Deschutes loamy sand, over cobbly material, 0 to 3 percent slopes	Dn	80	145	2. 1	3. 1	3. 5	6
Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes	Do	90	150	2. 5	3. 5	4. 5	8
Deschutes loamy sand, over gravelly material, 3 to 7 percent slopes	Dp	80	135	2. 3	3. 3	4	7
Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes.	Dr	90	150	2. 4	3. 4	4	7
Deschutes loamy sand, over semicemented sandy material, 3 to 7 percent slopes.	Ds	80	135	2. 2	3. 1	3. 5	6
Deschutes loamy sand, over semicemented sandy material, 7 to 12 percent slopes.	Dt	50	100	2. 0	2. 8	3	5
Deschutes sandy loam, 0 to 3 percent slopes	Du	115	185	2. 8	4. 0	5	9
Deschutes sandy loam, 3 to 7 percent slopes	Dv	100	170	2. 7	3. 7	4. 5	8
Deschutes sandy loam, 7 to 12 percent slopes	Dw	70	130	2. 3	3. 0	4	7
Deschutes sandy loam, 12 to 20 percent slopes	Dy						
Deschutes sandy loam, deep, 0 to 3 percent slopes	Dz	130	200	3. 5	4. 5	6	10
Deschutes sandy loam, deep, 3 to 7 percent slopes	Dea	110	180	3. 4	4. 3	5	8
Deschutes sandy loam, deep over cinders, 0 to 3 percent slopes	Deb	130	200	3. 5	4. 5	6	10
Deschutes sandy loam, eroded, 7 to 12 percent slopes	Dx	60	130	2. 2	3. 0	4	7
Deschutes sandy loam, over cinders, 0 to 3 percent slopes	Dec	110	185	2. 7	4. 0	4. 5	9
Deschutes sandy loam, over cinders, 3 to 7 percent slopes	Ded	90	170	2. 5	3. 7	4	8
Deschutes sandy loam, over cinders, eroded, 3 to 7 percent slopes	Del	80	170	2. 5	3. 7	4	8
Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes.	Deo	105	175	2. 8	4. 0	5	9
Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes.	Des	90	160	2. 7	3. 7	4. 5	8
Deschutes sandy loam, over semicemented sandy material, 7 to 12 percent slopes.	Dla	60	120	2. 3	3. 0	4	7
Deschutes sandy loam, over semicemented sandy material, eroded, 12 to 20 percent slopes.	Dlb						
Deschutes sandy loam, shallow, 0 to 3 percent slopes	Dlc	80	150	1	2. 0	3	5

See footnotes at end of table.

principal crops under two levels of management

a yield figure indicates the crop is not commonly grown on the soil and is not considered suitable for it under the management specified]

Irrigated												Nonirrigated			
Ladino clover seed		Hairy vetch seed		Barley		Oats		Spring wheat		Pasture		Winter wheat		Native range	
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
2. 3	4. 0	8	14	35	60	40	70	30	40	115	230	9. 5	11	3	6
2. 0	3. 8	7	13	30	50	35	60	25	35	105	210	9. 5	11	3	6
1. 7	3. 5	5	10	25	45	30	55	20	30	90	180	8	9	2. 5	5
1. 8	3. 5	5	11	25	45	30	55	20	30	90	180	9	10	2. 5	5
1. 5	3. 0	4	9	20	40	25	45	17	26	80	160	8	9	2	4
2. 5	4. 5	8	14	45	70	50	80	38	50	130	250	11	12	3. 5	7
2. 3	4. 2	7	13	42	65	47	75	35	46	120	230	11	12	3. 5	7
2. 0	4. 0	6	11	35	55	40	65	30	40	100	190	10	11	3	6
										80	140	9	10	2. 5	5
2. 3	4. 2	7	13	42	65	47	75	35	46	130	250	11	12	3. 5	7
2. 0	4. 0	6	12	37	60	40	65	30	40	110	220	10	11	3	6
														2	3. 5
										110	200			3	6
										100	190			3	6
										80	140			2. 5	5
										60	120			2	4
														2	3. 5
2. 5	4. 5	7	13	35	60	40	70	30	40	115	230	9. 5	11	3	6
2. 3	4. 2	6	12	30	50	35	60	25	35	105	210	9. 5	11	3	6
2. 3	4. 2	6	12	30	50	35	60	25	35	115	230	9. 5	11	3	6
2. 0	4. 0	5	11	25	45	30	55	20	30	90	180	9	10	2. 5	5
1. 7	3. 0	5	9	30	55	35	65	25	35	85	170			2	3. 5
		8	14	40	65	45	75	28	38	120	230			3	6
1. 6	2. 8	5	9	26	48	32	60	23	30	90	180			2	3. 5
1. 4	2. 5	4	7	23	40	26	55	19	26	80	160			2	3. 5
1. 7	3. 0	5	9	27	50	35	60	23	30	90	180			2	3. 5
1. 5	2. 6	4	7	24	42	30	55	19	26	80	160			2	3. 5
1. 3	2. 3	3	6	20	35	25	45	16	23	60	120			2	3. 5
1. 7	3. 0	5	9	24	50	30	60	20	30	90	180			2	3. 5
1. 6	2. 8	5	9	27	50	35	60	23	30	80	170			2	3. 5
1. 4	2. 5	4	7	23	40	30	55	18	25	70	150			2	3. 5
1. 3	2. 5	4	7	20	40	25	50	16	25	60	150			2	3. 5
1. 6	2. 8	5	9	27	50	35	60	23	30	80	170			2	3. 5
1. 7	3. 0	5	9	27	50	35	60	23	30	90	180			2	3. 5
1. 5	2. 6	4	7	24	42	30	55	19	26	80	160			2	3. 5
1. 7	3. 0	5	9	27	50	35	60	23	30	90	180			2	3. 5
1. 5	2. 6	4	7	24	42	30	55	19	26	80	160			2	3. 5
1. 3	2. 3	3	6	20	35	25	45	16	23	60	120			2	3. 5
1. 9	3. 3	7	13	35	60	40	70	28	38	110	225			2	3. 5
1. 8	3. 0	6	11	30	50	35	60	23	30	95	200			2	3. 5
1. 5	2. 7	5	9	25	45	30	55	18	27	75	150			2	3. 5
										50	100			2	3. 5
2. 1	3. 5	8	14	37	62	42	72	30	40	125	250			2. 5	4
1. 9	3. 1	7	12	32	52	37	62	24	32	110	215			2	3. 5
2. 1	3. 5	8	14	37	62	42	72	30	40	125	250			2. 5	4
1. 4	2. 6	5	9	21	40	25	45	15	24	70	150			2	3. 5
1. 7	3. 3	6	13	32	60	37	70	25	38	100	225			2	3. 5
1. 5	3. 0	5	11	27	50	32	60	20	30	85	200			2	3. 5
1. 5	3. 0	5	11	24	45	30	55	18	27	80	200			2	3. 5
1. 9	3. 3	7	13	35	60	40	70	28	38	110	225			2	3. 5
1. 8	3. 0	6	11	30	50	35	60	23	30	95	200			2	3. 5
1. 5	2. 7	5	9	25	45	30	55	18	27	75	150			2	3. 5
										50	100			2	3. 5
1	2	4	7	20	35	25	40	15	25	60	130			1	2
				15	30	20	35	12	20	40	100			1	2

TABLE 3.—*Estimated average acre yields of principal*

Soil or land type	Map symbol	Irrigated					
		Potatoes		Alfalfa		Alsike clover seed	
		A	B	A	B	A	B
		100-lb. bags	*100-lb. bags*	*Tons*	*Tons*	*Bu.*	*Bu.*
Deschutes sandy loam, shallow, 3 to 7 percent slopes	Dle	60	120				
Deschutes sandy loam, shallow over cinders, 0 to 3 percent slopes	Dlo	70	140	0.8	1.8	2.5	4
Deschutes sandy loam, shallow over cinders, eroded, 3 to 7 percent slopes.	Dls	40	100				
Deschutes sandy loam, stony, 0 to 3 percent slopes	Dsa	90	160	2.5	3.5	4.5	8
Deschutes sandy loam, stony, 3 to 7 percent slopes	Dsb	75	140	2.3	3.3	4	7
Deschutes sandy loam, stony, 7 to 12 percent slopes	Dsc			2.0	2.9	3.5	6
Deschutes sandy loam, stony, over cinders, 3 to 7 percent slopes	Dsd	70	135	2.1	3.1	3.5	6
Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes.	Dse	80	150	2.5	3.5	4.5	8
Deschutes sandy loam, stony, over semicemented sandy material, 3 to 7 percent slopes.	Dsl	65	120	2.3	3.3	4	7
Deschutes sandy loam, stony, over semicemented sandy material, 7 to 12 percent slopes.	Dso			2.0	2.9	3.5	6
Era sandy loam, 0 to 3 percent slopes [3]	Ea	135	205	2.9	4.3	5.5	10
Era sandy loam, 3 to 7 percent slopes [3]	Ec	120	190	2.8	4.2	5	9
Era sandy loam, 7 to 12 percent slopes [3]	Ee	100	160	2.3	3.5	4.5	8
Era sandy loam, 12 to 20 percent slopes [3]	Eg						
Era sandy loam, eroded, 0 to 3 percent slopes [3]	Eb	125	190	2.8	4.2	5	9
Era sandy loam, eroded, 3 to 7 percent slopes [3]	Ed	110	175	2.6	4.0	4.5	8
Era sandy loam, eroded, 7 to 12 percent slopes [3]	Ef	90	150	2.3	3.3	4	7
Era sandy loam, eroded, 12 to 20 percent slopes [3]	Eh						
Gem clay loam, eroded, 3 to 12 percent slopes	Ga						
Gem clay loam, eroded, 12 to 20 percent slopes	Gb						
Gem clay loam, shallow, 7 to 12 percent slopes	Gc						
Gem clay loam, shallow, eroded, 7 to 12 percent slopes	Gd						
Gem loam, 3 to 7 percent slopes	Ge						
Gem loam, 7 to 12 percent slopes	Go						
Gem loam, eroded, 7 to 12 percent slopes	Gs						
Laidlaw sandy loam, 0 to 3 percent slopes	La	95	160	2.5	3.7	5	9
Laidlaw sandy loam, 3 to 7 percent slopes	Lb	80	140	2.4	3.5	4.5	8
Laidlaw sandy loam, 7 to 12 percent slopes	Lc	50	100	2.0	3.0	4	7
Laidlaw sandy loam, eroded, 7 to 12 percent slopes	Ld	40	95	2.0	3.0	3.5	7
Laidlaw sandy loam, eroded, 12 to 20 percent slopes	Le						
Lamonta loam, 0 to 3 percent slopes [3]	Lf	75	120	2.5	3.5	5	9
Lamonta loam, 3 to 7 percent slopes [3]	Lh	60	100	2.4	3.4	4.5	8
Lamonta loam, 7 to 12 percent slopes [3]	Lm	40	75	2.0	3.0	4	7
Lamonta loam, 12 to 20 percent slopes [3]	Lo						
Lamonta loam, eroded, 0 to 3 percent slopes [3]	Lg	60	100	2.4	3.4	4.5	9
Lamonta loam, eroded, 3 to 7 percent slopes [3]	Lk	50	85	2.3	3.3	4	8
Lamonta loam, eroded, 7 to 12 percent slopes [3]	Ln			1.8	2.8	3.5	6
Lamonta loam, eroded, 12 to 20 percent slopes [3]	Lp						
Lamonta loam, shallow, 0 to 3 percent slopes [3]	Lr	50	85				
Lamonta loam, shallow, 3 to 7 percent slopes [3]	Ls						
Lamonta loam, shallow, eroded, 3 to 7 percent slopes [3]	Lt						
Lamonta loam, shallow, eroded, 7 to 12 percent slopes [3]	Lu						
Lamonta loam, stony, 0 to 3 percent slopes [3]	Lv						
Lamonta loam, stony, 3 to 7 percent slopes [3]	Lw						
Lamonta loam, stony, 7 to 12 percent slopes [3]	Lx						
Lamonta sandy clay loam, 0 to 3 percent slopes	Ly			2.5	3.5	5	9
Lamonta sandy clay loam, 3 to 7 percent slopes	Lea			2.4	3.4	4.5	8
Lamonta sandy clay loam, 7 to 12 percent slopes	Led			2.0	3.0	4	7
Lamonta sandy clay loam, eroded, 0 to 3 percent slopes	Lz			2.4	3.4	4.5	9
Lamonta sandy clay loam, eroded, 3 to 7 percent slopes	Lec			2.3	3.3	4	8
Lamonta sandy clay loam, eroded, 7 to 12 percent slopes	Leh			1.8	2.8	3.5	6
Lamonta sandy clay loam, eroded, 12 to 20 percent slopes	Ler						
Lamonta sandy clay loam, shallow, 0 to 3 percent slopes	Lev						
Lamonta sandy clay loam, shallow, 3 to 7 percent slopes	Lsa						
Lamonta sandy clay loam, shallow, eroded, 3 to 7 percent slopes	Lsb						
Lamonta sandy clay loam, shallow, eroded, 7 to 12 percent slopes	Lsc						
Lamonta sandy clay loam, stony, 0 to 3 percent slopes	Lsd						
Lamonta sandy clay loam, stony, 3 to 7 percent slopes	Lse						
Lamonta sandy clay loam, stony, 7 to 12 percent slopes	Lsl						
Lamonta sandy clay loam, stony, 12 to 20 percent slopes	Lso						
Madras loam, 0 to 3 percent slopes [3]	Ma	120	190	3	4.5	6	11
Madras loam, 3 to 7 percent slopes [3]	Mc	110	175	3	4.5	5.5	10

See footnotes at end of table.

crops under two levels of management—Continued

Irrigated												Nonirrigated			
Ladino clover seed		Hairy vetch seed		Barley		Oats		Spring wheat		Pasture		Winter wheat		Native range	
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
0. 8	1. 8	3	6	18	32	22	36	12	22	50	110	-------	-------	1	2
-------	-------	-------	-------	12	25	17	30	10	18	30	80	-------	-------	1	2
1. 8	3. 0	6	11	30	50	35	60	23	30	100	220	-------	-------	2	3. 5
1. 7	2. 8	5	9	25	40	30	50	18	25	85	190	-------	-------	2	3. 5
1. 4	2. 6	4	8	20	30	25	43	15	20	70	140	-------	-------	2	3. 5
1. 5	2. 6	4	8	22	35	27	45	15	22	75	170	-------	-------	2	3. 5
1. 8	3. 0	6	11	30	50	35	60	23	30	100	220	-------	-------	2	3. 5
1. 7	2. 8	5	9	25	40	30	50	18	25	85	190	-------	-------	2	3. 5
1. 4	2. 6	4	8	20	30	25	43	15	20	70	140	-------	-------	2	3. 5
2. 5	4. 5	8	14	35	60	40	70	30	40	115	230	9. 5	11	3	6
2. 3	4. 2	7	13	30	50	35	60	25	35	105	210	9. 5	11	3	6
2. 0	4. 0	6	11	25	45	30	55	20	30	90	170	8. 5	10	3	6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	80	130	7. 5	9	2. 5	5
2. 3	4. 2	7	13	30	50	35	60	25	35	115	230	9	11	3	6
2. 0	4. 0	6	11	25	45	30	55	20	30	90	180	9	11	3	6
1. 7	3. 5	5	9	22	42	27	50	17	26	80	160	8	10	2. 5	5
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	65	120	7	8	2. 5	5
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	15	17	5	7
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	12	15	4	6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	10	12	4	6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	9	11	3	5
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	16	18	6	8
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	15	17	5	7
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	14	16	5	7
1. 9	3. 3	7	13	35	60	40	70	27	37	100	210	-------	-------	2	3. 5
1. 8	3. 0	6	11	30	50	35	60	23	30	90	190	-------	-------	2	3. 5
1. 5	2. 7	5	9	25	45	30	55	18	27	70	140	-------	-------	2	3. 5
1. 4	2. 7	4	8	22	43	28	52	16	25	65	130	-------	-------	2	3. 5
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	45	90	-------	-------	1. 5	2. 5
2. 3	4. 0	8	14	45	70	50	80	38	50	130	250	[4] 11	[4] 12	[4] 3. 5	[4] 7
2. 2	3. 8	7	13	42	65	47	75	35	46	120	230	[4] 11	[4] 12	[4] 3. 5	[4] 7
1. 7	3. 0	5	10	35	55	40	65	30	40	100	190	[4] 10	[4] 11	[4] 3	[4] 6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	80	140	[4] 9	[4] 10	[4] 2. 5	[4] 5
2. 2	3. 8	7	13	42	65	47	75	35	46	130	250	[4] 11	[4] 12	[4] 3. 5	[4] 7
2. 1	3. 6	6	11	37	60	40	65	30	40	110	220	[4] 10	[4] 11	[4] 3	[4] 6
1. 5	2. 8	4	7	30	50	35	55	25	35	90	170	[4] 9	[4] 10	[4] 3	[4] 6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	70	120	[4] 8	[4] 9	[4] 2. 5	[4] 5
1. 5	2. 5	6	10	30	45	35	50	20	30	110	200	7	8	3	6
1. 3	2. 0	5	9	25	40	30	40	17	22	100	180	6	7	3	6
1. 1	1. 8	4	7	20	35	25	35	15	20	90	160	6	7	3	6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	70	150	5	6	2. 5	5
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	120	220	-------	-------	3. 5	7
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	110	200	-------	-------	3. 5	7
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	100	180	-------	-------	3	6
2. 3	4. 0	8	14	45	70	50	80	38	50	130	250	[4] 11	[4] 12	[4] 3. 5	[4] 7
2. 2	3. 8	7	13	42	65	47	75	35	46	120	230	[4] 11	[4] 12	[4] 3. 5	[4] 7
1. 7	3. 0	5	10	35	55	40	65	30	40	100	190	[4] 10	[4] 11	[4] 3	[4] 6
2. 2	3. 8	7	13	42	65	47	75	35	46	130	250	[4] 11	[4] 12	[4] 3. 5	[4] 7
2. 1	3. 6	6	11	37	60	40	65	30	40	110	220	[4] 10	[4] 11	[4] 3	[4] 6
1. 5	2. 8	4	7	30	50	35	55	25	35	90	170	[4] 9	[4] 10	[4] 3	[4] 6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	70	120	[4] 8	[4] 9	[4] 2. 5	[4] 5
1. 5	2. 5	6	10	30	45	35	50	20	30	110	200	7	8	3	6
1. 3	2. 0	5	9	25	40	30	40	17	22	100	180	6	7	3	6
1. 1	1. 8	4	7	20	35	25	35	15	20	90	160	6	7	3	6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	70	150	5	6	2. 5	5
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	120	220	-------	-------	3. 5	7
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	110	200	-------	-------	3. 5	7
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	100	180	-------	-------	3	6
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	70	120	-------	-------	2. 5	5
2. 5	4. 5	8	14	45	70	50	80	38	50	130	250	11	12	3. 5	7
2. 3	4. 2	7	13	42	65	47	75	35	46	120	230	11	12	3. 5	7

TABLE 3.—*Estimated average acre yields of principal*

Soil or land type	Map symbol	Irrigated					
		Potatoes		Alfalfa		Alsike clover seed	
		A	B	A	B	A	B
		100-lb. bags	*100-lb. bags*	*Tons*	*Tons*	*Bu.*	*Bu.*
Madras loam, 7 to 12 percent slopes [3]	Me	90	150	2. 5	3. 5	5	9
Madras loam, eroded, 0 to 3 percent slopes [3]	Mb	110	180	3	4. 5	5. 5	10
Madras loam, eroded, 3 to 7 percent slopes [3]	Md	100	170	2. 8	4. 2	5	9
Madras loam, eroded, 7 to 12 percent slopes [3]	Mf	80	140	2. 3	3. 5	4. 5	8
Madras loam, over sandstone, 0 to 3 percent slopes [3]	Mg	140	210	3. 2	4. 7	6. 5	12
Madras loam, over sandstone, 3 to 7 percent slopes [3]	Mk	130	200	3. 2	4. 7	6	11
Madras loam, over sandstone, eroded, 0 to 3 percent slopes [3]	Mh	130	200	3. 2	4. 7	6	11
Madras loam, over sandstone, eroded, 3 to 7 percent slopes [3]	Ml	120	190	3. 1	4. 6	5. 5	10
Madras loam, stony, 0 to 3 percent slopes [3]	Mm						
Madras loam, stony, 3 to 7 percent slopes [3]	Mn						
Madras loam, stony, 7 to 12 percent slopes [3]	Mo						
Madras loamy sand, over sandstone, 3 to 7 percent slopes [3]	Mp	100	160	2. 5	3. 8	4. 5	8
Madras loamy sand, over sandstone, eroded, 3 to 7 percent slopes [3]	Mr	90	150	2. 4	3. 7	4	8
Madras sandy loam, 0 to 3 percent slopes [3]	Ms	120	190	2. 8	4. 2	5	9
Madras sandy loam, 3 to 7 percent slopes [3]	Mu	110	175	2. 7	4. 1	4. 5	8
Madras sandy loam, 7 to 12 percent slopes [3]	My	90	150	2. 3	3. 8	4	7
Madras sandy loam, deep over sandstone, 0 to 3 percent slopes [3]	Mea	140	210	3. 5	5. 0	6. 5	12
Madras sandy loam, deep over sandstone, 3 to 7 percent slopes [3]	Meb	130	200	3. 5	5. 0	6	11
Madras sandy loam, deep over sandstone, eroded, 3 to 7 percent slopes [3].	Mec	120	190	3. 3	5. 0	5. 5	11
Madras sandy loam, eroded, 0 to 3 percent slopes [3]	Mt	110	180	2. 7	4. 2	4. 5	9
Madras sandy loam, eroded, 3 to 7 percent slopes [3]	Mv	100	170	2. 6	4. 1	4	7
Madras sandy loam, eroded, 7 to 12 percent slopes [3]	Mz	80	140	2. 3	3. 8	3. 5	6
Madras sandy loam, over sandstone, 0 to 3 percent slopes [3]	Med	140	210	3. 0	4. 5	5. 5	10
Madras sandy loam, over sandstone, 3 to 7 percent slopes [3]	Meh	130	200	2. 9	4. 3	5	9
Madras sandy loam, over sandstone, 7 to 12 percent slopes [3]	Meo	110	175	2. 5	4. 0	4. 5	8
Madras sandy loam, over sandstone, 12 to 20 percent slopes [3]	Mla						
Madras sandy loam, over sandstone, eroded, 0 to 3 percent slopes [3]	Mef	130	200	3. 0	4. 5	5	10
Madras sandy loam, over sandstone, eroded, 3 to 7 percent slopes [3]	Mel	120	190	2. 9	4. 3	4. 5	9
Madras sandy loam, over sandstone, eroded, 7 to 12 percent slopes [3]	Mes	90	150	2. 5	4. 0	4	7
Madras sandy loam, over sandstone, eroded, 12 to 20 percent slopes [3]	Mlc						
Madras sandy loam, shallow over sandstone, 0 to 3 percent slopes [3]	Mld	80	150	1. 5	2. 5	3	5
Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes [3]	Mle	60	110	1. 5	2. 5	2. 5	4
Madras sandy loam, shallow over sandstone, 12 to 20 percent slopes [3]	Moc						
Madras sandy loam, shallow over sandstone, eroded, 3 to 7 percent slopes [3].	Mlo	50	100	1. 5	2. 5	2. 5	4
Madras sandy loam, shallow over sandstone, eroded, 7 to 12 percent slopes [3].	Mls						
Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes [3]	Mod						
Madras sandy loam, stony, over sandstone, 3 to 7 percent slopes [3]	Moe						
Madras sandy loam, stony, over sandstone, 7 to 12 percent slopes [3]	Mol						
Madras sandy loam, stony, over sandstone, 12 to 20 percent slopes [3]	Mos						
Metolius sandy loam, 0 to 3 percent slopes [3]	Mta	140	210	4. 0	5. 5	7	13
Metolius sandy loam, 3 to 7 percent slopes [3]	Mtd	130	200	3. 9	5. 0	6. 5	12
Metolius sandy loam, 7 to 12 percent slopes [3]	Mts	100	160	3. 5	4. 5	5. 5	10
Metolius sandy loam, eroded, 0 to 3 percent slopes [3]	Mtc	130	195	4. 0	5. 5	7	13
Metolius sandy loam, eroded, 3 to 7 percent slopes [3]	Mte	115	185	3. 6	5. 0	5. 5	11
Metolius sandy loam, terrace position, 0 to 3 percent slopes [3]	Mtl	140	210	3. 5	4. 5	6	10
Metolius sandy loam, terrace position, 3 to 7 percent slopes [3]	Mto	130	200	3. 4	4. 4	5. 5	11
Odin clay loam, 0 to 3 percent slopes	Oa					4	7
Odin clay loam, 3 to 7 percent slopes [3]	Ob					4	7
Odin sandy loam, 0 to 3 percent slopes	Oc	115	185			4	7
Redmond clay loam, 0 to 3 percent slopes	Ra			2. 5	3. 5	5	9
Redmond loam, 0 to 3 percent slopes	Rb	135	200	2. 7	3. 8	5	9
Redmond sandy loam, 0 to 3 percent slopes	Rc	125	195	2. 7	3. 8	5	9
Redmond sandy loam, 3 to 7 percent slopes	Rd	110	180	2. 8	4. 2	4. 5	8
Redmond sandy loam, deep, 0 to 3 percent slopes	Re	125	195	2. 9	4. 3	5. 5	10
Riverwash	Rk						
Rough broken land, Era and Deschutes soil materials, 12 to 50 percent slopes.	Ro						
Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes.	Rs						
Scabland, 0 to 3 percent slopes	Sa						
Scabland, 3 to 12 percent slopes	Sb						
Volcanic ash, 0 to 3 percent slopes [3]	Vo	60	100	2. 0	3. 0	3	5

[1] Ordinary management is the level of management practiced by most farmers in the Area. Improved management is the type of management practiced by those farmers who consistently obtain high yields.

[2] "Cow-acre-days" is a term used to express the carrying capacity of pasture or range. It equals the number of days of grazing 1 acre will provide for 1 animal unit in a year, without injury to the sod. One animal unit is a mature cow, steer, or horse, or five mature sheep.

crops under two levels of management—Continued

Irrigated												Nonirrigated			
Ladino clover seed		Hairy vetch seed		Barley		Oats		Spring wheat		Pasture		Winter wheat		Native range	
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
2. 0	4. 0	6	11	35	55	40	65	30	40	100	190	10	11	3	6
2. 3	4. 2	7	13	42	65	47	75	35	46	130	250	11	12	3. 5	7
2. 0	4. 0	6	12	37	60	40	65	30	40	110	220	10	11	3	6
1. 8	3. 7	5	10	30	50	35	60	25	35	90	180	9	10	3	6
2. 5	4. 5	8	14	45	70	50	80	38	50	130	250	11	12	3. 5	7
2. 3	4. 2	7	13	42	65	47	75	35	46	120	230	11	12	3. 5	7
2. 3	4. 2	7	13	42	65	47	75	35	46	130	250	11	12	3. 5	7
2. 0	4. 0	6	12	37	60	40	65	30	40	110	220	10	11	3	6
										110	200			3	6
										100	190			3	6
										80	140			2. 5	5
2. 0	3. 8	6	11	27	46	32	55	22	30	95	190	7	8	3	6
1. 9	3. 7	5	11	24	45	30	55	20	30	90	190	7	8	2. 5	5
2. 5	4. 5	7	13	35	60	40	70	30	40	115	230	10	11	3	6
2. 3	4. 2	6	12	30	50	35	60	25	35	105	210	10	11	3	6
2. 0	4. 0	5	10	25	42	30	50	20	30	90	180	9	10	2. 5	5
2. 5	4. 5	7	13	37	62	42	72	30	40	125	250	10	11	3	6
2. 3	4. 2	6	12	32	52	37	62	25	35	115	220	10	11	3	6
2. 1	4. 2	5	11	25	45	30	55	20	30	100	200	10	11	3	6
2. 3	4. 2	6	12	30	50	35	60	25	35	110	230	10	11	3	6
2. 0	4. 0	5	11	25	45	30	55	20	30	90	180	9	10	2. 5	5
1. 8	3. 7	4	8	20	38	25	45	15	25	80	160	9	10	2. 5	5
2. 5	4. 5	7	13	35	60	40	70	30	40	120	230	10	11	3	6
2. 3	4. 2	6	12	30	50	35	60	25	35	105	210	10	11	3	6
2. 0	4. 0	5	10	25	42	30	50	20	30	90	180	9	10	2. 5	5
										70	140	8	9	2. 5	5
2. 3	4. 2	6	12	30	55	35	65	25	35	110	220	10	11	3	6
2. 0	4. 0	5	10	25	45	30	50	20	30	100	200	10	11	3	6
1. 8	3. 7	4	8	20	38	25	45	15	25	90	180	9	10	2. 5	5
										60	130	8	9	2. 5	5
1. 0	2. 0	4	7	20	35	25	40	15	25	70	140	6	7	2	4
1. 0	2. 0	3	6	17	30	23	35	12	20	60	120	6	7	2	4
										40	80	4	5	1. 5	3
1. 0	2. 0	3	6	15	28	21	32	10	18	50	120	6	7	2	4
										40	100	5	6	2	4
										100	200			3	6
										90	180			3	6
										70	150			2. 5	5
														2. 5	5
2. 5	4. 5	8	14	37	62	42	72	30	40	125	250	9	10	3	6
2. 3	4. 2	7	12	32	52	37	62	25	35	110	215	9	10	3	6
2. 0	4. 0	6	11	25	45	30	55	20	30	90	170	8	9	3	6
2. 4	4. 4	8	14	35	60	40	70	28	38	120	240	9	10	3	6
2. 0	4. 0	6	11	25	45	30	55	20	30	90	190	8	9	3	6
2. 4	4. 4	8	14	37	62	42	72	30	40	125	250	9	10	3	6
2. 3	4. 2	7	12	32	52	37	62	25	35	110	215	9	10	3	6
1. 8	3. 0	6	12	30	55	40	70	25	35	150	260	10	11	6	10
1. 8	3. 0	6	12	30	55	40	70	25	35	120	230	10	11	6	10
1. 8	3. 0	6	12	30	55	40	70	25	35	140	250	9	10	6	10
2. 0	3. 5	8	14	45	70	50	80	38	50	130	250	10	11	4	7
2. 0	3. 5	8	14	40	65	45	75	33	43	125	240	9	10	3. 5	7
2. 0	3. 5	7	13	35	60	40	70	28	38	120	230	8	9	3	6
1. 8	3. 2	6	11	30	50	35	60	23	30	105	210	8	9	3	6
2. 0	3. 5	7	13	35	60	40	70	28	38	125	240	9	10	3	6
														2	3. 5
														2	3. 5
										30	50			1	2
														1	2
1. 1	2. 0	3	6	15	25	20	35	12	20	60	120			2	3. 5

In the Deschutes Area, the grazing season is considered to be 150 days for irrigated pasture and 135 days for range.

[3] This soil will be irrigated when the facilities of the Deschutes Irrigation Project are finished.

[4] Slightly higher yields are obtained in the areas near Haystack Butte.

The Capability Classification

The capability classification is a means of showing the relative suitability of different soils for agricultural uses. The classification of a particular soil depends on the variety of uses to which it is suited, its susceptibility to erosion or other damage when it is used, and the kind of management it needs to protect it from erosion and to maintain its productivity.

Capability classes.—Eight general capability classes are recognized. In classes I, II, and III are soils that are suitable for annual or periodic cultivation. Class I soils are those that have the widest range of use and the least risk of damage. They are level or nearly level, productive, well drained, and easy to work. They can be cultivated continuously with practically no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping and consequently need moderate care to prevent erosion; others may be slightly droughty or slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use and need still more careful management.

In class IV are soils that should be cultivated only occasionally or only under very careful management.

In classes V, VI, and VII are soils that should not be cultivated but that can be used for pasture, for range, or for forest. Class V soils are level but are droughty, wet, low in fertility, or otherwise unsuitable for cultivation. None of the soils in the Deschutes Area are in class V.

Class VI soils are not suitable for crops because they are steep or droughty or otherwise limited, but they give fair yields of forage or forest products. Some soils in class VI can, without damage, be cultivated enough so that fruit trees or forest trees can be set out or pasture plants seeded.

Class VII soils provide only poor to fair yields of forage or forest products.

In class VIII are soils that have practically no agricultural use. They produce little useful vegetation, but they may constitute attractive scenery; they may form parts of watersheds; or they may provide shelter for wildlife. Some areas have been developed as recreational sites. Mountains, deserts, and sand dunes are examples of class VIII land.

Capability subclasses.—The soils in any one capability class are limited to the same degree, but they may be limited for different reasons. To show the main kind of limiting factor, any one of classes II through VIII may be divided into subclasses, each identified by a letter following the capability class number. The letter "e" indicates that the risk of erosion is what limits the uses of the soil the letter "w" is used if the soil is too wet for general use. the letter "s" shows that the soil is shallow, droughty, or unusually low in fertility; and the letter "c" is used to indicate that the climate is so hazardous that it limits the uses of the soil.

Capability Classes and Subclasses in the Deschutes Area

In the following outline, the capability classes and subclasses in the Deschutes Area are defined. For each subclass, a brief description of the general nature of the dominant soils is given.

Class I.—Deep, nearly level, productive soils, suitable for intensive cultivation without special practices other than those normally used in the Area for good farming.

Class II.—Soils suitable for tilled crops, pasture, and trees. These soils have moderate limitations if used for tilled crops.

- Subclass IIs: Level and nearly level loamy soils that have slightly limited moisture-supplying capacity. Some are eroded.
- Subclass IIw: Level and nearly level clay loam and sandy loam soils that are too wet during a part of each growing season.

Class III.—Soils suitable for tilled crops, pasture, and trees. These soils have moderately severe limitations if used for tilled crops.

- Subclass IIIe: Gently sloping soils subject to erosion.
- Subclass IIIs: Nearly level, sandy or stony, droughty soils.

Class IV.—Soils suitable for grass and trees. These soils are severely limited if used for tilled crops.

- Subclass IVe: Moderately sloping and gently sloping soils subject to erosion.
- Subclass IVs: Loamy and sandy, shallow, droughty soils.

Class VI.—Soils suitable for pasture or trees. These soils ordinarily are not suitable for tilled crops because they are steep, wet, shallow, or otherwise limited.

- Subclass VIe: Strongly sloping and moderately sloping soils that are extremely erodible if tilled.

Class VII.—Soils not suitable for cultivation and of severely limited use for pasture or as woodland.

- Subclass VIIe: Scabland and strongly sloping to steep Rough broken land and Rough stony land.

Class VIII.—Soils not suitable for growing vegetation for commercial use.

The capability class and subclass for each soil in the Deschutes Area are given in the following list:

	Capability class and subclass
Agency gravelly loam, 0 to 3 percent slopes (Aa)	IIs
Agency gravelly loam, 3 to 7 percent slopes (Ab)	IIIe
Agency gravelly loam, 7 to 12 percent slopes (Ad)	IVe
Agency gravelly loam, eroded, 3 to 7 percent slopes (Ac)	IIIe
Agency gravelly loam, eroded, 7 to 12 percent slopes (Ae)	IVe
Agency loam, 0 to 3 percent slopes (Af)	IIs
Agency loam, 3 to 7 percent slopes (Ah)	IIIe
Agency loam, 7 to 12 percent slopes (Al)	IVe
Agency loam, 12 to 20 percent slopes (Am)	VIe
Agency loam, eroded, 0 to 3 percent slopes (Ag)	IIs
Agency loam, eroded, 3 to 7 percent slopes (Ak)	IIIe
Agency loam, eroded, 20 to 35 percent slopes (An)	VIe
Agency loam, stony, 0 to 3 percent slopes (Ao)	VIs
Agency loam, stony, 3 to 7 percent slopes (Ap)	VIs
Agency loam, stony, 7 to 12 percent slopes (Ar)	VIs
Agency loam, stony, 12 to 20 percent slopes (As)	VIe
Agency loam, stony, 20 to 35 percent slopes (At)	VIe

	Capability class and subclass
Agency sandy loam, 0 to 3 percent slopes (Au)	IIs
Agency sandy loam, 3 to 7 percent slopes (Aw)	IIIe
Agency sandy loam, eroded, 0 to 3 percent slopes (Av)	IIs
Agency sandy loam, eroded, 3 to 7 percent slopes (Ax)	IIIe
Deschutes coarse sandy loam, over sandy material, 0 to 3 percent slopes (Da)	IVs
Deschutes loam, stony, 0 to 3 percent slopes (Db)	IIIs
Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent slopes (Dc)	IIs
Deschutes loamy coarse sand, over gravelly material, 3 to 7 percent slopes (Dd)	IIIe
Deschutes loamy sand, 0 to 3 percent slopes (De)	IIIs
Deschutes loamy sand, 3 to 7 percent slopes (Dg)	IVe
Deschutes loamy sand, 7 to 12 percent slopes (Dh)	VIe
Deschutes loamy sand, eroded, 0 to 3 percent slopes (Df)	IIIs
Deschutes loamy sand, over cinders, 0 to 3 percent slopes (Dk)	IIIs
Deschutes loamy sand, over cinders, 3 to 7 percent slopes (Dl)	IVe
Deschutes loamy sand, over cinders, eroded, 3 to 7 percent slopes (Dm)	IVe
Deschutes loamy sand, over cobbly material, 0 to 3 percent slopes (Dn)	IVs
Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes (Do)	IIs
Deschutes loamy sand, over gravelly material, 3 to 7 percent slopes (Dp)	IIIe
Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes (Dr)	IIIs
Deschutes loamy sand, over semicemented sandy material, 3 to 7 percent slopes (Ds)	IVe
Deschutes loamy sand, over semicemented sandy material, 7 to 12 percent slopes (Dt)	VIe
Deschutes sandy loam, 0 to 3 percent slopes (Du)	IIs
Deschutes sandy loam, 3 to 7 percent slopes (Dv)	IIIe
Deschutes sandy loam, 7 to 12 percent slopes (Dw)	IVe
Deschutes sandy loam, 12 to 20 percent slopes (Dy)	VIe
Deschutes sandy loam, deep, 0 to 3 percent slopes (Dz)	I
Deschutes sandy loam, deep, 3 to 7 percent slopes (Dea)	IIIe
Deschutes sandy loam, deep over cinders, 0 to 3 percent clopes (Deb)	IIs
Deschutes sandy loam, eroded, 7 to 12 percent slopes (Dx)	IVe
Deschutes sandy loam, over cinders, 0 to 3 percent slopes (Dec)	IIs
Deschutes sandy loam, over cinders, 3 to 7 percent slopes (Ded)	IIIe
Deschutes sandy loam, over cinders, eroded, 3 to 7 percent slopes (Del)	IIIe
Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes (Deo)	IIs
Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes (Des)	IIIe
Deschutes sandy loam, over semicemented sandy material, 7 to 12 percent slopes (Dla)	IVe
Deschutes sandy loam, over semicemented sandy material, eroded, 12 to 20 percent slopes (Dlb)	VIe
Deschutes sandy loam, shallow, 0 to 3 percent slopes (Dlc)	IVs
Deschutes sandy loam, shallow, 3 to 7 percent slopes (Dle)	IVe
Deschutes sandy loam, shallow over cinders, 0 to 3 percent slopes (Dlo)	IVs
Deschutes sandy loam, shallow over cinders, eroded, 3 to 7 percent slopes (Dls)	IVe
Deschutes sandy loam, stony, 0 to 3 percent slopes (Dsa)	IIIs
Deschutes sandy loam, stony, 3 to 7 percent slopes (Dsb)	IIIe
Deschutes sandy loam, stony, 7 to 12 percent slopes (Dsc)	IVe
Deschutes sandy loam, stony, over cinders, 3 to 7 percent slopes (Dsd)	IIIe
Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes (Dse)	IIIs
Deschutes sandy loam, stony, over semicemented sandy material, 3 to 7 percent slopes (Dsl)	IIIe
Deschutes sandy loam, stony, over semicemented sandy material, 7 to 12 percent slopes (Dso)	IVe
Era sandy loam, 0 to 3 percent slopes (Ea)	IIs
Era sandy loam, 3 to 7 percent slopes (Ec)	IIIe
Era sandy loam, 7 to 12 percent slopes (Ee)	IVe
Era sandy loam, 12 to 20 percent slopes (Eg)	VIe
Era sandy loam, eroded, 0 to 3 percent slopes (Eb)	IIs
Era sandy loam, eroded, 3 to 7 percent slopes (Ed)	IIIe
Era sandy loam, eroded, 7 to 12 percent slopes (Ef)	IVe
Era sandy loam, eroded, 12 to 20 percent slopes (Eh)	VIe
Gem clay loam, eroded, 3 to 12 percent slopes (Ga)	IIIe or IVe[4]
Gem clay loam, eroded, 12 to 20 percent slopes (Gb)	VIe
Gem clay loam, shallow, 7 to 12 percent slopes (Gc)	IVe
Gem clay loam, shallow, eroded, 7 to 12 percent slopes (Gd)	IVe
Gem loam, 3 to 7 percent slopes (Ge)	IIIe
Gem loam, 7 to 12 percent slopes (Go)	IVe
Gem loam, eroded, 7 to 12 percent slopes (Gs)	IVe
Laidlaw sandy loam, 0 to 3 percent slopes (La)	IIIs
Laidlaw sandy loam, 3 to 7 percent slopes (Lb)	IVe
Laidlaw sandy loam, 7 to 12 percent slopes (Lc)	VIe
Laidlaw sandy loam, eroded, 7 to 12 percent slopes (Ld)	VIe
Laidlaw sandy loam, eroded, 12 to 20 percent slopes (Le)	VIe
Lamonta loam, 0 to 3 percent slopes (Lf)	IIs
Lamonta loam, 3 to 7 percent slopes (Lh)	IIIe
Lamonta loam, 7 to 12 percent slopes (Lm)	IVe
Lamonta loam, 12 to 20 percent slopes (Lo)	VIe
Lamonta loam, eroded, 0 to 3 percent slopes (Lg)	IIs
Lamonta loam, eroded, 3 to 7 percent slopes (Lk)	IIIe
Lamonta loam, eroded, 7 to 12 percent slopes (Ln)	IVe
Lamonta loam, eroded, 12 to 20 percent slopes (Lp)	VIe
Lamonta loam, shallow, 0 to 3 percent slopes (Lr)	IVs
Lamonta loam, shallow, 3 to 7 percent slopes (Ls)	IVe
Lamonta loam, shallow, eroded, 3 to 7 percent slopes (Lt)	IVe
Lamonta loam, shallow, eroded, 7 to 12 percent slopes (Lu)	IVe
Lamonta loam, stony, 0 to 3 percent slopes (Lv)	VIs
Lamonta loam, stony, 3 to 7 percent slopes (Lw)	VIs
Lamonta loam, stony, 7 to 12 percent slopes (Lx)	IVe
Lamonta sandy clay loam, 0 to 3 percent slopes (Ly)	IIs
Lamonta sandy clay loam, 3 to 7 percent slopes (Lea)	IIIe
Lamonta sandy clay loam, 7 to 12 percent slopes (Led)	IVe
Lamonta sandy clay loam, eroded, 0 to 3 percent slopes (Lz)	IIs
Lamonta sandy clay loam, eroded, 3 to 7 percent slopes (Lec)	IIIe
Lamonta sandy clay loam, eroded, 7 to 12 percent slopes (Leh)	IVe
Lamonta sandy clay loam, eroded, 12 to 20 percent slopes (Ler)	VIe
Lamonta sandy clay loam, shallow, 0 to 3 percent slopes (Lev)	IVs
Lamonta sandy clay loam, shallow, 3 to 7 percent slopes (Lsa)	IVe
Lamonta sandy clay loam, shallow, eroded, 3 to 7 percent slopes (Lsb)	IVe
Lamonta sandy clay loam, shallow, eroded, 7 to 12 percent slopes (Lsc)	IVe
Lamonta sandy clay loam, stony, 0 to 3 percent slopes (Lsd)	VIs
Lamonta sandy clay loam, stony, 3 to 7 percent slopes (Lse)	VIs
Lamonta sandy clay loam, stony, 7 to 12 percent slopes (Lsl)	VIs

[4] Gem clay loam, eroded, 3 to 12 percent slopes, has two capability classifications. The soil with a slope range of 3 to 7 percent is classified IIIe; that with a slope range of 7 to 12 percent is classified IVe.

	Capability class and subclass
Lamonta sandy clay loam, stony, 12 to 20 percent slopes (Lso)	VIe
Madras loam, 0 to 3 percent slopes (Ma)	IIs
Madras loam, 3 to 7 percent slopes (Mc)	IIIe
Madras loam, 7 to 12 percent slopes (Me)	IVe
Madras loam, eroded, 0 to 3 percent slopes (Mb)	IIs
Madras loam, eroded, 3 to 7 percent slopes (Md)	IIIe
Madras loam, eroded, 7 to 12 percent slopes (Mf)	IVe
Madras loam, over sandstone, 0 to 3 percent slopes (Mg)	IIs
Madras loam, over sandstone, 3 to 7 percent slopes (Mk)	IIIe
Madras loam, over sandstone, eroded, 0 to 3 percent slopes (Mh)	IIs
Madras loam, over sandstone, eroded, 3 to 7 percent slopes (Ml)	IIIe
Madras loam, stony, 0 to 3 percent slopes (Mm)	VIs
Madras loam, stony, 3 to 7 percent slopes (Mn)	VIs
Madras loam, stony, 7 to 12 percent slopes (Mo)	VIs
Madras loamy sand, over sandstone, 3 to 7 percent slopes (Mp)	IVe
Madras loamy sand, over sandstone, eroded, 3 to 7 percent slopes (Mr)	IVe
Madras sandy loam, 0 to 3 percent slopes (Ms)	IIs
Madras sandy loam, 3 to 7 percent slopes (Mu)	IIIe
Madras sandy loam, 7 to 12 percent slopes (My)	IVe
Madras sandy loam, deep over sandstone, 0 to 3 percent slopes (Mea)	I
Madras sandy loam, deep over sandstone, 3 to 7 percent slopes (Meb)	IIIe
Madras sandy loam, deep over sandstone, eroded, 3 to 7 percent slopes (Mec)	IIIe
Madras sandy loam, eroded, 0 to 3 percent slopes (Mt)	IIs
Madras sandy loam, eroded, 3 to 7 percent slopes (Mv)	IIIe
Madras sandy loam, eroded, 7 to 12 percent slopes (Mz)	IVe
Madras sandy loam, over sandstone, 0 to 3 percent slopes (Med)	IIs
Madras sandy loam, over sandstone, 3 to 7 percent slopes (Meh)	IIIe
Madras sandy loam, over sandstone, 7 to 12 percent slopes (Meo)	IVe
Madras sandy loam, over sandstone, 12 to 20 percent slopes (Mla)	VIe
Madras sandy loam, over sandstone, eroded, 0 to 3 percent slopes (Mef)	IIs
Madras sandy loam, over sandstone, eroded, 3 to 7 percent slopes (Mel)	IIIe
Madras sandy loam, over sandstone, eroded, 7 to 12 percent slopes (Mes)	IVe
Madras sandy loam, over sandstone, eroded, 12 to 20 percent slopes (Mlc)	VIe
Madras sandy loam, shallow over sandstone, 0 to 3 percent slopes (Mld)	IVs
Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes (Mle)	IVe
Madras sandy loam, shallow over sandstone, 12 to 20 percent slopes (Moc)	VIe
Madras sandy loam, shallow over sandstone, eroded, 3 to 7 percent slopes (Mlo)	IVe
Madras sandy loam, shallow over sandstone, eroded, 7 to 12 percent slopes (Mls)	IVe
Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes (Mod)	VIs
Madras sandy loam, stony, over sandstone, 3 to 7 percent slopes (Moe)	VIs
Madras sandy loam stony, over sandstone, 7 to 12 percent slopes (Mol)	VIs
Madras sandy loam, stony, over sandstone, 12 to 20 percent slopes (Mos)	VIe
Metolius sandy loam, 0 to 3 percent slopes (Mta)	I
Metolius sandy loam, 3 to 7 percent slopes (Mtd)	IIIe
Metolius sandy loam. 7 to 12 percent slopes (Mts)	IVe
Metolius sandy loam, eroded. 0 to 3 percent slopes (Mtc)	I
Metolius sandy loam, eroded, 3 to 7 percent slopes (Mte)	IIIe
Metolius sandy loam, terrace position, 0 to 3 percent slopes (Mtl)	IIs
Metolius sandy loam, terrace position, 3 to 7 percent slopes (Mto)	IIIe
Odin clay loam, 0 to 3 percent slopes (Oa)	IIw
Odin clay loam, 3 to 7 percent slopes (Ob)	IIIw
Odin sandy loam, 0 to 3 percent slopes (Oc)	IIw
Redmond clay loam, 0 to 3 percent slopes (Ra)	IIs
Redmond loam, 0 to 3 percent slopes (Rb)	IIs
Redmond sandy loam, 0 to 3 percent slopes (Rc)	IIs
Redmond sandy loam, 3 to 7 percent slopes (Rd)	IIIe
Redmond sandy loam, deep, 0 to 3 percent slopes (Re)	IIs
Riverwash (Rk)	VIII
Rough broken land, Era and Deschutes soil materials, 12 to 50 percent slopes (Ro)	VIIe
Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes (Rs)	VIIe
Scabland, 0 to 3 percent slopes (Sa)	VIIe
Scabland, 3 to 12 percent slopes (Sb)	VIIe
Volcanic ash, 0 to 3 percent slopes, (Vo)	IVs

General Nature of the Deschutes Area

The Deschutes Area consists of 336,795 acres, or 526.2 square miles, in west-central Oregon. The Area begins a few miles east of the Cascade Mountains. It extends from about 3 miles south of Bend, in Deschutes County, almost to the northern boundary of Jefferson County. Its area is about equally divided between these two counties. Irregularly shaped, the Area is 57 miles long from north to south, and 7 to 15 miles wide.

Bend, the largest town in the Area and the county seat of Deschutes County, is about 180 miles by highway southeast of Portland. Madras, the county seat of Jefferson County, is 45 miles north of Bend.

Physiography and Drainage

The Deschutes Area is in the southwestern part of the Walla Walla section of the Columbia Plateau physiographic province (*4*). It consists principally of a nearly level to rolling high plain, or plateau, which slopes very gently northward. The altitude is about 3,700 feet south of Bend; 3,000 feet near Redmond; 2,850 feet near Opal City; 2,650 feet near Culver; and 2,300 to 2,500 feet on the Agency Plains.

A number of buttes rise 100 to 1,600 feet above the plain. Some, including Tetherow Butte, Round Butte, and Pilot Butte, are volcanic peaks. Apparently they were the sources of some of the lava flows and cinder deposits in the Area. Pilot Butte is 4,136 feet above sea level.

The range in altitude within the surveyed Area is 3,130 feet. The highest point is southeast of Opal City, at the summit of an unnamed butte that rises to an altitude of 4,420 feet. This butte is a secondary peak connected with Gray Butte (altitude 5,108 feet), which is in the southern part of Jefferson County, outside the surveyed Area. Gray Butte, Haystack Butte, and Juniper Butte and the surrounding higher region east of Opal City are eroded remnants of the southwestern part of the Hay Creek uplift, which extends northeastward toward the Blue Mountains (*5*). The lowest point in the Area—about 1,290 feet—is where the Deschutes River crosses the northern boundary.

The Area is drained by the Deschutes River and its tributaries. The main tributaries are the Crooked River, Mud Spring Creek, and Willow Creek. The Deschutes River enters the Area from the south at an altitude of about 3,700 feet. It flows in a shallow valley only 50 to 100 feet lower than the adjoining plain to the east. The valley becomes only slightly deeper as the river flows northward to Big Falls. Below Big Falls, the river has cut deeper, and it flows across most of Jefferson County in a narrow V-shaped canyon 700 to 1,000 feet below the plain. It crosses the northern boundary of the Area at an altitude of about 1,290 feet.

The Crooked River enters the Area from the east at an altitude of about 2,760 feet. Like the Deschutes River, it flows first in a shallow valley only slightly lower than the plain to the south; but farther north, it has cut a narrow box canyon. The Crooked River flows into the Deschutes River at an altitude of about 1,610 feet. Only very small areas of bottom land occur along these rivers.

Much of the Area has a constructional topography in which streams have caused little or no dissection. This is particularly noticeable in areas underlain by lava flows and in areas west of the Deschutes River that are underlain by outwash sand and gravel. Most of the southeastern part of the Area was covered by the most recent lava flow. This region is undulating or somewhat rolling. The higher parts of the uneven surface are narrow ridges, mounds, or swells of outcropping lava, or shallow very stony soils. Between the higher parts are swales, disconnected shallow basins, and level areas where the soils are deeper and arable. Many of the swales and basins have no surface drainage outlets.

Climate

The climate of the Deschutes Area is continental, but the moderating effects of the Pacific Ocean are not entirely shut off by the Cascade Mountains. The prevailing weather is not so mild as that of western Oregon nor so rigorous as that of the Rocky Mountain region or the Great Plains.

The Area has light precipitation. Summers are dry, with warm days and cool nights. Winters are cold, with moderate snowfall. The climate is healthful and invigorating, and there is a high percentage of sunshine. Because the frost-free season is short in much of the Area, hay, grain, potatoes, legumes for seed, or other hardy or short-season crops are grown.

Table 4 gives the climatic data for four United States Weather Bureau Stations in or near the Area. The data for most of these places are representative of the climate of the respective localities, but the data for Madras is not representative of the climate of the region around Madras. Madras lies in a low, wide pocket in the valley of Willow Creek, about 300 feet below the surrounding plains. It probably has slightly less precipitation and a warmer summer than the surrounding plains, and its growing season is shorter.

Most of the Deschutes Area is semiarid, but the extreme southern and western parts are subhumid. The normal annual precipitation of the semiarid region is about 8 to 10 inches. The precipitation increases as altitude increases, or generally in the direction of the top of the Cascade Mountains. Most of the moisture in the prevailing westerly winds falls on the western side of the Cascades; consequently, the lower areas on the leeward side of the mountains are relatively dry. Warm Springs, which is nearer the Cascade Mountains than Madras, receives more than 1 inch more precipitation than Madras, even though it lies in a valley 700 feet lower than Madras.

As the westerly winds move eastward over the Hay Creek uplift (*9*) and Ochoco Mountains, precipitation increases. At Hay Creek, which is about 9 miles east of Madras and at an altitude of 2,938 feet, the average annual precipitation is 11.75 inches, almost 3 inches higher than at Madras; the snowfall is 6.3 inches higher. At Juniper Butte (3,935 ft.), Haystack Butte (4,023 ft.), and the higher adjoining area east of Opal City, precipitation is a few inches more than on the low-lying plain around Madras and Redmond.

From Redmond westward and southwestward toward the Cascades, the precipitation increases. The highest precipitation in the Area apparently is in the extreme southern part, south of Bend; in the extreme western part near Cloverdale; and in places along the southwestern boundary between these areas. In these regions the normal annual precipitation probably is about 13 to 15 inches.

The annual rainfall varies greatly from year to year. At Bend it has varied from 6.04 to 25.74 inches and at Redmond, from 4.39 to 14.19 inches. The precipitation is distributed unevenly throughout the year, but it is

TABLE 4.—*Temperature and precipitation at four weather stations*

BEND, ELEVATION 3,599 FEET

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year	Wettest year	Average snowfall
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	31. 9	69	−25	1. 70	0. 42	4. 78	9. 1
January	30. 4	66	−26	1. 70	. 35	6. 34	11. 0
February	34. 2	76	−26	1. 51	1. 20	4. 00	7. 0
Winter	32. 2	76	−26	4. 91	1. 97	15. 12	27. 1
March	38. 9	83	−13	1. 10	1. 11	2. 33	4. 1
April	44. 6	90	8	. 79	. 07	1. 30	1. 0
May	50. 8	90	11	1. 14	. 60	1. 42	. 3
Spring	44. 8	90	−13	3. 03	1. 78	5. 05	5. 4
June	58. 6	100	22	1. 00	. 21	1. 79	[3]
July	65. 0	104	28	. 50	[3]	. 23	0
August	63. 3	100	25	. 31	. 07	1. 44	[3]
Summer	62. 3	104	22	1. 81	. 28	3. 46	[3]
September	55. 5	97	12	. 64	. 26	. 96	[3]
October	48. 0	91	10	. 68	. 15	. 40	. 4
November	39. 1	77	−5	1. 65	1. 60	. 76	3. 0
Fall	47. 5	97	−5	2. 97	2. 01	2. 12	3. 4
Year	46. 7	104	−26	12. 72	[4] 6. 04	[5] 25. 75	35. 9

See footnotes at end of table.

TABLE 4.—*Temperature and precipitation at four weather stations*—Continued

HAY CREEK, ELEVATION 3,599 FEET

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year	Wettest year	Average snowfall
	° F.	° F.	° F.	*Inches*	*Inches*	*Inches*	*Inches*
December	33.4	72	−28	1.30	1.78	1.41	6.2
January	30.9	66	−25	1.43	.30	2.46	8.8
February	35.2	72	−22	.98	.55	1.27	3.9
Winter	33.2	72	−28	3.71	2.63	5.14	18.9
March	40.7	85	−2	.90	.58	1.13	1.7
April	45.9	87	12	.78	.04	2.02	1.2
May	52.0	92	19	1.49	(3)	2.98	.2
Spring	46.2	92	−2	3.17	.62	6.13	3.1
June	58.0	98	28	.81	.04	2.04	0
July	65.3	110	31	.51	0	.38	0
August	63.4	101	29	.31	(3)	.78	0
Summer	62.2	110	28	1.63	.04	3.20	0
September	56.2	97	15	.84	(3)	.79	.1
October	48.1	87	6	.74	.48	.94	.3
November	38.7	73	−7	1.66	1.31	1.32	1.2
Fall	47.6	97	−7	3.24	1.79	3.05	1.6
Year	47.3	110	−28	11.75	[6] 5.08	[7] 17.52	23.6

MADRAS, ELEVATION 2,994 FEET

December	31.5	66	−45	1.10	0.17	1.80	4.4
January	29.7	70	−40	1.09	.20	1.34	7.4
February	34.6	76	−34	.69	.19	1.28	2.7
Winter	31.9	76	−45	2.28	.56	4.42	14.5
March	40.9	81	−7	.64	.92	1.32	1.4
April	46.2	93	6	.63	.07	1.24	.2
May	52.6	98	12	.86	.43	2.30	(3)
Spring	46.6	98	−7	2.13	1.42	4.86	1.6
June	59.5	105	21	.70	0	2.21	(3)
July	66.5	112	26	.20	(3)	.43	0
August	64.2	105	26	.28	0	.56	0
Summer	63.4	112	21	1.18	(3)	3.20	(3)
September	56.8	101	9	.66	.05	1.33	(3)
October	48.0	88	0	.65	.29	.16	.1
November	38.2	80	−12	1.30	1.81	1.27	1.1
Fall	47.7	101	−12	2.61	2.15	2.76	1.2
Year	47.4	112	−45	8.80	[4] 4.13	[8] 15.24	17.3

TABLE 4.—*Temperature and precipitation at four weather stations*—Continued

REDMOND, ELEVATION 2,994 FEET

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year	Wettest year	Average snowfall
	° F.	° F.	° F.	*Inches*	*Inches*	*Inches*	*Inches*
December	34.0	72	−19	0.86	0.40	2.38	3.5
January	32.0	66	−24	1.01	.44	.93	7.5
February	36.2	72	−24	.65	.44	1.43	3.4
Winter	34.1	72	−24	2.52	1.28	4.74	14.4
March	41.8	82	9	.56	1.31	.64	.9
April	47.8	86	14	.70	.18	.78	.7
May	52.9	95	21	.75	.63	2.38	(3)
Spring	47.5	95	9	2.01	2.12	3.80	1.6
June	58.6	100	26	1.02	.02	1.68	(3)
July	65.8	105	31	.48	0	.60	0
August	64.3	98	29	.22	(3)	.79	0
Summer	62.9	105	26	1.72	.02	3.07	(3)
September	57.4	97	22	.45	.18	1.27	(3)
October	49.1	93	9	.57	.08	.16	.3
November	39.5	74	−5	.87	.71	1.15	.7
Fall	48.7	97	−5	1.89	.97	2.58	1.0
Year	48.3	105	−24	8.14	[4] 4.39	[8] 4.19	17.0

[1] Bend: Average temperature based on a 49-year record, 1907–55; highest and lowest temperatures from a 47-year record, 1906–52. Hay Creek: Average temperature based on a 28-year record, 1916–43; highest and lowest temperatures from a 24-year record, 1929–52. Madras: Average temperature based on a 34-year record, 1922–55; highest and lowest temperature from a 35-year record, 1918–52. Redmond: Average temperature based on a 25-year record, 1931–55; highest and lowest temperature from a 22-year record, 1931–52.

[2] Bend: Average precipitation based on a 51-year record, 1905–55; wettest and driest years based on a 53-year record, in the period 1902–55; snowfall based on a 48-year record, 1905–52. Hay Creek: Average precipitation based on a 28-year record, 1916–43; wettest and driest years based on a 26-year record, in the period 1910–44; snowfall based on a 29-year record, 1924–52. Madras: Average precipitation based on a 35-year record, 1921–55; wettest and driest year based on a 39-year record, 1909–55; snowfall based on a 35-year record, 1918–52. Redmond: Average precipitation based on a 24-year record, 1932–55; wettest and driest years based on a 19-year record, in the period 1931–52; snowfall based on a 40-year record, 1913–52.

[3] Trace or no record.

[4] In 1949.

[5] In 1907.

[6] In 1924.

[7] In 1912.

[8] In 1948.

distributed more evenly than that west of the Cascade Mountains. The precipitation is greatest in winter, when a large part falls as snow. Generally, May and June are months of relatively high rainfall; August and July commonly are the driest months. Most of the rains are light, but thunderstorms are somewhat frequent in summer. The average snowfall varies from 17.0 inches at Redmond to 35.9 inches at Bend.

The extremes in temperature are wide. A temperature of 45° F. below zero was recorded at Madras. Although temperatures rise above 100°, the humidity is low in summer, and nights are cool. The coldest weather in winter and the warmest in summer occur when the ocean winds cease and the Area is dominated by a mass of continental air.

The average growing season is 88 days at Bend, 101 days at Madras, and 123 days at Hay Creek. The length of growing season, however, varies from year to year. Frost has occurred at Bend as late as July 29 and as early as August 14. At Madras it has occurred as late as June 17 and as early as August 24.

In some of the high areas near the Cascade Mountains and in some low pockets, freezing temperatures may occur every month. At the Madras station, which is in a low pocketlike valley, freezing temperatures occurred every month in 7 of the years from 1909 to 1930. These low temperatures, however, are not typical of the surrounding higher plains. Successful crop production in areas of low temperature is largely limited to grasses, legumes, small grains, and the more hardy crops.

In most of the Area, late spring frost occasionally injures potatoes, corn, and garden vegetables; less frequently, frost damages wheat or grain. Potatoes, corn, and less hardy crops generally are not planted until the danger of frost is largely past. The growing season normally is too short for winter cover crops to follow the potato harvest.

Hail and glaze-ice storms occasionally occur but seldom do material damage. Tornadoes are very rare. Winds are variable. On the Agency Plains, northwesterly winds generally dominate, although southwesterly winds prevail in winter. Here, they sometimes cause wind erosion. At Madras, the prevailing winds are southwesterly in winter and northwesterly in summer. At Bend, westerly winds prevail.

Vegetation and Wildlife

In a considerable part of the Deschutes Area, the natural vegetation is dominated by big sagebrush (*Artemisia tridentata*), bunchgrasses, and western juniper (*Juniperus occidentalis*), in varying proportions. In many places, big sagebrush is associated with rabbitbrush (*Chrysothamnus* spp.), short annual grasses, and weeds.

In the northern part of the Area, in Jefferson County, the natural vegetation is mostly big sagebrush, cheatgrass (*Bromus tectorum*), bunchgrasses, and weeds or other herbs. Junipers are scarce in this part of the Area. There are practically none on the Agency Plains or on the plain near Metolius and Culver. A few grow in the moister places near streams and near Juniper Butte and Haystack Butte.

Before the northern part of the Area was used for grazing, bunchgrasses were probably the predominant vegetation (*13*). They are still abundant on rangelands that have not been overgrazed. The predominant bunchgrasses are bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*), and Sandberg bluegrass (*Poa secunda*). Other less abundant perennial grasses are needlegrass (*Stipa* spp.), Indian ricegrass (*Orzopsis hymenoides*), thickspike wheatgrass (*Agropyron dasystachyum*), junegrass (*Koeleria cristata*), and giant wild-rye (*Elymus cinereus*) (*8*). Giant wild-rye grows in swales and other moist sites. Idaho fescue is most abundant on deep soils and on moist northern exposures. On the sandy soils, Indian ricegrass, sand dropseed (*Sporobolus cryptandrus*), beardless wild-rye (*Elymus triticoides*), needlegrass, and thickspike wheatgrass commonly predominate (*8*).

In Deschutes County the junipers form an open woodland. The trees are 50 to 100 feet apart, and some are 15 to 20 inches in diameter and 20 or 30 feet tall. The larger trees have a spreading branchy form. The understory of big sagebrush, rabbitbrush, bunchgrasses, annual grasses, and associated herbs is similar to the natural cover on the open range in Jefferson County. The junipers are used to a considerable extent for fuel and posts.

Toward the south, as the elevation becomes higher and the amount of precipitation increases, the junipers and other plants become somewhat larger and the stands denser. In the southern and western parts of the Area, where the annual precipitation is about 12 inches and the altitude is 3,100 to 3,700 feet, ponderosa pines are scattered among the junipers. At about the same elevation or slightly lower, bitterbrush (*Purshia tridentata*) appears as part of the understory. Bitterbrush, also called antelope brush, is a shrub that provides good browse for livestock and big game animals.

Around the southwestern edge of the Area, partly within and partly outside the Area, is a belt 2 to 4 miles wide in which the natural cover consists of an open stand of junipers and ponderosa pines, and an understory of big sagebrush, bitterbrush, rabbitbrush, bunchgrasses, annual grasses, and herbs.

The junipers and big sagebrush gradually give way to ponderosa pines and an understory of bitterbrush mixed with grasses and herbs. In the extreme southern part of the surveyed Area, southwest of Bend, where the annual precipitation is about 13 inches, ponderosa pines predominate over junipers, and the understory is principally bitterbrush mixed with grasses and herbs. In the higher moister places near the western boundary of the Area, some snowbrush (*Ceanothus velutinus*) and greenleaf manzanita (*Arctostaphylos patula*) are associated with the bitterbrush in the understory.

Because much of the Area is farmed, wildlife is less abundant than in the surrounding forests and rangeland. Jackrabbits, pocket gophers, woodchucks, ground squirrels, and coyotes are common, and there are some badgers and porcupines. Pocket gophers, woodchucks, and ground squirrels damage ditches and cause considerable loss of irrigation water. Coyotes kill some poultry and livestock. Deer, which are rather plentiful in the adjoining higher forested region and in the Cascade Mountains, are sometimes found in the Area. Mule deer are the most common. There are some Columbia black-tail deer and a few white-tail deer. Except on rocky talus slopes along the rivers, rattlesnakes are few. Sage hens, pheasants, quail, and ducks are the principal game birds.

Magpies are sometimes pests. The rivers and creeks and many of the lakes in the higher, forested region south and west of the Area and in the Cascades are noted for their trout.

Settlement and Development

Except for nomadic trappers, the first white men known to have visited the Deschutes Area were Gen. John C. Fremont and Kit Carson who, in 1843, traveled across the southern part of the Area near the site of Bend and up the Deschutes River (*13*). The first white settler in this general region located along Hay Creek, east of Madras, in 1863 and herded cattle in the surrounding hills (*13*). Within the next few years, other settlers located on Trout Creek, east of Gateway, on Willow Creek within the present boundaries of the Area, and on Squaw Creek in Deschutes County.

Homesteading started in 1898. After irrigation on a large scale was undertaken, about 1900, many settlers came into the Area. The building of railroads further stimulated settlement. By 1920, most of the arable land was occupied.

Indian wars or skirmishes continued in central and eastern Oregon until about 1879. The Indians now live on the Warm Springs Indian Reservation, just west of the northern part of the Area.

Oregon became a territory in 1848 and a State in 1859 (*1*). Jefferson County was formed in 1914, from what had been the northwestern part of Crook County. Culver was the county seat for the first 2 years; then Madras became the county seat. In 1916, Deschutes County was created from the southwestern part of Crook County.

Early agriculture.—When the Area was first settled, agriculture consisted mainly of raising cattle, sheep, and horses. Grass was abundant in most places, and most ranchers tried to graze their stock on the open range throughout the year without reserve feed. This practice was risky because the winters were severe and the summers very dry.

Within a short time after railroads were built, most of the arable soils in Jefferson County were cleared and used to grow dry-farmed wheat and other small grains, mostly for shipment to outside markets. Wheat crops depended on precipitation. In the drier years yields were low and crop failures were common, especially in the dry areas on the Agency Plains and near Madras and Metolius. Good yields were obtained in probably only 1 year out of 4. After a few successive years of deficient rainfall, much of the less productive land was taken out of cultivation, many homes were abandoned, and some farms were combined into larger units. In the early 1930's, some land in the eastern part of Jefferson County was retired from cultivation and reseeded to grass as part of the controlled-grazing program administered by the Federal Government.

In the early days, some home orchards were planted, and potatoes, corn, and other crops were grown for home use. The orchards did not thrive, and the corn crops often failed. Dairying was not successful because pasture and hay were scarce. In Deschutes County, potatoes were grown under irrigation for shipment to outside markets.

Roads and railroads.—For the early settlers, the nearest shipping point was The Dalles, which is on the Columbia River in Wasco County. Later a branch railroad was built from Biggs, on the Columbia River in Sherman County, to Shaniko, which is in Wasco County but nearer the surveyed Area than The Dalles. The wagon road to Shaniko was rough and hilly, and little produce was transported by wagon except wool. Stock was driven to market. In 1905, a road was constructed from Cross Keys, a stage station 23 miles south of Shaniko, to Bend for use by an automobile stage (*13*).

In 1911, the Oregon Trunk Railway was built. It followed the valleys of the Deschutes River, Trout Creek, and Mud Spring Creek and connected Gateway, Paxton, Madras Station, and Metolius. Also in 1911, the Union Pacific Railroad was extended from the north by way of the valleys of the Deschutes River and Willow Creek. This railroad connected Mecca, which is outside the northwest corner of the Area, with Madras and Metolius. The following year, the Oregon Trunk Railway was extended to Bend, and a branch line of the Great Northern Railway, connecting Bend with Chemult, was built. Later the City of Prineville Railroad was constructed from Prineville Junction eastward to Prineville, in Crook County.

Population

The Deschutes Area consists of the most thickly populated parts of Deschutes County and Jefferson County. The population of Deschutes County was 9,622 in 1920; 18,631 in 1940; and 21,812 in 1950.

The population of Jefferson County was 3,211 in 1920; by 1940 it had declined to 2,042, probably because several years of drought had made dry farming unprofitable. In 1950, after the extension of irrigation, the population had grown to 5,536. In 1950, 36 percent of the population of Deschutes County was classed as rural; all of the population of Jefferson County was classed as rural.

Bend was incorporated in 1904. It became the headquarters of several irrigation projects. Bend is the largest town in the Area. The population increased from 5,415 in 1920 to 11,409 in 1950. Redmond, the second largest town in the Area, was incorporated in 1910. Its population increased from 585 in 1920 to 2,956 in 1950. Madras, the largest town in Jefferson County, was incorporated in 1910. Its population in 1920 was 337, and in 1950 it was 1,258. Metolius, Culver, Opal City, and Gateway are smaller towns in Jefferson County. Terrebonne and Tumalo are smaller towns in Deschutes County.

Industries

Next to farming, the lumber industry is the most important enterprise in the Area. This industry is very important in the southern part of the Area; it is the chief source of income in and around Bend. The lumber comes from the extensive forests south and west of the Area.

Ponderosa pine is the most important commercial tree, but also important are lodgepole pine, Douglas-fir, sugar pine, western white pine, white fir, and incense cedar. Some lodgepole pine is used for poles, posts, and lumber. Juniper is used for posts and to a small extent for wood

novelties. Cedar shingles are made in small quantities.

The principal outside markets for lumber are California, the Middle West, and New York (*2*). A considerable amount is sold locally and made into sashes, doors, and box shook, which are shipped to other parts of the country. The byproducts of the sawmills are used for fuel in homes and in power-generating plants.

The extension of the railroad to Bend accelerated the development of the lumber industry. Two large sawmills began operation there in 1916. In 1946 these mills employed about 1,500 people and accounted for 83 percent of the industrial employment in Bend (*6*). Two mills in Redmond that produced finished lumber employed about 130 people in 1946 (*7*). Madras has a smaller sawmill.

A leading wood-using industry is the manufacture of box shook (*2*). Two mills in Bend that make mouldings and special cut stock employed about 50 men in 1946. Two mills in Redmond that make mouldings, box shook, and lath employed 57 people. A furniture manufacturer in Bend employed about 40 people (*6*). Other small establishments in Bend make such things as furniture, cabinets, wood novelties and toys, or treated poles.

Tourists and vacationists bring much income to the Area, particularly to Bend and its vicinity. Visitors are attracted by the varied scenery south and west of the Area. Sportsmen come to fish for trout and to hunt deer, pheasants, ducks, and quail. The dry summer weather is pleasant for camping, horseback riding, and other outdoor activities.

About 60 people, most of whom live in Redmond, Terrebonne, or the surrounding rural area, are employed in mining diatomaceous earth from deposits near Lower Bridge. A little pumice is mined. It is used in making concrete building blocks in Redmond and Bend.

Small dams and electric power plants are located at The Cove on the Crooked River and at Cline Falls on the Deschutes River. These plants and steam power plants at the sawmills in Bend supply electric power for the Area.

Transportation and Markets

Four railroads serve the Deschutes Area. The Oregon Trunk Railway provides freight and passenger service to the north. The Union Pacific provides freight service to the north. The Great Northern Railway gives freight service from Bend southward. The municipally owned City of Prineville Railroad provides freight service from Prineville Junction eastward to Prineville, in Crook County.

The Deschutes Area is well supplied with paved highways. Federal highways, State highways, and local paved roads serve the Area. The local roads are generally good. Most of them are passable throughout the year.

Bus lines connect the towns in the Area with The Dalles and Portland to the north; with Klamath Falls and Lakeview to the south; with Salem, Albany, and Eugene to the west; and with Prairie City and Burns and Boise, Idaho, to the east. Two large common-carrier truck lines maintain service from Bend to Portland, to Spokane, Wash., and to Oakland, Calif. Smaller intrastate carriers operate to other cities.

A scheduled air line provides service north and south from the airport near Redmond. Charter flight service is available from the airport at Bend.

Portland and the nearby districts are the principal markets for most of the agricultural products that are shipped out of the Area. Most of the potatoes are sent there by rail. About 20 percent of the potatoes that are shipped out are hauled by trucks, primarily to the small communities of the Willamette Valley (*3*). Some potatoes are marketed in Washington, and a few carloads are sold in the San Francisco Bay district.

Most of the wheat grown in Jefferson County is sold at markets in or near Portland. Some is sold in Deschutes County. Some barley raised in Deschutes County is sold on the Portland market for brewing and feed. A considerable part of the clover seed and hairy vetch seed is shipped to the southeastern and eastern States.

Cattle and sheep are sold principally on the Portland market; some are sent to San Francisco, and a few are killed in a small local plant. Sheep and wool are marketed through a growers' shipping association. Two creameries in Bend, two in Redmond, and a small one in Madras handle most of the dairy products sold. Local buyers ship some cream to Portland, and producers or distributors sell whole milk and cream in the cities. The cooperative creamery in Redmond processes cream and whole milk into butter and cheese. Turkeys and other poultry are dressed and shipped.

Community Facilities

The elementary schools in the Area are mostly consolidated. There are high schools in Bend, Redmond, and Madras. Students from rural areas are transported by buses to the high schools and consolidated schools. Many denominations have churches in the larger towns. Deschutes, Jefferson, and Crook Counties have a tricounty health unit that employs a staff of full-time nurses. There are two hospitals in Bend and a small one in Redmond. Both of these towns have public libraries.

The Grange, the Farm Bureau, the Farmers Union, the Four-H Clubs, the Future Homemakers of America, and the Future Farmers of America are active in the Area. Vocational agriculture is taught in the high schools at Redmond and Madras. A county fair is held annually at Redmond.

Irrigation and Water Supply

Since the early 1900's, substantial acreages in Deschutes County have been irrigated by water supplied by commercial and cooperative irrigation companies. In Jefferson County, as late as 1945, only a few acres were irrigated by water pumped from the Deschutes River. Between 1945 and 1950, a large acreage in Jefferson County was brought under irrigation.

The data in table 5 show irrigation facilities and their expansion in Deschutes County and Jefferson County since 1940. Most of the irrigated land in the two counties is in the survey Area; consequently the data in table 5 can be considered applicable to the Area.

TABLE 5.—*Data on irrigation in Deschutes and Jefferson Counties, Oreg., in stated years*

[Blank spaces indicate that the item was not reported]

	Deschutes County [1]			Jefferson County [2]		
	1940	1950	1954	1940	1950	1954
Irrigated farms—number	[3] 940	865	965	[3] 54	460	493
Irrigated land in farms—acres	[3] 43, 119	[4] 48, 079	44, 424	[3] 3, 779	[4] 39, 635	54, 789
Cropland harvested—acres	[3] 30, 270	[4] 28, 823	26, 438	[3] 2, 487	[4] 34, 647	48, 581
Pasture—acres	[3] 12, 849	[4] 16, 707	17, 986	[3] 1, 292	[4] 2, 043	6, 208
Cropland not harvested and not pastured—acres		[4] 2, 549			[4] 2, 945	
Irrigation enterprises—number	23	47		42	49	
Average water delivered—acre-feet		[4] 4. 3			[4] 3. 0	
Diversion dams—number	39	28		43	89	
Canals and ditches—miles	846	402		64	398	
Pipelines—miles	1	2		1	1	
Reservoirs—number	3	13			2	
Irrigation pumps—number	[5] 1	29		[5] 8	6	
Pumped wells—number		3		3	1	

[1] Most of the irrigated land in Deschutes County is in the Deschutes Area.

[2] In 1940, all except a very few of the irrigated farms in Jefferson County were outside the Deschutes Area. In 1950 and 1954, most of the irrigated land in Jefferson County was in the Deschutes Area.

[3] 1939.

[4] 1949.

[5] Pumping plants.

Sources of water

The Deschutes River is the source of most of the water used for irrigation in the Area. This river rises in the Cascade Mountains. It is fed partly by large, steadily flowing springs. Upstream from the irrigation diversions, the flow of the river is remarkably uniform. Below the intakes of the diversion canals, the rate of flow varies. During the irrigation season, generally, there is enough water for irrigation needs.

Although Squaw Creek and Tumalo Creek are outside the Area, they supply much water for irrigation in the Area. Squaw Creek rises near the western border of Deschutes County at the foot of the glaciers of the Three Sisters. It flows northwest and joins the Deschutes River below Lower Bridge. The entire flow of Squaw Creek below the gaging station near McAllister ditch is diverted during summer. Generally, there is not enough water for irrigation needs.

Tumalo Creek rises near the foot of Broken Top Mountain, flows northwest, and empties into the Deschutes River about 2.5 miles above Tumalo. During the irrigation season, generally, there is not enough water in Tumalo Creek to meet irrigation needs.

The Crooked River, which rises in a group of mountains to the east, furnishes very little water for irrigation in the Area, except to a few farms that are supplied by pumping. Nearly all of the flow of the Crooked River above Prineville, in Crook County, is used in Crook County during the irrigation season; a very small flow enters the Deschutes Area in summer. Between Prineville and the junction with the Deschutes River, the Crooked River is fed by many springs, which increase its flow. Near the mouth of the river, the flow is large enough to supply large quantities of irrigation water.

The Metolius River rises outside of the Area at the foot of the snowfields of Mount Washington, Three Fingered Jack, and Mount Jefferson. It is fed by huge springs. It flows into the Deschutes River from the west about 2 miles below the mouth of the Crooked River. At present no water is diverted from the Metolius River for irrigation in the Area.

Water for domestic use and for livestock.—In Deschutes County irrigation water is used on the farms for domestic purposes and for livestock. Water is stored in cisterns for home use and in ponds for livestock. During winter, water is turned into the ditches once a month to fill the cisterns and ponds.

In Jefferson County water for domestic use is pumped from Opal Springs in the Crooked River canyon and piped to Culver, Metolius, and Madras by the Deschutes Valley Water district, which was formed for this purpose only. Most of the farms in these areas and on the Agency Plains obtain water from this source. The water is excellent.

Some water for domestic use is obtained from wells. In much of the upland part of the Area, wells must be about 300 to 700 feet deep. These wells are expensive to drill and to operate. The flow from wells in the sedimentary beds of the Dalles formation is extremely variable; in places it is insufficient for domestic use. Wells drilled in the Clarno formation, in the vicinity of Haystack and Juniper Buttes, generally yield ample water for domestic use. A few springs or seeps occur in this locality. Well water in the Area is usually excellent.

History of irrigation

The history of irrigation in this region has been long and complex. Since 1871, when water was diverted from Squaw Creek to irrigate 45 acres near Sisters just west of the Area, many companies were formed, but most of these companies were short lived. Small companies merged into larger ones, but generally the facilities of the private companies were taken over by landowners who organized irrigation districts. Irrigation districts are cooperative ventures that administer the irrigation of designated areas.

TABLE 6.—*Land in farms according to use in Deschutes and Jefferson Counties, Oreg., in stated years*

[Absence of figure indicates that acreage was not reported]

	Deschutes County				Jefferson County			
	1929	1939	1949	1954	1929	1939	1949	1954
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Land in farms	155, 432	185, 146	298, 108	337, 810	620, 567	697, 232	445, 226	539, 985
Average size of farms	188. 6	176. 8	318. 2	316. 6	1, 852. 4	3, 071. 5	785. 2	915. 2
Cropland total	38, 397	62, 698	60, 808	48, 515	113, 982	87, 311	115, 476	96, 904
Harvested	26, 765	33, 033	33, 996	33, 838	59, 316	24, 870	56, 274	69, 906
Used only for pasture		21, 938	15, 458	8, 157		5, 692	24, 716	3, 889
Not harvested and not pastured			11, 354	6, 520			34, 486	23, 109
Failed	2, 900	2, 661			2, 889	10, 064		
Idle or fallow	8, 732	5, 066			51, 777	46, 685		
Woodland	34, 003	10, 265	71, 366	109, 549	31, 824	115, 923	67, 874	29, 748
Pastured	28, 462		58, 727	101, 960	29, 994		64, 154	28, 592
Not pastured	5, 541		12, 639	7, 589	1, 830		3, 720	1, 156
Pasture, not woodland and not cropland	54, 961		154, 669	163, 915	459, 662		252, 818	395, 143
Pasture total	89, 130		228, 854	274, 032	498, 920		341, 688	427, 624
Other land	22, 364	[1] 112, 183	11, 265	15, 831	5, 835	[1] 493, 998	9, 058	18, 190

[1] Includes pasture that was not woodland and not cropland.

Construction of storage facilities began in the mid-twenties, when it became apparent that the flow of the streams was not large enough to supply all projects at the time the water was needed. Several reservoirs were built to supply irrigation districts.

Before 1945 most of the irrigation in the Area was in Deschutes County. Since 1945 about 50,000 acres have been irrigated in Jefferson County north of the Crooked River in the North Unit of the Deschutes Irrigation Project.

Irrigation practices and problems

The irrigation season commonly extends from the first of April to the middle or last of October. Water is delivered to farms by a continuous flow in most of the districts. This practice necessitates constant attention, and at times the head of water is smaller than that needed. In the Squaw Creek district, a turn-flow system is used. Under this system fewer ditches are used at one time, and the head of water is larger than it would be if more ditches were used. A rotation system is used in some of the ditches of the Swalley district.

A serious problem for all the districts is conveyance loss, that is, loss of water between the point of diversion and the irrigated field. Conveyance loss may be as much as 30 to 65 percent. The loss is high largely because the canals are not lined and the sandy, pumiceous soils and permeable underlying material absorb water rapidly.

Agriculture

The Deschutes Area is approximately half in Deschutes County and half in Jefferson County. In Deschutes County agriculture under irrigation has prevailed for many years; some livestock has been raised on the range, but there has been very little dry farming. In Jefferson County dry farming of wheat has prevailed; some livestock has been raised on the range. The differences in the systems of agriculture are reflected in the size of farms, the use of the land, and in other ways. The North Unit of the Deschutes Irrigation Project, under development at the time of the survey, will supply water to irrigate that part of the Area that is in Jefferson County.

Land Use

Table 6 shows the total acreage in farms and the acreage in farms according to use, in all of Deschutes County and Jefferson County in 1929, 1939, 1949, and 1954. An estimated three-fourths of the cropland in the two counties is in the surveyed Area.

Crops

Table 7 gives the acreage of the principal crops in all of Deschutes County and Jefferson County for 1939, 1949, and 1954. Since three-fourths of the cropland of the two counties is in the surveyed Area, the data are representative of the Area. Between 1939 and 1949, the pattern of agriculture in Jefferson County changed significantly, as a result of the extension of irrigation in the North Unit of the Deschutes Irrigation Project. The major changes are reflected in table 7.

Minor crops grown in the Area are corn, strawberries, red raspberries, peppermint, onions, green peas, sweet corn, alfalfa for seed, crested wheatgrass for seed, Chewings fescue for seed, sweetclover for hay, apples, and peaches. Both irrigated pastures and range are important.

Potatoes.—Potatoes are grown throughout the irrigated parts of the Area, except in the extreme southern and southwestern parts where the soils are sandy and the frost hazard is high. They have been the principal cash crop in Deschutes County ever since the railroads provided transportation to markets, but hardly any were grown in Jefferson County before the North Unit of the Deschutes

TABLE 7.—*Acreage of principal crops in Deschutes and Jefferson Counties, Oreg., in stated years*

	Deschutes County			Jefferson County		
	1939	1949	1954	1939	1949	1954
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Winter wheat threshed	283	345	1, 335	15, 117	12, 072	13, 189
Spring wheat threshed	1, 323	1, 238	1, 223	3, 210	13, 605	14, 890
Barley threshed	2, 032	3, 797	1, 791	419	6, 511	13, 126
Oats threshed	2, 789	2, 331	1, 736	58	706	1, 344
Oats cut for feeding	426	370	[1]	[1]	251	[1]
Rye threshed	693	1, 036	[1]	265	90	[1]
Mixed grains threshed	114	159	93	[1]	322	402
Other grain threshed	[1]	1, 041	1, 808	[1]	90	275
Clover for seed	4, 642	1, 722	509	[1]	9, 172	3, 375
Potatoes	1, 884	3, 746	[2] 2, 435	9	2, 001	[2] 5, 984
All hay	17, 099	18, 590	22, 427	5, 418	10, 486	15, 058
Alfalfa	11, 235	11, 329	13, 252	2, 067	7, 849	9, 881
Clover or timothy, alone or mixed	359	870	971	38	279	611
Small grains cut for hay	4, 928	5, 185	7, 494	3, 255	2, 044	2, 709
Wild hay	272	203	217	[1]	95	462
Other	305	1, 002	493	58	219	1, 395

[1] Not reported.
[2] Does not include acreage of farms that had less than 10 bags harvested.

Irrigation Project was completed. Potatoes are seldom grown on the inadequately drained Odin soils, and are grown on only a small acreage of the fine-textured Redmond soils.

Potatoes are normally grown in rotation with alfalfa, clover, or pasture, but they may be grown on the same acreage for 2 or more successive years. They are planted in April or May, by machine. Generally a complete fertilizer is applied. Irrigation is by the furrow method. Many soils in the Area apparently need only a small amount of irrigation water (*11*). Late in fall, the potatoes are dug by machines and picked up by hand. The Area is quarantined to keep bacterial ring-rot out. The potatoes are blocky and well shaped, easily cleaned, and attractively colored. They have a low peeling loss. Production of certified seed potatoes has been profitable in Deschutes County for several years (*14*).

Wheat.—After the extension of railroads into the Area, dryland wheat became the chief cash crop of the nonirrigated part of the Area in Jefferson County. In much of this region the normal annual precipitation is about the minimum for growing dryland wheat. A very dry year or a series of dry years results in a significant decrease in the acreage of wheat.

Under dryland farming, winter wheat gives better yields than spring wheat. Winter wheat is planted late in October or early in November and harvested the following August or September. Wheat is grown every other year. In the alternate years the stubble is plowed in the spring and a trashy fallow is left through the summer. To control weeds the fields are cultivated with a rod-weeder or other implement three or more times during the summer. Since the extension of irrigation in Jefferson County, the acreage of winter wheat has decreased and the acreage of irrigated spring wheat has increased.

In Deschutes County, where large areas have been irrigated for many years, wheat is less commonly grown. When wheat follows potatoes in the rotation, it is usually spring wheat. More spring wheat than winter wheat is grown in the vicinity of Cloverdale and Bend, where the frost hazard is serious.

Oats.—Oats are grown only in the irrigated parts of the Area. Most of the crop is either combined or cut with a binder, shocked in the field, and threshed. Some of it is used unthreshed for feed. Practically all the oats grown are fed on the farm.

Barley.—Barley is widely grown under irrigation. It is harvested in the same way as wheat. Most of it is used for feed in the Area, but a small part is exported. Small acreages of dry-farmed barley have been grown in Jefferson County.

Rye.—Only a small acreage of rye is grown in the Area. Most of this is grown under irrigation. A small acreage of dry-farmed rye is grown in Jefferson County in the western part of the Area. Yields have been low. Almost all the rye grown is used for feed.

Alfalfa.—Alfalfa, the principal hay crop, is grown throughout the irrigated parts of the Area. It generally follows a grain crop. It is commonly fertilized with light applications of sulfur or gypsum. A considerable part of the crop is baled in the field. Some unbaled hay is put into barns, some is stacked, and a little is ground or chopped. Two or three cuttings a season are obtained. Nearly all the alfalfa hay is fed on the farm.

Alsike clover.—Alsike clover grown for seed has been one of the most important cash crops in the irrigated districts. Yields are fairly high and can be increased if the crop is fertilized with sulfur and phosphorus and if there are enough bees for pollination. Most of the seed is shipped to the eastern part of the country.

Oats and barley are commonly used as nurse crops in seeding the alsike clover; winter-sown grain is less suitable for this use. Most of the alsike clover is harvested by a combine, and the straw is spread on the ground. Two seed crops are obtained from one planting in places where damage from weeds and insects is not serious, but the second-year crop may be unprofitable because of weeds.

In 1947, several hundred acres in the newly irrigated

North Unit were used successfully for this crop. The newly irrigated soils produce good yields because they are practically free of weeds.

Other legumes.—Ladino clover grown for seed has become an important crop on the newly irrigated soils in Jefferson County. These soils are still relatively free of weeds and insects, and they produce high yields of good seed. According to an estimate by the Oregon Farmer, about 440 acres of Ladino clover was harvested for seed in 1947. The average yield was estimated at about 270 pounds of seed an acre.

Ladino clover is commonly sown in the spring in a nurse crop of barley that has been lightly fertilized with sulfur. If there is no nurse crop, the clover can be planted any time between April and September; it should be fertilized with sulfur. There should be enough bees to pollinate the crop. Two crops of seed are generally obtained from each planting; after the second seed crop, the clover is cut for hay or used for pasture.

Ladino clover is not extensively grown for seed in Deschutes County, because the stand is likely to be invaded by weeds and alsike clover.

Hairy vetch is a suitable seed crop for irrigated soils. It needs little water. It is a 1-year crop, but it can be grown on the same field for successive years. It reseeds itself and requires little soil preparation. It can be seeded during slack periods in winter and harvested early so that, by midseason, irrigation water can be used for other crops. The straw can be plowed under or used as winter feed for livestock.

The seed must be harvested at the right time to minimize losses that result from cutting when the vetch is too green and from shattering. Because it reseeds voluntarily, hairy vetch is generally followed by potatoes or pasture instead of winter grain.

Garden peas, for seed, is a newly introduced crop on soil recently brought under irrigation in Jefferson County in the North Unit; in 1946, this crop was grown on about 950 acres of soil irrigated for the first time.

The acreage of Austrian peas grown in Deschutes County has declined because of a decrease in the price of the seed and the infestation by aphids and weevils.

Only a small amount of red clover has been grown for seed in Deschutes County. Since the irrigation of the North Unit, however, the acreage of this crop has increased. On dairy or livestock farms, red clover is somewhat better suited than alsike clover because the red clover can be cut for hay by the first of June or can be pastured until about the middle of May.

Minor field crops.—Some corn has been grown in Deschutes County, but the climate is not suitable for corn. A small amount of crested wheatgrass has been harvested for seed in Deschutes and Jefferson Counties. At times a few acres of Chewings fescue is grown for seed.

Vegetables.—Vegetables, other than potatoes, are minor crops. In some years a few acres of onions are grown for sale and shipment out of the Area. String beans, cabbage, carrots, green peas, lettuce, and other vegetables are grown mainly for home use and local sale. Possibly some onions, sugar beets, carrots, and lettuce will be grown for seed in the North Unit.

Fruits.—Orchards and vineyards occupied 18 acres in Deschutes County and 14 acres in Jefferson County in 1954. The few farms that specialize in tree fruits or grapes are in the canyons of the Deschutes and Crooked Rivers. At these low altitudes frosts are less injurious, and the growing season is fairly long. In 1954, strawberries were harvested on 9 acres and raspberries on 9 acres in Deschutes County. Some of these small fruits are sold locally.

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Permanent Pasture

Most of the permanent pasture in the Area is nonirrigated range. It consists chiefly of areas of Scabland and associated shallow and stony soils and of strongly sloping and steep areas of other soils. The natural range vegetation is mostly big sagebrush, bunchgrasses, cheatgrass, and herbs. In places this vegetation is mixed with rabbitbrush and western juniper. In the extreme southern and southwestern parts of the Area it is mixed with ponderosa pine and bitterbrush.

Much of the range is in poor or very poor condition. It is used mostly for spring and fall grazing. The carrying capacity is low.

A large acreage, mostly in Jefferson County, that was formerly dry farmed has been seeded to crested wheatgrass. Most of this acreage was purchased by the Federal Government in the 1930's and is now administered as a grazing project by the Soil Conservation Service.

Where the range is in excellent or good condition, the bunchgrasses are abundant, and most of the plants associated with the bunchgrasses are good for forage.

Where the range is in poor or very poor condition, most of the forage is furnished by cheatgrass, also called downy chess or downy brome, an annual or summer annual grass native to Europe. It is now common in this general region and, in places, predominant. Squirreltail and annual fescue occur in places.

Other plants commonly associated with bunchgrasses—balsamroot (*Balsamorhiza* spp.), lupine (*Lupinus* spp.), hawksbeard (*Crepis* spp.), yarrow (*Achillea* spp.), wild-buckwheat (*Eriogonum* spp.), pussytoes (*Antennaria* spp.), wild onion (*Allium* spp.), and biscuitroot (*Cogswellia* spp.)—are less abundant than the grasses and are of less value for forage. Plants that occur as weeds on deteriorated ranges include tumblemustard (*Norta altissima*), also known as Jim Hill mustard, an invader of European origin; Russian-thistle (*Salsola pestifer*), a native of Eurasia; fanweed, tarweed; and fiddleneck (*8*).

Most of the permanent irrigated pastures are on shallow and stony soils, strongly sloping or steep areas, the inadequately drained Odin soils, or fields convenient to the barn. Bluegrass and whiteclover are the common pasture plants. Some of the better and more productive pastures are in a mixture of alta fescue, orchardgrass, smooth brome, meadow foxtail, perennial ryegrass, Ladino clover, white clover, and alsike clover. A few pastures are grazed in rotation, and on some farms sulfur or gypsum, phosphorus, and nitrogen fertilizers are applied.

Livestock and Livestock Products

Table 8 gives the number of livestock on farms in 1940, 1950, and 1954 in all of Deschutes County and Jefferson County. In Deschutes County in 1954, 150 farms were classified as livestock farms, 101 as dairy farms, and 41 as poultry farms. In that year in Jefferson County, 96

TABLE 8.—*Number of livestock on farms in Deschutes and Jefferson Counties, Oreg., in stated years*

Livestock	Deschutes County			Jefferson County		
	1940	1950	1954	1940	1950	1954
Horses and mules	[1] 2, 769	1, 651	1, 313	[1] 1, 499	1, 033	958
Cattle and calves	[1] 10, 243	13, 384	24, 437	[1] 9, 845	11, 831	24, 805
Milk cows	4, 452	3, 567	3, 383	507	1, 024	1, 213
Swine	[2] 3, 350	2, 967	2, 260	[2] 598	1, 745	1, 865
Sheep	[3] 12, 794	3, 468	5, 375	[3] 28, 305	13, 890	12, 142
Chickens	[2] 44, 781	[2] 41, 945	[2] 49, 581	[2] 7, 532	[2] 12, 155	[2] 20, 839
Turkeys raised	104, 358	[4] 43, 894	43, 135	2, 206	[4] 65	220
Other poultry raised	399	407	661	[5]	152	213
Beehives	952	[4] 1, 477	[5]	31	[4] 141	[5]

[1] Over 3 months old.
[2] Over 4 months old.
[3] Over 6 months old.
[4] 1949.
[5] Not reported.

farms were classified as livestock farms, 5 as dairy farms, and none as poultry farms.

Beef cattle.—Beef cattle are an important source of income in the Deschutes Area. Before the North Unit was irrigated, beef cattle enterprises in Jefferson County were dependent on the carrying capacity of the ranges and the supply of winter feed, both of which varied according to the amount of precipitation.

In Deschutes County, cattle are grazed on range and irrigated pasture. From 1940 to 1945, the number of cattle raised for beef increased, partly because sheep were replaced on the range and dairy cattle were replaced on the irrigated farms. The number of cattle in both Deschutes and Jefferson Counties continued to increase from 1950 to 1954.

Hereford and Shorthorn are the dominant breeds; several herds are purebred. Most of the cattle are shipped to Portland. A few are sold to local butchers.

Dairy cattle.—Most of the dairy farms are in the irrigated districts near Redmond and Bend where creameries process whole milk and cream into butter and cheese. Irrigation of the North Unit will probably be followed by an increase in dairying in that part of the Area.

Most of the dairy cattle are Jersey or Guernsey; some are Holstein. A large part of the feed is raised on the farm, but some of it is bought, particularly corn, other grain, and mixed feed.

Turkeys.—Many turkeys are raised in Deschutes County, but only a few are raised in Jefferson County. Several specialized commercial farms raise thousands of turkeys per year; many diversified farms raise smaller flocks for market. Rape, alfalfa, clover, sunflowers, and some grain normally are grown for turkey feed, and a considerable quantity of mixed feed is bought. The turkeys are dressed and prepared for shipment in Redmond.

Other Poultry.—Chickens are generally raised in small flocks as a sideline to other types of farming. Leghorn, Rhode Island Red, and New Hampshire are common breeds.

About enough chickens are raised to supply the local markets. The distance to large markets and the competition from other areas discourage expansion of the chicken industry. Only a few ducks, geese, and guineas are raised.

Sheep.—More sheep have been raised in Jefferson county than in Deschutes County. In Jefferson County the sheep are kept on the range in spring, summer, and fall. In winter they are fed hay. Since irrigation of the North Unit began, the number of sheep in Jefferson County has declined.

The number of sheep in Deschutes County has decreased sharply since 1935. Most of the operators of large sheep ranges have changed to raising other livestock or have gone out of the livestock business (*14*). A considerable proportion of the sheep are in small bands on irrigated farms where nearly all the feed is grown on the farm. The medium-wool breeds predominate. Common breeds are Corriedale, Oxford Down, and Rambouillet.

Swine.—Only a few swine are raised in the Area. The number raised depends somewhat on the amount of available skim milk, cull potatoes, and other farm by-products and waste. Swine are more common on the irrigated farms than on the nonirrigated ones. Practically all the hogs are sold to local butchers or butchered on the farm.

Farm Power and Mechanical Equipment

The number of work horses and mules on farms has decreased with the increase in mechanization. In 1954, 450 farms in Deschutes County reported having 1,313 horses and mules, and 250 farms in Jefferson County reported having 958 horses and mules. Most of the horses are good draft breeds, but many horses are kept mainly for riding.

The kind and quantity of mechanical equipment on the farm depend on the type of farming. The large dryland wheat farms in Jefferson County are highly mechanized. The typical farm has one or more large caterpillar tractors that furnish the power for most of the field operations. Other common equipment on these farms include gang plows, spike- or spring-toothed harrows, rod weeders, grain drills, a large combine, and one or more trucks. In contrast, the cattle or sheep farms that depend largely on ranges for grazing have few or no large implements, except possibly a mower and other hay-making equipment. Some of these farms depend on horses or trucks for power. Heavy equipment is not common on irrigated farms.

In 1954, there were 926 tractors on 691 farms in Deschutes County and 941 tractors on 477 farms in Jefferson County. Most of these tractors are of the small or medium wheel

type. Tractor-drawn or horse-drawn plows of various sizes are used. Most farms are equipped with a small or medium spike- or spring-toothed harrow, disk, grain drill, hay mower, hayrake, hay-stacking equipment, and either a grain binder or a small combine. Some custom work is done with rather small combines, grain binders, threshing machines, ensilage cutters, hay choppers, hay bailers, potato graders, seed cleaners, and leveling equipment. Most farms on which potatoes are grown for sale are equipped with potato planters and one-row potato diggers. In 1954, there were 891 trucks on 688 farms in Deschutes County, as compared to 383 trucks on 347 farms in 1945.

Type and Size of Farms

In 1954, 150 farms in Deschutes County were classified as livestock, 101 as dairy, 41 as poultry, 158 as general, and 77 as field crop; 549 farms were not classified. In 1954, 96 farms in Jefferson County were classified as livestock, 5 as dairy, 91 as general, 290 as field crop, and 5 as fruit and nut; 45 farms were not classified.

The 1,067 farms in Deschutes County in 1954 covered 337,810 acres, an average of 316.6 acres per farm. The 590 farms in Jefferson County in 1954 covered 539,985 acres, an average of 915.2 acres. In recent years large farms have become more numerous in Deschutes County; in Jefferson County the number of farms larger than 1,000 acres has decreased and the number of farms smaller than 1,000 acres has increased.

Farm Tenure

In 1954, owners and part owners operated 979 farms in Deschutes County, tenants operated 83, and managers 5; the owners and part owners operated almost 92 percent of the total number of farms. Tenancy decreased from 20.3 percent in 1940 to 7.8 percent in 1954.

In 1954, owners and part owners operated 450 farms in Jefferson County, tenants operated 134, and managers 6; the owners and part owners operated about 76 percent of the total number of farms. Tenancy increased from 15.0 percent in 1940 to 22.7 percent in 1954.

One common rental arrangement is for the operator to pay all operating expenses and to deliver to the owner one-quarter of the potatoes, one-third of the grain, and one-half of the hay. Another common system is for the operator and the owner to divide the cash expenses and the crops equally.

Farm Home Facilities

In 1954, 1,052 farms in Deschutes County had electricity and 838 had telephones; in Jefferson County 498 farms had electricity and 386 had telephones. The same year, 928 farms in Deschutes County and 472 farms in Jefferson County had running water. In both counties almost all the farmhouses are heated by wood stoves. In 1954, on 879 farms in Deschutes County there were 1,117 automobiles; on 486 farms in Jefferson County there were 639 automobiles.

Soil Survey Methods and Definitions

Soil surveying consists of the examination, classification, and mapping of soils in the field. The soil scientist walks over the area at intervals of not more than one-quarter of a mile and bores into the soil with an auger or digs holes with a spade. Each such boring or hole shows the soil to consist of several distinctly different layers or horizons, collectively known as the soil profile. Each of these layers is studied carefully for the things about it that affect plant growth.

The color of each layer is noted. The darkness of the topmost layer is usually related to its content of organic matter; streaks and spots of gray, yellow, and brown in lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay in each layer, is determined by the way the material feels when rubbed between the fingers. Texture is later checked by mechanical analysis in the laboratory. Texture has much to do with the quantity of moisture the soil will hold available to plants, whether plant nutrients or fertilizers will be held by the soil in forms available to plants or will be leached, and how difficult the soil may be to cultivate.

Soil structure, or the way the soil granulates and the size and number of pore spaces between particles, indicate how easily plant roots can penetrate the soil and how readily water enters it.

Consistence, or the tendency of the soil to crumble or stick together, indicates how difficult it is to keep the soil open and porous under cultivation.

The kinds of rocks or mineral material from which the soil has been developed, or its parent material, affects the quantities and kinds of plant nutrients the soil may have naturally. Simple chemical tests show how acid the soil may be. The depth to bedrock, cemented or compact layers, or loose gravel strata is determined. The presence of gravel or rocks that may interfere with cultivation, the steepness and kind of slope, the quantity of soil lost through erosion, and other external features are observed.

On the basis of all these characteristics, soil areas that are much alike in the kind, thickness, and arrangement of their layers are mapped as one soil type. Some soil types are separated into two or more phases. For example, if a soil type has slopes that range from 0 to 7 percent, the type may be mapped in two phases, 0 to 3 percent slopes and 3 to 7 percent slopes; or a soil that has been eroded in places may be mapped in two or more phases, an uneroded (or normal) phase and an eroded phase. A soil type is divided into phases primarily because of differences in the soil other than those of kind, thickness, and arrangement of layers. Examples of characteristics on the basis of which a soil type might be divided into phases are slope, the number of outcrops of bedrock, the extent of erosion, the degree of drainage, and the nature of or depth to underlying material.

Two or more soil types may have similar profiles; that is, the soil layers may be nearly the same except that the texture, especially the texture of the surface layer, may differ. As long as the other characteristics of the soil layers are similar, these soils are considered to belong in the same soil series. A soil series, therefore, consists of all the soil types that, except for texture, particularly texture of the surface layer, have about the same kind, thickness, and arrangement of layers.

The name of a place near where a soil series was first found is chosen as the name of the series. Thus, Redmond is the name of a soil series in Deschutes County first recognized near Redmond. Three types of the Redmond series are mapped—Redmond sandy loam, Redmond loam, and Redmond clay loam. These soil types differ in the texture of the surface soil, as their names show. Redmond sandy loam is divided into two slope phases, areas of soils having 0 to 3 percent slopes and areas having 3 to 7 percent slopes. The normal phase of Redmond sandy loam is between 16 and 36 inches deep to bedrock, and it is called Redmond sandy loam. Where the depth to bedrock is greater than 36 inches, the soil is called Redmond sandy loam, deep.

Steep rocky mountainsides, loose coarse material in stream channels, and other areas that have little or no true soil are not given soil series and type names. They are considered to be land types and are given descriptive names such as Rough stony land, Riverwash, and Scabland.

The soil type, or if the soil type is subdivided, the soil phase, is the unit of mapping in soil surveys. It is the unit, or the kind, of soil that is most uniform and has the narrowest range of characteristics. For this reason, soil use and management practices can be more definitely specified for it than for broader groups of soils that contain more variation. One can say, for example, that soils of the Deschutes series need additions of organic matter for intertilled crops. In contrast, for Deschutes sandy loam, 0 to 3 percent, it can be said that it needs organic matter and is suited to row crops grown in short rotations. Then, for Deschutes sandy loam, 7 to 12 percent, it can be stated that it is difficult to irrigate, erodes easily, and should be used principally for long-term hay or pasture. Both of these phases are in the Deschutes series.

The soil surveyor makes a map of the county that shows the location of each of the soil types, phases, complexes, and miscellaneous land types in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

Morphology, Genesis, and Classification

Factors of Soil Formation

Soil is the product of the forces of the environment acting on the parent soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by: (1) the physical and mineralogical composition of the parent soil material; (2) the climate under which the soil material has accumulated and developed; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material. The influence of climate on soils depends not only on temperature, rainfall, and humidity, but also on the relief and the physical characteristics of the soil or soil material. The relief, in turn, strongly affects drainage, aeration, runoff, erosion, and exposure to sun and wind.

Climate and vegetation change the parent material from an inert, heterogeneous mass to a body having more or less definite genetic morphology. Their action on the parent material is hastened or hindered to varying degrees by the relief, which helps to determine runoff, natural erosion, the movement of water through the soil, and the natural vegetation. As time passes during the genesis of soil, the slow natural processes cause changes in the soil; hence, time is a factor in the development of the soil into a body that is in equilibrium with its environment. The degree of soil development depends not only on time but also on the rate at which the forces of climate and vegetation act. These forces, in turn, are conditioned somewhat by the relief and parent material.

Parent materials

The Clarno formation (Eocene), which is the oldest exposed formation in the Area, underlies Juniper Butte, Haystack Butte, Gray Butte, and the adjoining hilly, higher region to the east. This formation consists mainly of large massive agglomerates, breccias, tuffs, ashes, and other volcanic materials. It also includes gravels, sands, and clays that were carried by streams from nearby areas and by many lava flows. The lava consisted mainly of rhyolite, but included andesites and basalts (*5*). Because much of the Clarno formation resists geologic erosion, several high peaks occur. The strata of this formation are variously colored; they are exposed in Smith Rock near the Crooked River. Some of the Lamonta, Agency, and Era soils and areas of Rough stony land and Rough broken land overlie materials of the Clarno formation.

Basalt, called Trail Crossing basalt (Eocene?) (*15*), occurs east of Haystack Butte, where it is apparently intercalated in the tuff beds of the Clarno formation. The Gem soils and Rough stony land have formed on this basalt.

The John Day formation (Oligocene) is exposed only in the northern part of the Area in the lower part of the canyons of the Deschutes River and Trout Creek. This formation is white, buff, or varicolored. It is composed largely of volcanic ashes and tuffs. All exposed areas are steep talus slopes or cliffs that extend below a rimrock strata of lava. They are mapped as Rough stony land.

The Columbia River basalt, or Coriba formation (Miocene), at one time lay upon the John Day formation, but it has been eroded away or buried beneath other material in most of the surveyed Area (*5*). It is exposed mainly as rimrock or other strata in the canyons of the Deschutes River and Trout Creek in the northeastern part of the Area. Much of the exposed area of this formation is mapped as Rough stony land, but probably some of the Agency, Era, and Lamonta soils overlie this formation.

The Dalles formation (Pliocene) (*5*), also called the Deschutes formation (*15*), overlies Columbia River basalt at or near the surface in much of the surveyed Area in Jefferson County and in places in the northern part of Deschutes County. Most of the materials of this formation are of volcanic origin and consist of horizontal beds of water-spread materials intercalated with lava flows, mainly basalt. The fluvial beds consist of sandstones, agglomerates, agglomerate mudflows, gravels, sands, silt, tuffs, cinders, volcanic ashes, and, in places, diatomite.

The sandstones, agglomerates, mudflows, and tuffs are more or less consolidated, but some of the materials are loose or only weakly consolidated.

Streams readily cut the fluvial beds, but the interbedded lava flows are resistant to geologic erosion and form rimrock. Beneath the edges of the rimrock, the water-laid sediments are easily carried away and the edges break off. As these beds are nearly horizontal, a plain forms when they are eroded down to one of the interbedded lava flows. The nearly level Agency Plains north of Madras is largely preserved because its northwestern side is protected by the underlying resistant Columbia River basalt. Remnants of similar plains lie west of Madras and near Metolius, Culver, and Opal City.

A mature topography of rolling hills forms where the rimrock has been removed and a thick section of the water-laid sediments is exposed to erosion. The basin at and east of Madras that extends from Gateway to Haystack Butte was formed in this way. In this basin the intermittent streams have formed a dendritic pattern, but further downcutting is prevented, at a temporary base level, by the underlying Columbia River basalt near Gateway (*5*). Some of the Madras, Agency, Era, and Lamonta soils were derived from these thick water-laid sediments overlying basalt.

The Cascan formation (late Pliocene) lies above the Dalles beds in part of the area west of the Deschutes River (*5*). It consists mainly of andesitic lava flows; much agglomerate, tuff, and ash; and some dacites, basalts, and rhyolites. But most of this formation in the surveyed Area is covered by water-laid gravel and sand, possibly of glacial outwash origin. These areas are nearly level. In places the material resembles unassorted or poorly assorted glacial drift.

In late Pleistocene or Recent time, after the rivers had cut canyons about 1,000 feet deep, volcanoes again erupted in the southern part of the Area, particularly near Bend and southward. From volcanoes near Bend and perhaps from local vents elsewhere, very liquid olivine-basalt lava flowed great distances northward and in places spilled into the valleys of the Crooked and Deschutes Rivers (*5* and *15*). Flows entered the Deschutes River north of Bend and near Tetherow Bridge, the latter flow filling the canyon for several miles downstream. One flow entered the Crooked River east of the surveyed Area and flowed down the canyon to below its junction with the canyon of the Deschutes River. Since then the Deschutes River and the Crooked River have cut narrow box canyons with vertical sides in this intracanyon basalt, practically to the level of the original canyons. Below Opal Springs the box canyon cut by the Crooked River is 465 feet deep. The railroad bridge over this box canyon south of Opal City is about 340 feet long and 320 feet above the river.

This intracanyon basalt covered most of the surveyed Area in Deschutes County east of the Deschutes River, except some of the northern part. The surface of the upland lava is vesicular, ropy, and ragged. It has many split mounds, blisters, or "bread crust" swells. The lava may contain opals (*15*). The original topography has been practically unchanged by geologic erosion, and practically no streams have formed. The plain is undulating or somewhat rolling. It consists of alternating narrow ridges, mounds, or swells of outcrops of basalt, and very stony soils or Scabland and intervening swales or disconnected shallow basins. Many of these swales or basins have no surface drainage outlet, but only a few are too poorly drained for the common crops. A few are ponded and need a well drilled into the basalt or an open ditch for an outlet. The arable areas consist of the deeper soils in these swales and basins and in the level areas between the ridges of Scabland. The Redmond and Odin soils and some of the Deschutes soils occur in these areas.

Subsequent to the intracanyon lava flows, a mantle of windborne, very pale brown or light yellowish-brown pumice was laid down over the area. Apparently the pumice is composed of glassy hypersthene-augite dacite with accessory hornblende (*16*). Its source probably was the former volcano (Mt. Mazama) at Crater Lake, although some of it may have come from Newberry Crater, Devil's Hill, or another volcano of the region. In the southern part of the Area, the pumice mantle is about 2 or 2.5 feet thick on the level areas between ridges of Scabland. Apparently water or wind have removed much, and in places all, of the pumice mantle from the ridges of Scabland. Probably the pumice accumulated in the intervening lower flats or basins. To the north, the pumice mantle is thinner than in the south and is composed of fine particles. In the southern part of the Area, the pumice contains a considerable amount of particles the size of coarse and very coarse sand. In Jefferson County north of Juniper and Haystack Buttes, most of the pumice particles are the size of medium and fine sand or smaller, and no distinct mantle of pumice is apparent. Fine volcanic ash and volcanic dust likely were carried across the Area. The Deschutes, Laidlaw, Redmond, and Odin soils were derived principally from this pumice.

Relatively minor quantities of other windborne silt or loess may have been deposited on the soils in the northern part of the Area.

Climate

In the semiarid microthermal climate of the Area, zonal soils of the Brown great soil group have formed. Although the total precipitation is rather low, the relatively high altitude and cool summers cause less evaporation, and moisture is therefore used effectively in the formation of soils. Not enough rain falls to leach the soils strongly, but the upper few inches of many of the virgin soils are neutral to slightly acid. Only a small part of the precipitation falls during the hot months when evaporation is highest; the soils, therefore, are leached to a greater depth than in regions that have about the same annual precipitation but a higher proportion of it in summer.

In general, the total precipitation increases with increase in altitude and with the approach to the Cascade Mountains. Juniper Butte, Haystack Butte, and the surrounding higher area apparently receive a few inches more precipitation than Redmond and Madras. East and southeast of Haystack Butte, at an altitude higher than that in most of the Area and on a northward exposure, soils of the Chestnut great soil group have formed under an annual precipitation of 11 to 12 inches. In these soils, calcium carbonate is leached to a somewhat greater depth than in other soils of the Area.

From Redmond west, southwest, and south toward the Cascades and other high mountains, the precipitation in-

creases to about 13 inches or slightly more at the border of the surveyed Area. This precipitation should be favorable for the formation of Chestnut soils. The soils, however, are forming in somewhat coarse sandy pumice of Recent age, and they are not typical Chestnut soils. They resemble azonal soils of the Regosol great soil group but perhaps should be considered Brown-Brown Podzolic transitional soils that have minimal development. Not much organic matter has accumulated in these soils. The coarse texture and higher precipitation have caused the little calcium carbonate that has formed in them to be leached deeply into or from the profile.

Vegetation and animal activity

The soils in most of the Area were formed under a cover of big sagebrush, bunchgrasses, widely spaced junipers, and associated rabbitbrush, annual grasses, and herbs. In the southern half of the Area where the soils were formed in a mantle of pumice, the junipers are larger and somewhat denser than they are in other regions. Because the vegetation is rather sparse in most of the Area, light-colored soils that are relatively low in organic matter were formed.

In the vicinity of Haystack Butte, where precipitation was higher, the vegetation was similar to that of the rest of the Area, but it was more luxuriant. In this region the soils are darker and contain more organic matter.

In a small part of the surveyed Area along the southern and western borders, the precipitation is higher, the altitude greater, and the summer cooler than in the rest of the Area. Here there is a scattered growth of ponderosa pine mixed with juniper and an understory of bitterbrush, big sagebrush, and grasses. In these areas the precipitation—12 to 13 inches or slightly more—is low for the growth of ponderosa pine. The pumicy material in the soil apparently accounts for the growth of pine and the good growth of juniper. The pumice is vesicular and holds more moisture than other materials of similar texture. It is not, however, suitable for a dense growth of grasses, and the accumulation of organic matter in the soil has been low. Not enough leaf litter has accumulated under the pines and junipers to form a continuous layer. Under the junipers, the litter is as thick as 1 to 2 inches at the base of the trunks of old trees, but there is little or no litter a few feet from the trunk.

The activity of animals, particularly rodents and ants, probably has affected the development of the soil considerably. Ant hills are numerous. Fragments of caliche have been brought to the surface by rodents in digging their burrows. Animals mix the materials of the various horizons and slow the formation of soil horizons.

Relief

Relief has been important in the development of some of the soils; in others it has been less significant. Madras soils, for example, are characterized by caliche in the lower subsoil, but this pan is much more weakly cemented in the strongly sloping soils than it is in the nearly level ones. Similarly, the profile development of the strongly developed Lamonta soils is weaker in areas of greater slopes. The Deschutes soils, however, which have developed in pumicy material, are little affected by a wide range of slopes.

Much of the Area is nearly level, undulating, or rolling. Most of the steep and hilly regions of the buttes and canyons along the rivers and creeks have been included in Rough stony land and Rough broken land. In the steepest areas, geological erosion has been great and only Lithosols or Regosols have developed. On some steep slopes, however, soils with developed horizons have formed.

The small areas of imperfect or poor drainage consist principally of swales or shallow basins underlain by basalt and occupied by Odin soils.

Time

In the different parts of the Area the soil-forming processes have worked on the parent materials for various lengths of time. Factors other than time have significantly affected the rate of soil development. In the nearly level parts of the northern half of the Area, the soil material has been acted on by climatic and biologic forces for a long time. In these regions soils that have a strongly developed or well developed subsoil or a caliche horizon have formed in the residuum of the Dalles or older formations. On slopes where dissection has been more rapid, the profile development is commonly weaker.

In the southern part of the Area, most of the soils are forming in a mantle of sandy pumice of Recent age that perhaps was laid down only 4,000 to 7,000 years ago (*16*). The profile development in these soils is weak where drainage is good to excessive. In the poorly drained swales and shallow basins, profile development is stronger. In these low areas, however, local material probably has been washed onto the soils.

Classification of Soils of the Area

In table 9 the soil series of the Deschutes Area are classified by soil orders and great soil groups, and some of the important factors that affect the development of the soils are given for each series.

Most of the soils are in the Brown great soil group. In places, the Lamonta, Agency, and Era soils have some characteristics of Chestnut soils. The Laidlaw soils lie in a climatic region similar to that of Chestnut soils, but Laidlaw soils probably can be best classified as Brown soils transitional to Brown Podzolic, as they have minimal profile development. They are also somewhat transitional to Regosols. In places, the Metolius soils are transitional to zonal soils.

The Deschutes, Redmond, and Odin series may be considered a catena of soils that formed principally in dacite pumice. The Deschutes series is well drained to somewhat excessively drained, the Redmond series is moderately well drained, and the Odin series is imperfectly to poorly drained.

Morphology of the Soils of the Area

In the following pages, the great soil groups that occur in the Area are described, and the morphology of soil series representative of each great soil group is discussed.

Brown soils

The soils of the Brown great soil group dominate in the Deschutes Area. Their surface soil is light brownish gray, grayish brown, pale brown, or brown. It is about neutral in reaction and fairly low in organic matter. In uncultivated areas that have little vegetation the ½- to 1-inch surface layer is vesicular, and the next 2 to 3 inches is platy. The subsoil is more alkaline than the surface soil and generally more compact or finer textured. It has a

TABLE 9.—*Soil series classified by higher categories and their principal soil-forming factors*

ZONAL

Great soil group and series	Precipitation	Natural vegetation	Parent material	Relief	Drainage	Horizon development
Brown soils:	*Inches*					
Agency	8.5 to 11	Big sagebrush, bunchgrasses, cheatgrass, rabbitbrush, and scattered junipers.	Weathered partly consolidated sandstones, agglomerates, and other fluvial materials, mainly of volcanic origin, including rhyolite, andesite, and basalt; small amount of fine windborne pumice, ash, and loess in upper part; weathered basaltic or other lava material in lower part.	Nearly level to hilly uplands.	Good	Moderate.
Deschutes	8 to 12	Big sagebrush, juniper, rabbitbrush, bunchgrasses, and cheatgrass.	Windborne dacite pumice; in lower part small amount of basaltic and gravelly and sandy materials from other sources; variable substratum.	Same	Good to somewhat excessive.	Weak.
Era	8.5 to 11	Big sagebrush, bunchgrasses, cheatgrass, rabbitbrush, and scattered junipers.	Weathered partly consolidated sandstones, agglomerates, and other fluvial materials, mainly of volcanic origin, including rhyolite, andesite, and basalt; small amount of fine windborne pumice, ash, and loess in upper part; weathered basaltic or other lava material in lower part.	Same	Good	Weak.
Lamonta	8.5 to 11	Same	Weathered partly consolidated sandstones, agglomerates, and other fluvial materials, mainly of volcanic origin, dominantly rhyolitic but includes andesitic and basaltic materials; small amount of windborne pumice, ash, and loess in upper part; in places, basalt substratum.	Nearly level to rolling uplands.	Good	Strong.
Madras	8.5 to 11	Same	Weathered partly consolidated sandstone, agglomerate, and other old fluvial materials, mainly of volcanic origin, including rhyolitic, andesitic, and basaltic materials.	Same	Good	Moderate.
Redmond	8 to 10	Big sagebrush, juniper, bunchgrasses, cheatgrass, and rabbitbrush.	Windborne dacite pumice and, in lower part, small amount of basaltic and gravelly or sandy materials.	Nearly level uplands; in places somewhat concave.	Moderately good.	Moderate.
Chestnut soil:						
Gem	11 to 12	Same	Weathered basalt	Undulating and rolling uplands.	Good	Moderate.
Chestnutlike or transitional between Brown and Brown Podzolic:						
Laidlaw	11 to 13	Big sagebrush, juniper, rabbitbrush, and bunchgrasses; in places some ponderosa pine and bitterbrush.	Windborne dacite pumice, in most places over a pumice flow.	Nearly level to rolling uplands.	Good to somewhat excessive.	Weak.

TABLE 9.—*Soil series classified by higher categories and their principal soil-forming factors*—Continued

Great soil group and series	Precipitation	Natural vegetation	Parent material	Relief	Drainage	Horizon development
INTRAZONAL						
Low-Humic Gley: Odin	8 to 10	Grasses, big sagebrush, rabbitbrush; in places, sedges and reeds.	Windborne dacite pumice, probably mixed with or overlying weathered partly consolidated sandstone or other water-laid materials from nearby sources.	Depressions and small basins in uplands.	Imperfect to poor.	Medium.
AZONAL						
Alluvial soil: Metolius	8.5 to 11	Big sagebrush, bunchgrasses, cheatgrass, rabbitbrush, and scattered junipers.	Stratified sandy and loamy alluvium derived from dacite pumice and mixed volcanic materials.	Nearly level and gently undulating bottom lands and alluvial fans.	Good	Very weak.

horizon of lime accumulation below depths of 1.5 to 3 feet.

The Brown soils occur in areas that have a semiarid microthermal climate with an average annual precipitation between 8 and 11 inches and a natural vegetation dominated by big sagebrush, bunchgrasses, juniper, rabbitbrush, and cheatgrass.

AGENCY SERIES

In the Agency series are soils of the Brown great soil group that formed under a normal annual precipitation of 8.5 to 11 inches and a natural vegetation of big sagebrush, bunchgrasses, scattered junipers, and associated plants. These well-drained soils occur mainly in nearly level or gently undulating upland plains, and in some areas that are more dissected.

The upper part of Agency soils was derived principally from weathered, partly consolidated, sedimentary materials of the Dalles formation. These materials include pumiceous or tuffaceous sandstones, agglomerates, gravel, sands, tuffs, cinders, ashes, and agglomerate-mudflows (*5*). The water-spread materials are mostly volcanic. The sandstones and agglomerates dominate in the parent material. They are mixed and contain much rhyolitic and other acidic materials and materials that are andesitic and more basic. In some places the upper part of the soil contains a small admixture of fine pumice, volcanic ash, and loess. The lower parts of the soil typically are affected by or derived from weathered basaltic fragments which overlie basalt bedrock. The soils are moderately developed.

The following representative profile of Agency loam was observed on a north-facing slope of 5 percent in the northeastern part of the Agency Plains in the northeastern corner of sec. 26, T. 9 S., R. 13 E. The natural vegetation is dominated by big sagebrush, bunchgrasses, and cheatgrass.

A_1 0 to 7 inches, light brownish-gray to grayish-brown (10YR 5.5/2) light loam; weak very fine granular structure; when moist, very dark grayish brown (10YR 3/2) and very friable; pH 6.7 (bromthymol blue) at a depth of ½ inch, 7.0 at 5 inches; between shrubs thin fragile crust forms rough surface over ½ to 1 inch of vesicular material; when dry, vertical cracks form 5- or 6-sided plates 2 to 4 inches in diameter; next lower 2 or 3 inches is thin platy.

A_3 7 to 11 inches, loam slightly browner (10YR 5.5/2.5) than horizon above; when moist, dark grayish brown (10YR 4/2) and friable; pH 7.2 (bromthymol blue); moderately porous but otherwise similar to layer above.

B_{21} 11 to 15 inches, brown to pale-brown (10YR 5.5/3) light clay loam containing a few small stones of basalt; hard weak to moderate medium and fine subangular blocky structure; when moist, dark brown (10YR 4/3) and firm to friable; aggregates very thinly coated with slightly darker colloidal material; moderately porous; pH 7.6 (cresol red).

B_{22} 15 to 23 inches, brown (10YR 5/3) very hard clay loam containing a moderate number of angular fragments of basalt as much as 8 inches in diameter; moderate fine subangular blocky structure; when moist, dark yellowish brown (10YR 4/4) and firm; aggregates thinly coated with darker brown (7.5YR 4/3 moist) colloidal material; slightly to moderately porous; contains a few lighter colored krotovinas; pH 7.8 (cresol red).

C_{ca} 23 to 31 inches, principally fragments of basalt; small amount of interstitial material similar to material of the horizon above; lime in veins and as coatings; grades into basalt bedrock at a depth of about 31 inches.

The upper 16 inches of this soil apparently was derived mainly from pumiceous or tuffaceous sandstone. It contains a small quantity of very pale brown, light yellowish-brown, or yellow pumice the size of medium and fine sand. Probably small amounts of windborne fine pumice, volcanic ash, and loess have been added. The B_{22} horizon was derived from mixed residuum from sandstone and basalt. In places enough basalt fragments are on and in the surface soil to prevent tillage. The upper part of this soil commonly contains a few red rhyolitic and dark-colored basaltic and andesitic pebbles. These pebbles are rounded and subangular.

DESCHUTES SERIES

The Deschutes series consists of Brown soils that have formed in a climate and on relief similar to those in which

the Agency soils have formed. The junipers on the Deschutes soils, however, are larger and more numerous than those on the Agency soils, and the bunchgrasses are sparser. Some of the junipers have a trunk 20 inches in diameter and a height of 30 feet. The higher water-holding capacity of the vesicular pumiceous material of the Deschutes soils possibly accounts for the more vigorous growth of the junipers.

The Deschutes soils differ from Agency soils in their parent material and degree of development. They were formed principally in dacite pumice sand, probably mixed with some finer volcanic dust. The lower part of the soils may be more or less mixed with fragments of basalt, pebbles, and other local alluvium from nearby ridges of Scabland, or with gravelly or sandy material from other sources. The pumice may have been deposited 4,000 to 7,000 years ago (*16*). The parent materials have been only slightly altered. A weakly developed profile has formed. A small amount of organic matter has accumulated in the surface soil.

The pumice was laid down on a basalt flow, probably of Recent age; on sandy and gravelly outwash fans, perhaps glacial outwash; on semicemented older gravelly and sandy materials; on volcanic cinders; and perhaps on other materials. The pumiceous material generally is deep enough to constitute the solum. Included in the Deschutes series are several soils having a solum similar to that of typical Deschutes soils but a substratum that differs widely.

Some of the coarser textured Deschutes soils are somewhat transitional to Regosols. In the extreme southern and western parts of the Area where the precipitation is higher and bitterbrush and ponderosa pine grow, some of the Deschutes soils differ somewhat from the typical soils of the series in being noncalcareous throughout, slightly less alkaline, and slightly darker in the surface soils. These soils are mapping inclusions. They somewhat resemble the Laidlaw soils.

The following is a representative profile of Deschutes sandy loam, observed about a mile southeast of Redmond in the SE¼SE¼ sec. 15, T. 15 S., R. 13 E. This soil occurs in nearly level areas or swales that lie about 5 feet lower than the adjacent ridges of Scabland. The natural vegetation is dominated by big sagebrush but includes considerable rabbitbrush, scattered junipers, and sparse bunchgrasses. Scattered basalt fragments are on and in this soil.

A_1 0 to 4 inches, light brownish-gray to pale-brown (10YR 6/2.5), soft sandy loam; mostly pumiceous material containing a moderate quantity of light yellowish-brown, very pale brown, or pale-yellow coarse sandy pumice and a little pumice the size of small pebbles. Structure of ½-inch surface layer is single grain to very weak very fine granular and, in lower part, vesicular; rest of layer is weak thin platy; top of plates is grayer and smoother than bottoms; when moist, dark grayish brown (10YR 4/2) and very friable; pH 6.6 (bromthymol blue) at depth of ⅛ inch; 6.7 at 3 inches.

A_3 4 to 13 inches, similar to layer above except slightly browner or yellower; single-grain to very weak very fine granular structure, and pH of 7.2 (bromthymol blue).

B_2 13 to 21 inches, light yellowish-brown (2.5Y 6/3) to pale-brown (10YR 6/3), hard heavy sandy loam; weak fine and medium subangular blocky structure; aggregates slightly dense to slightly porous, pumiceous, like layer above, but contains a little dark-colored material; pH 7.8 (cresol red); when moist, dark brown (10YR 4/3) to dark grayish brown (10YR 4/2) and olive brown (2.5Y 4/3) and firm to friable.

B_{3ca} 21 to 28 inches, similar to layer above but has few lime veins in places and a pH of 8.0 (cresol red); aggregates themselves slightly dense but, between aggregates, very porous and somewhat loose.

D 28 inches +, basalt bedrock; top and cracks coated with white lime.

ERA SERIES

In the Era series are soils of the Brown great soil group that developed from parent material similar to that of Agency soils and under the influence of similar climate and relief. The degree of profile development of Era soils, however, is weak instead of moderate. The Era subsoil is a sandy loam or loam instead of a clay loam. Several factors cause the weak profile development. In many places the dissection is greater or more recent than that of Agency soils and the slopes are steeper. In some areas the water-spread materials are recent. In other places the cause of the weak development is unknown. Era soils contain considerably less pumice than Deschutes soils and have a more friable subsoil.

The following description of Era sandy loam is representative of the series:

A_p 0 to 7 inches, light brownish-gray to grayish-brown (10YR 5.5/2) slightly hard sandy loam; contains a small amount of pumice sand and a moderate number of red angular and subangular rhyolitic pebbles less than an inch in diameter; single-grained to very weak very fine granular structure; when moist, very dark grayish brown (10YR 3/2), and very friable; pH 7.1 (bromthymol blue).

B_1 7 to 14 inches, slightly finer textured and slightly paler brown than layer above; mainly massive to single-grain structure; friable; pH 7.5.

B_2 14 to 23 inches, pale-brown to brown (10YR 5.5/3) heavy sandy loam or light loam; contains pebbles and pumice sand and a few small fragments like soil in layers above; weak subangular blocky to massive; when moist, dark grayish brown to dark brown (10YR 4/2.5) and friable; pH 7.8 (cresol red).

B_{3ca} 23 to 31 inches, similar to horizon above except that (1) it is slightly calcareous and has lime in segregations and as coatings on some pebbles and rock fragments; (2) it is slightly more distinct in structure; and (3) it contains more rock fragments.

31 inches +, basalt coated with lime.

LAMONTA SERIES

In the Lamonta series are soils of the Brown great soil group. They formed under conditions of climate, relief, and vegetation similar to those under which the Agency soils formed. The parent material of the soils of the two series was rather similar, but in places the Lamonta soils were derived to a greater extent from residuum from fragments of rhyolite. Instead of basalt, the Lamonta soils in most areas are underlain by partly consolidated agglomerates and sandstones of the Dalles formation or by old water-spread or colluvial material from nearby buttes.

Lamonta soils have a claypan subsoil that is finer textured and denser than the subsoil of Agency and Madras soils. This subsoil may result from parent material that is slightly different and finer textured than the parent material of Agency and Madras soils, or it may result from a more advanced stage of development. Because of higher

precipitation and denser vegetation, some of the Lamonta soils near Haystack Butte are slightly darker than typical. These soils have some characteristics of Chestnut soils.

The following representative profile of Lamonta sandy clay loam was observed in a gently sloping upland plain about 3 miles southeast of Culver, about ⅛ mile from the base of a butte in the SE¼NW¼ sec. 27, T. 12 S., R. 13 E:

A_p 0 to 9 inches, grayish-brown (10YR 5/2) hard sandy clay loam containing a moderate number of angular and subangular red rhyolitic pebbles; moderate fine granular structure; when moist, very dark brown (10YR 2/2) and friable; slightly sticky and slightly plastic; pH 7.2 (bromthymol blue).

B_1 9 to 13 inches, grayish-brown to brown (10YR 4.5/2.5) hard heavy sandy clay loam containing pebbles similar to those in layer above; weak medium subangular blocky structure; aggregates very slightly coated with colloids; when moist, very dark grayish brown (10YR 2.5/2) and firm to friable; pH 7.4 (bromthymol blue).

B_2 13 to 26 inches, brown (10YR 4.5/3) very hard dense clay containing a moderate number of subangular and angular red rhyolitic pebbles and small cobblestones; strong fine and medium blocky or subangular blocky structure, very weakly or weakly prismatic; aggregates thickly coated with dark brown colloidal material; when moist, dark brown (10YR 4/3) and firm or very firm; sticky and plastic; pH 7.8 (cresol red); noncalcareous.

B_{31ca} 26 to 35 inches, very pale brown (10YR 7/4) friable hard light clay loam containing a few pebbles and cobblestones similar to those in layer above; weak very fine subangular blocky structure; moderately porous; highly calcareous, with splotches, veins, and coatings of white lime; pH 8.5 (thymol blue).

B_{32ca} 35 to 41 inches, similar to layer above but contains less lime and is more massive.

C_{ca} 41 inches +, weakly cemented or semiconsolidated sandstone or agglomerates; lime in seams and splotches.

MADRAS SERIES

The Madras soils belong to the Brown great soil group. They formed under climate and vegetation similar to those under which the Agency soils formed. Madras soils were derived mainly from residuum from the underlying Dalles formation, mainly partly consolidated pumiceous or tuffaceous sandstone and agglomerate. In places the upper part of the parent material has a small admixture of fine pumice, volcanic ash, and loess.

Unlike the Agency soils, the Madras soils typically have a lime-and-silica hardpan or caliche that overlies or is in a layer of somewhat consolidated sandstone and agglomerate. In places the hardpan is dense and several inches thick. It may be in the form of variously thick plates, which in places are fractured; or it may consist mainly of crusts or cemented thin coats of lime that are on or between the strata of the sedimentary materials or in cracks. In places the hardpan is not continuous. It is more strongly developed in the nearly level higher plains than in the more strongly sloping areas. Generally it is only weakly cemented where the slopes are stronger than 6 to 8 percent.

The typical Madras soil is moderately developed and has a clay loam B_2 horizon. It differs from the Lamonta soils, which have a clay B_2 horizon.

The following representative profile of Madras loam was observed in a pit that was dug in an area having a cover of much big sagebrush, considerable rabbitbrush and cheatgrass, and rather sparse bunchgrasses. The profile was in a level area in the upland plain northwest of Culver in the SE¼NW¼ sec. 12, T. 12 S., R. 12 E.

A_1 0 to 6 inches, grayish-brown to light brownish-gray (10YR 5.5/2) slightly hard to soft loam fine granular structure; contains small amount of medium and coarse sand pumice; and a few red subangular rhyolitic and dark angular vesicular basaltic pebbles as large as 1 inch in diameter; when moist, very dark grayish brown (10YR 3/2) and very friable; pH 6.7 (bromthymol blue) at a depth of ¼ inch, 6.7 at 3 inches; between shrubs, a thin, fragile, micro-rough surface crust overlies ½ inch of slightly vesicular material; structure of next 2½ inches is weak thin or medium platy; lower 3 inches is very thick platy; very many roots.

B_1 (or A_3) 6 to 10 inches, brown to pale-brown (10YR 5.5/3) slightly hard heavy loam or light clay loam containing pebbles like those in horizon above; weak fine granular to subangular blocky structure; when moist, dark grayish brown (10YR 4/2); pH 7.2 (bromthymol blue); many roots.

B_{21} 10 to 18 inches, pale-brown to brown (10YR 5.5/3) very hard clay loam; contains a little pumice sand; and a few rounded and subangular pebbles smaller than 2 inches in diameter; strong fine subangular blocky structure; aggregates coated with brown (10YR 5/3) colloidal material; when moist, firm and brown (10YR 5/3) with dark-brown (7.5YR 3/2) coating on aggregates; few to moderate number of fine pores; pH 7.9 (cresol red); moderate number of roots.

B_{22} 18 to 26 inches, light yellowish-brown (10YR 6/4) firm gravelly clay loam; contains many subangular and rounded pebbles and little pumice sand; moderate subangular fine blocky structure; aggregates coated with pale-brown (10YR 6/3) colloidal material; slightly porous; pH 8.2 (cresol red); moderate number of roots; lower 2 inches slightly calcareous.

C_{mca} 26 to 32 inches, light brownish-gray (10YR 5.5/2) indurated tuffaceous sandstone that can be broken with a spade; stratified or platy; pH 8.5 (cresol red); top part has a 0.1 inch coating of white and pinkish-white, smooth, glazed lime and perhaps siliceous material; bottom of layers micro-rough with stalactites.

D_r 32 inches+, semiconsolidated tuffaceous sandstone.

REDMOND SERIES

The Redmond series consists of Brown soils of the group that formed under climatic and biologic conditions similar to those under which the Deschutes soils formed. The parent material of the soils of the two series were somewhat similar but the pumice of Redmond soils has been mixed with more wash from nearby higher areas. In many places the lower part of Redmond soils was influenced by material weathered from basalt or partly consolidated tuffaceous or pumiceous sandstone. Typically, these soils lie in nearly level, level, or shallow swalelike or concave areas between ridges and mounds of Scabland, or in low areas among higher lying Deschutes soils. In most places, especially where irrigated, these soils are moderately well drained. Some runoff is received from the higher areas.

Redmond soils are in the Deschutes-Redmond-Odin catena, which is a group of soils developed principally in sandy pumice. Redmond soils differ from the weakly developed Deschutes soil in being moderately to moderately weakly developed and in having a B_2 horizon that is distinctly finer in texture and more compact. This development apparently results from the greater moisture and the slightly finer parent material. Redmond soils

are better drained and browner than the Odin soils, and they differ from the Agency soils in being derived mainly from pumiceous material.

The following representative profile was observed under natural cover east of Prineville Junction in NE¼NE¼ sec. 25, T. 14 S., R. 13 E., in a nearly level, very shallow swale, ⅛ mile wide. This moderately well drained area has a cover of big sagebrush, junipers, some rabbitbrush and cheatgrass, and sparse bunchgrasses. The big sagebrush is 2 to 3 feet tall, and the plants are 2 to 4 feet apart. The junipers are as large as 20 inches in diameter and 25 feet tall; they are about 50 to 100 feet apart.

A_{11} 0 to ½ inch, light brownish-gray to grayish-brown (2.5Y 5.5/2) soft sandy loam; contains a moderate quantity of very pale brown, light yellowish-brown, or pale-yellow pumice the size of coarse, medium, and fine sand, a small quantity of pumice the size of very coarse sand, some dark-colored fine sand, and a little red fine sand; also contains a very few angular basalt fragments as large as 1 inch in diameter; very weak very fine granular structure; slightly vesicular and very porous beneath a very thin, fragile, surface crust; when moist, very dark grayish brown (10YR 3/2) and very friable; at depth of ⅛ inch pH 6.5 (bromthymol blue); under juniper trees and big sagebrush shrubs, pH about 6.2; pumice sand collects in miniature depressions on the surface and when dry colors the surface a pale brown or light yellowish brown.

A_{12} ½ to 4 inches, similar to layer above, but structure weak thin to medium platy, with top of plates smooth and grayish, and bottoms of plates pale brownish and rough; pH 6.9 (bromthymol blue).

A_3 4 to 9 inches, light olive-brown (2.5Y 5.5/3) to pale-brown or light brownish-gray (10YR 6/2.5) soft sandy loam; single-grain to very weak very fine granular structure; when moist, dark grayish brown (10YR 3.5/2); pH 7.5 (cresol red); not platy; otherwise similar to horizon above; many roots.

B_1 9 to 11 inches, light yellowish-brown (2.5Y 6/3) to pale-brown (10YR 6/3), slightly hard friable light gritty loam; contains pumice and coarse particles similar to those in horizons above; very weak fine and medium subangular blocky to rounded structure; when moist, dark grayish brown (10YR 3.5/2) and friable; moderate number of fine pores; pH 7.8 (cresol red); very few hard, rounded, slightly dense nodules of soil material; many roots.

B_2 11 to 20 inches, light yellowish-brown (2.5Y 6/3) hard to very hard heavy loam or light clay loam; contains pumice and coarse fragments of basalt like those in horizons above; moderate medium and fine subangular blocky structure; few fine pores; when moist, olive brown (2.5Y 4/3) to dark grayish brown or dark brown (10YR 4/2.5) and firm to friable; pH 8.0 (cresol red); numerous roots; channels coated with brown or dark-brown organic material; few to moderate number of rounded very hard and dense nodules of soil material less than 1 inch in diameter.

B_3 20 to 24 inches, light yellowish-brown to light brownish-gray (2.5Y 6/2.5) hard fine sandy loam; contains a small quantity of pumice sand and a few to moderate number of angular and subangular fragments of basalt as large as 1 inch in diameter; weak medium and fine subangular blocky structure; few to moderate number of fine pores; when moist, olive brown (2.5Y 4/3) to dark grayish brown (10YR 4/2); noncalcareous; pH 8.3 (thymol blue); few to moderate number of roots.

B_{3ca} 24 to 28 inches, similar to horizon above but somewhat calcareous, with lime coatings on lower sides of basalt fragments; pH 8.5.

D 28 inches +, basalt bedrock lime, coated on top and in cracks.

Chestnut soils

Soils of the Chestnut great soil group occupy a small part of the Area southeast and east of Haystack Butte. This region is higher than most of the Area and has more precipitation. In places the soils are on north-facing slopes. Consequently, there is more vegetation, particularly grasses. The soils have a dark and more granular surface soil than Brown soils, as well as a slightly greater depth to the horizon of lime accumulation.

GEM SERIES

Gem soils are well-drained Chestnut soils that formed in residuum from basalt in nearly level to rolling or somewhat hilly uplands. These soils formed under an annual precipitation of 11 or 12 inches. The cover was moderately abundant bunchgrasses, big sagebrush, rabbitbrush, juniper, bitterbrush, and associated herbs. The decaying roots of this vegetation, particularly the bunchgrasses, helped form soils with fairly dark granular surface soils of moderate organic matter content. The finer textured material helped to retain organic matter. Gem soils are moderately developed.

The following representative profile of Gem clay loam was observed in the NW¼NE¼ sec. 13, T. 13 S., R. 13 E:

A 0 to 8 inches, dark grayish-brown (10YR 4/2) hard to very hard clay loam; contains a few angular and subangular fragments of basalt smaller than 4 inches in diameter; when moist, very dark grayish brown (10YR 2.5/2) and firm; neutral to slightly acid; upper 3 inches strong to moderate fine granular structure; rest of layer moderately fine and medium granular; widely spaced vertical cracks.

B_2 8 to 23 inches, brown (10YR 4.5/3) heavy clay loam or clay of a very weak prismatic structure that breaks into dense very hard moderate medium subangular blocky aggregates; aggregates coated with glossy colloid darker than soil material; when moist, dark brown and firm to very firm; noncalcareous; mildly alkaline; contains fragments of basalt like that in horizon above.

B_{3ca} 23 to 28 inches, brown (10YR 5/3) very hard, firm, heavy clay loam containing rock fragments like in layer above; weak medium subangular blocky structure; aggregates glossy and coated with colloid but only faintly darker outside than inside; few large lime veins and splotches.

C_{ca} 28 to 38 inches, light yellowish-brown (10YR 6/4) very hard, heavy clay loam containing numerous basalt fragments; weak subangular blocky structure; moderate amount of lime in veins, on lower side of rock fragments and in splotches.

D 38 inches +, lime-coated fragments of basalt over basalt bedrock.

Chestnutlike or Brown soils transitional to Brown Podzolic

In the southern and southwestern parts of the Area where the normal annual precipitation is 11 to 12 inches or slightly more, the soils that developed differ from typical Chestnut soils. They are noncalcareous throughout, somewhat less dark, lower in organic matter, and less granular. These differences result partly from the coarse pumiceous parent material that has been deposited fairly recently. The little calcium carbonate that has formed has been leached from the sandy material. Less organic matter has formed because this coarse-textured soil with high water-holding capacity seems better suited to trees

than to grasses. In this zone the sagebrush and juniper are mixed with ponderosa pine, which becomes thicker as the precipitation increases. Brown Podzolic soils have formed in this area of higher precipitation where the pine is thicker.

The soils in this transitional zone perhaps can best be classified as Brown-Brown Podzolic transitional soils. They have very weak profile development, and therefore are somewhat transitional to Regosols. A few soils mapped in the Deschutes series have characteristics similar to those of this group.

LAIDLAW SERIES

The Laidlaw soils are transitional between Brown soils and Brown Podzolic soils. They have formed in 2 or 3 feet of windborne pumice sand that was deposited on a pumice flow several feet deep. The pumice apparently is a dacite. This dacite contained or was mixed with small crystals of plagioclase and hypersthene, smaller quantities of augite and hornblende, and some fragments of basalt and andesite. The Laidlaw soils differ from the Deschutes soils mainly in being entirely noncalcareous, somewhat darker, and slightly higher in organic matter.

The following representative profile of Laidlaw sandy loam was observed in the rolling uplands southwest of Tumalo, on an undulating ridge in the SE¼SW¼ sec. 36, T. 16 S., R. 11 E. The natural vegetation consisted of a moderate growth of big sagebrush, widely spaced junipers, some rabbitbrush, and rather sparse bunchgrasses.

0 to 7 inches, grayish-brown (10YR 5/2) soft light sandy loam; contains much pumice the size of medium and coarse sand, a moderate quantity of pumice the size of very coarse sand, small pebbles of pumice as large as 3/16 inch in diameter, a very few pebbles of pumice 3/16 to 1 inch in diameter, and a few subangular pebbles of basalt or andesite as large as 1 inch in diameter; single grain; when moist, very dark grayish brown (10YR 3/2) and very friable; pH 6.4 (bromthymol blue); between shrubs, a very thin fragile surface crust overlies 3 inches of material that is slightly coarse and slightly platy; here pumice particles are light yellowish brown, very pale brown, or pale yellow.

7 to 17 inches, similar to layer above but slightly browner and not platy; very many roots.

17 to 23 inches, pale-brown (10YR 6/3) hard to slightly hard light sandy loam containing pumice and pebbles like those in layer above; weak to very weak medium rounded and subangular blocky structure; when moist, dark grayish brown (10YR 4/2) and friable to firm; noncalcareous; pH 6.9 (bromthymol blue); very many roots.

23 to 30 inches, pale-brown (10YR 6/3) soft, very friable, gravelly loamy sand made up mostly of pumice; contains many rounded and subangular pebbles of pumice as large as 1.5 inches in diameter, and few fragments of pumice as large as 4 inches in diameter; single grain; noncalcareous; many roots; pH 7.6 (cresol red).

30 to 80 inches, light-gray, splotched with yellowish brown, noncalcareous pumice-flow material; consists mostly of fine sandy interstitial pumiceous material among rounded to angular pebbles and lumps of pumice as large as 10 inches in diameter; contains some dark basic rock fragments the size of sand and small pebbles, pumice is light in weight and very vesicular; in most places this material is capped by an indurated layer about 1/20 inch thick; layer apparently cemented by siliceous material; pick or heavy bar needed to break layer; next few inches are weakly to strongly cemented.

Low-Humic Gley soils

The Low-Humic Gley soils have been more affected by depressed relief and imperfect drainage than by climate and vegetation. Gleyed horizons have formed and mottles are common. The lime has been leached from the soil, and not much organic matter has accumulated.

ODIN SERIES

The Odin soils are imperfectly to poorly drained Low-Humic Gleys. They lie in depressions and small basins that generally have no natural outlets. Most of these areas receive runoff from surrounding higher soils. Particularly in irrigated sections, at least a moderately high water table occurs part of the time, and a few areas are flooded for short periods. The poor drainage of some of the areas is probably caused by long periods of irrigation. The natural vegetation probably consisted of bunchgrasses, big sagebrush, rabbitbrush, and junipers, but some areas now have water-loving grasses, sedges, and reeds, and a few places have cattails. The annual precipitation ranges from 8 to 10 inches.

Odin soils are the poorest drained soils of the Deschutes-Redmond-Odin catena, the soils of which formed principally in dacite pumice. In some places, however, the parent material of Odin soils contains local wash. In other places the lower part of the soil was derived from or affected by the underlying partly consolidated sandstone, other water-laid materials, or basalt. The parent material is mixed, but it is mostly acid and igneous. The soils differ from Redmond soils in being more poorly drained, grayer, mottled, and noncalcareous in most places. In many places a weakly cemented layer occurs in the lower part of the Odin soils. This layer appears to be a geologic stratum of the Dalles formation.

The following representative profile of Odin sandy loam was observed southeast of Terrebonne in the NE¼SE¼ sec. 26, T. 14 S., R. 13 E. The site is in a slightly depressed area that is surrounded by Redmond sandy loam and Scabland. The vegetation includes sedges and water-loving grasses, and cattails grow in intermittent ponds in the lowest parts of the site. The entire profile is noncalcareous.

1 to 0 inch, partly decomposed roots and stems of grasses and sedges; pH 6.2.

0 to 3 inches, light-gray heavy sandy loam (2.5Y 7/1) with very few mottles of light yellowish brown (2.5Y 6/4); contains much medium and coarse pumice sand; single grain; when moist, friable and dark gray (2.5Y 4/1), with a very few light olive-brown mottles; pH 6.5 (bromthymol blue); very many roots.

3 to 11 inches, mottled, friable to very friable heavy sandy loam containing pumiceous material like that in layer above; massive to single grain; when moist, dark gray (2.5Y 4/1) mottled with dark brown (7.5YR 4/3) and dark grayish brown (10YR 3.5/2); pH 6.7 (bromthymol blue).

11 to 20 inches, mottled, firm to friable, moderately porous, light sandy clay loam; contains pumice like that in layer above; moderate medium subangular blocky structure; contains some rounded, firm nodules of soil material ½ inch in diameter; when moist, dark grayish brown (10YR 4/2.5) mottled with dark gray (2.5Y 4/1); black or very dark gray stains of iron and manganese on many aggregates; pH 6.8 (bromthymol blue); moderate number of roots.

20 to 37 inches, firm clay loam containing a little pumice sand and a very few cobblestones; moderate to strong fine subangular blocky structure; when moist, dark grayish brown (10YR 4/2) with a few dark-gray mottles and a few dark stains of iron and manganese on aggregates; contains very hard, small, rounded concretions as large as 1/16 inch in diameter; pH 6.9 (bromthymol blue); few roots.

37 to 45 inches, firm, softly cemented sandstone consisting mostly of light-colored materials but containing considerable reddish and dark sand; when moist, dark grayish brown to dark brown (10YR 4/2.5), with a few mottles of darker brown; pH 7.6 (cresol red).

45 to 53 inches, similar to layer above but not mottled.
53 to 60 inches, dark grayish brown (10YR 4/2 when moist) very friable, sandy loam with pockets of dark-brown (7.5YR 4/3) friable clay loam; massive; pH 7.6 (cresol red).

Alluvial soils

Alluvial soils are forming in fairly recent alluvium. These soils do not have a well-developed profile, although some characteristics of the zonal soils may be very weakly expressed. Alluvial soils resemble zonal soils in color of the surface soils, but they have no, or only very weak, textural and structural development, and they have no, or only a weak, horizon of lime accumulation.

METOLIUS SERIES

The Metolius soils are Alluvial soils that are associated with the Brown soils. In places they are somewhat transitional to the Brown soils. The well-drained Metolius soils lie in nearly level to very gently undulating bottom lands of intermittent streams in elongated swales, in plains, and on sloping alluvial fans. They are forming in somewhat stratified sandy and loamy alluvium. This alluvium contains a large quantity of light-colored pumice sand mixed with material from basalt, andesite, and rhyolite. Possibly some of the material was deposited from the air as fine pumice, volcanic ash, or loess. The annual precipitation ranges from 8 to 10 inches. Big sagebrush and bunchgrasses dominate.

The following representative profile of Metolius sandy loam was observed on the nearly level flood plains of the intermittent Mud Spring Creek southeast of Paxton in the SE¼SW¼ sec. 17, T. 10 S., R. 14 E. The pit was dug in a dry-farmed wheatfield. The soil is generally well drained; it is infrequently flooded. The annual precipitation is about 9 inches.

A_p 0 to 6 inches, light brownish-gray to grayish-brown (10YR 5.5/2) slightly hard heavy sandy loam; contains much medium, fine, and coarse pumice sand mixed with sand from other lavas; single-grain to very weak very fine granular structure; when moist, very dark grayish brown (10YR 3.5/2) and very friable; noncalcareous; pH 7.8 (cresol red).

C_{11} 6 to 14 inches, light brownish-gray to pale-brown (10YR 6/2.5) soft moderately porous sandy loam containing pumice and other materials like those in horizon above; single grain; when moist, dark grayish brown (10YR 4/2) and very friable; noncalcareous; pH 7.8 (cresol red).

C_{12} 14 to 22 inches, similar to horizon above in color; very friable heavy sandy loam containing a few firm, dense, rounded to elongated nodules as long as 1 inch; single grain to very weak medium and coarse subangular blocky structure; moderately porous; noncalcareous; pH 8.2 (cresol red).

C_{13} 22 to 29 inches, similar to horizon above in color; very friable light sandy loam containing pumice and other material like those in surface horizon; single-grain structure; slightly calcareous, with the lime disseminated; pH 8.2 (cresol red).

C_{21} 29 to 38 inches, light-gray (10YR 7/1.5) soft very porous loamy sand; single grain; when moist, light olive-brown (2.5Y 5/3) and very friable; slightly calcareous; pH 8.6 (cresol red); much pumice the size of medium- and coarse sand.

C_{22} 38 to 46 inches, light brownish-gray (10YR 6/2) soft very porous light sandy loam; single grain; when moist, dark grayish brown (10YR 4/2) and very friable; noncalcareous or slightly calcareous; pH 8.4.

C_{23} 46 to 49 inches +, light brownish-gray (10YR 6/2) loose gravelly sand; single grain; moderately calcareous, the pebbles slightly lime-coated; contains a little pumice.

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SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(*Feet*)
Agency gravelly loam, 0 to 3 percent slopes.	Aa	Light brownish-gray to grayish-brown noncalcareous gravelly loam; very dark grayish brown when moist.	Brown gravelly clay loam; breaks into subangular blocky aggregates; noncalcareous except in lower part.	Lime-coated rock fragments over basalt bedrock.	1.5 to 3
Agency gravelly loam, 3 to 7 percent slopes.	Ab	Same	Same	Same	1.5 to 3
Agency gravelly loam, 7 to 12 percent slopes.	Ad	Same	Same	Same	1.5 to 2.5
Agency gravelly loam, eroded, 3 to 7 percent slopes.	Ac	Same	Same	Same	1.3 to 2.7
Agency gravelly loam, eroded, 7 to 12 percent slopes.	Ae	Same	Same	Same	1.3 to 2.2
Agency loam, 0 to 3 percent slopes	Af	Light brownish-gray to grayish-brown, noncalcareous, slightly hard loam; very fine granular structure; when moist, very dark grayish brown.	Brown, hard clay loam grading to pale brown or light yellowish brown in the lower part; subangular blocky structure; noncalcareous except in lower part.	Same	1.7 to 3
Agency loam, 3 to 7 percent slopes	Ah	Same	Same	Same	1.7 to 3
Agency loam, 7 to 12 percent slopes	Al	Same	Same	Same	1.5 to 2.5
Agency loam, 12 to 20 percent slopes.	Am	Same	Same	Same	1.5 to 2.5
Agency loam, eroded, 0 to 3 percent slopes.	Ag	Same	Same	Same	1.5 to 2.8
Agency loam, eroded, 3 to 7 percent slopes.	Ak	Same	Same	Same	1.5 to 2.8
Agency loam, eroded, 20 to 35 percent slopes.	An	Same	Same	Same	1.3 to 2.2
Agency loam, stony, 0 to 3 percent slopes.	Ao	Light brownish-gray to grayish-brown, noncalcareous, slightly hard stony loam; very fine granular structure; when moist, very dark grayish brown.	Brown, hard stony clay loam grading to pale brown or light yellowish brown in lower part; subangular blocky structure; noncalcareous except in lower part.	Same	1.7 to 3
Agency loam, stony, 3 to 7 percent slopes.	Ap	Same	Same	Same	1.6 to 2.8
Agency loam, stony, 7 to 12 percent slopes.	Ar	Same	Same	Same	1.5 to 2.5
Agency loam, stony, 12 to 20 percent slopes.	As	Same	Same	Same	1.5 to 2.5
Agency loam, stony, 20 to 35 percent slopes.	At	Same	Same	Same	1.1 to 2.2
Agency sandy loam, 0 to 3 percent slopes.	Au	Light brownish-gray to grayish-brown noncalcareous sandy loam; very dark grayish brown when moist.	Brown, hard sandy clay loam grading to pale brown or light yellowish brown in the lower part; subangular blocky structure; noncalcareous except in lower part.	Same	1.7 to 3
Agency sandy loam, 3 to 7 percent slopes.	Aw	Same	Same	Same	1.7 to 3
Agency sandy loam, eroded, 0 to 3 percent slopes.	Av	Same	Same	Same	1.5 to 2.8
Agency sandy loam, eroded, 3 to 7 percent slopes.	Ax	Same	Same	Same	1.5 to 2.8

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Moderate to somewhat low.	Moderate	Moderate	Very slow; in places, slow or none.	Slight	Moderate	Very easy	Good	Dry-farmed wheat; range.
Same	Moderate	Moderate	Same	Moderate	Moderate	Slightly difficult.	Good	Range; dry-farmed wheat.
Same	Moderate	Moderate	Same	High	Moderate	Difficult	Fair	Range; dry-farmed wheat.
Same	Moderate	Moderate	Same	Moderate	Moderate to low.	Slightly difficult.	Good	Range; dry-farmed wheat.
Same	Moderate	Moderate	Same	High	Same	Difficult	Fair	Range; dry-farmed wheat.
Moderate to somewhat high.	Moderate	Moderate	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Same	Moderate	Moderate	Same	Moderate	Moderate	Slightly difficult.	Very good	Range; dry-farmed wheat.
Same	Moderate	Moderate	Same	High	Moderate	Difficult	Good	Range.
Same	Moderate	Moderate	Same	Very high	Moderate	Very difficult.	Fair	Range; dry-farmed wheat.
Same	Moderate	Moderate	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Same	Moderate	Moderate	Same	Moderate	Moderate	Slightly difficult.	Very good	Range; dry-farmed wheat.
Moderate to low.	Moderate	Moderate	Same	Very high	Moderate to low.	Very difficult.	Poor	Range.
Moderate	Moderate	Moderate	Same	Slight	Moderate	Easy	Very poor	Range.
Moderate	Moderate	Moderate	Same	Moderate	Moderate	Slightly difficult.	Very poor	Range.
Moderate	Moderate	Moderate	Same	High	Moderate	Difficult	Very poor	Range.
Moderate	Moderate	Moderate	Same	Very high	Moderate	Very difficult.	Very poor	Range.
Moderate to low.	Moderate	Moderate	Same	Very high	Moderate to low.	Very difficult.	Very poor	Range.
Moderate	Moderate to somewhat rapid.	Moderate	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; range.
Moderate	Same	Moderate	Same	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Moderate	Same	Moderate	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Moderate	Same	Moderate	Same	Moderate	Moderate	Slightly difficult.	Good	Dry-farmed wheat; range.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	(*Feet*)
Deschutes coarse sandy loam, over sandy material, 0 to 3 percent slopes.	Da	Grayish-brown to dark grayish-brown, noncalcareous, soft coarse sandy loam; single grain; when moist, very dark grayish brown; neutral reaction; slightly gravelly.	Grayish-brown to brown, very porous, very friable coarse sandy loam; single grain; slightly firmer in lower part; noncalcareous; neutral reaction	Gray and dark-gray, loose gravelly sand or coarse sand; single grain; noncalcareous.	1.7 to 3
Deschutes loam, stony, 0 to 3 percent slopes.	Db	Light brownish-gray to grayish-brown, noncalcareous, slightly hard light loam containing much pumice; stony.	Pale-brown or light yellowish-brown loam; weak subangular blocky aggregates; noncalcareous except in lower part.	Basalt bedrock, thinly coated with lime.	1.7 to 3
Deschutes loamy coarse sand, over gravelly material, 0 to 3 percent slopes.	Dc	Brown or grayish-brown, soft, noncalcareous loamy coarse sand; some pebbles; mostly pumice.	Brown or grayish-brown to pale-brown, slightly hard or soft, noncalcareous coarse sandy loam or loamy sand.	Noncalcareous somewhat loose gravelly loamy sand.	1.7 to 3
Deschutes loamy coarse sand, over gravelly material, 3 to 7 percent slopes.	Dd	Same	Same	Same	1.7 to 3
Deschutes loamy sand, 0 to 3 percent slopes.	De	Grayish-brown or light brownish-gray loamy sand grading to brown or pale brown; soft or very friable; single grain; noncalcareous; mostly pumice; when moist, dark grayish brown or very dark grayish brown.	Grayish-brown or light brownish-gray slightly hard loamy sand or sandy loam grading to brown or pale brown; weak subangular blocky structure; slightly calcareous in lower part; mostly pumice.	Basalt bedrock or cemented sedimentary material; top commonly coated with lime.	1.4 to 3
Deschutes loamy sand, 3 to 7 percent slopes.	Dg	Same	Same	Same	1.4 to 3
Deschutes loamy sand, 7 to 12 percent slopes.	Dh	Same	Same	Same	1.4 to 3
Deschutes loamy sand, eroded, 0 to 3 percent slopes.	Df	Same	Same	Same	1.3 to 2.9
Deschutes loamy sand, over cinders, 0 to 3 percent slopes.	Dk	Same	Same	Volcanic cinders, generally loose and porous.	1.4 to 3
Deschutes loamy sand, over cinders, 3 to 7 percent slopes.	Dl	Same	Same	Same	1.4 to 3
Deschutes loamy sand, over cinders, eroded, 3 to 7 percent slopes.	Dm	Same	Same	Same	1.3 to 2.9
Deschutes loamy sand, over cobbly material, 0 to 3 percent slopes.	Dn	Grayish-brown or light brownish-gray loamy sand grading to brown or pale brown; soft or very friable; single grain; noncalcareous; mostly pumice; contains some pebbles; when moist, dark grayish brown or very dark grayish brown.	Grayish-brown or light brownish-gray, slightly hard loamy sand or sandy loam grading to brown or pale brown; weak subangular blocky structure; slightly calcareous in lower part; mostly pumice; contains some pebbles and cobblestones.	Loose gravel, cobblestones, and few boulders.	1.5 to 3

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Low	Somewhat rapid.	Somewhat rapid.	Very rapid	Slight	Moderate to low.	Very easy to easy.	Excellent	Irrigated hay, grain, alsike clover and vetch seed, and potatoes.
Moderate to somewhat high.	Moderate	Moderate	Very slow; in places, slow or none.	Slight	Moderate	Very easy	Fair	Range; irrigated pasture and hay.
Low	Rapid	Rapid	Very rapid to rapid.	Slight	Low	Easy to slightly difficult.	Excellent	Range; irrigated crops and pasture.
Low	Rapid	Rapid	Same	Moderate	Low	Slightly difficult.	Excellent	Range; irrigated crops and pasture.
Low	Rapid	Rapid	Very slow; in places, slow or none.	Slight	Low	Easy to slightly difficult.	Very good	Irrigated crops and pasture; range; some forest.
Low	Rapid	Rapid	Same	Moderate to somewhat high.	Low	Slightly difficult.	Very good	Same.
Low	Rapid	Rapid	Same	High	Low	Difficult	Good	Range; irrigated hay and pasture.
Low	Rapid	Rapid	Same	Slight	Low	Easy to slightly difficult.	Very good	Range.
Low	Rapid	Rapid	Generally very rapid.	Slight	Low	Same	Very good	Irrigated crops and pastures; range.
Low	Rapid	Rapid	Same	Moderate to somewhat high.	Low	Slightly difficult.	Very good	Range; irrigated crops and pasture.
Low	Rapid	Rapid	Same	Same	Low	Same	Very good	Irrigated crops and pasture.
Low	Rapid	Rapid	Very rapid	Slight	Low	Easy to slightly difficult.	Very good	Irrigated crops and pasture; gravel pits.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(*Feet*)
Deschutes loamy sand, over gravelly material, 0 to 3 percent slopes.	Do	Grayish-brown or light brownish-gray loamy sand grading to brown or pale brown; soft or very friable; single grain; noncalcareous; mostly pumice; contains a few pebbles; when moist, dark grayish brown or very dark grayish brown.	Grayish-brown or light brownish-gray, slightly hard loamy sand or sandy loam grading to brown or pale brown; weak subangular blocky structure; slightly calcareous in lower part; in places, noncalcareous; mostly pumice; contains some gravel.	Nearly loose or very friable gravelly cobbly sandy loam or loamy sand.	2 to 3.5
Deschutes loamy sand, over gravelly material, 3 to 7 percent slopes.	Dp	Same	Same	Same	1.5 to 3
Deschutes loamy sand, over semicemented sandy material, 0 to 3 percent slopes.	Dr	Same	Same	Weakly to strongly cemented sandy material, mixed in many places with gravel and cobblestones; mostly highly calcareous; over sand or sand, gravel, and cobblestones.	2 to 3
Deschutes loamy sand, over semicemented sandy material, 3 to 7 percent slopes.	Ds	Same	Same	Same	2 to 3
Deschutes loamy sand, over semicemented sandy material, 7 to 12 percent slopes.	Dt	Same	Same	Same	1.5 to 3
Deschutes sandy loam, 0 to 3 percent slopes.	Du	Grayish-brown or light brownish-gray to brown or pale-brown, soft or very friable sandy loam; noncalcareous; mostly pumice.	Pale-brown or light yellowish-brown, hard or firm sandy loam; weak subangular blocky structure; slightly calcareous in lower part; mostly pumice.	Basalt bedrock or cemented sedimentary material; commonly coated with lime on top.	1.4 to 3
Deschutes sandy loam, 3 to 7 percent slopes.	Dv	Same	Same	Same	1.4 to 3
Deschutes sandy loam, 7 to 12 percent slopes.	Dw	Same	Same	Same	1.4 to 3
Deschutes sandy loam, 12 to 20 percent slopes.	Dy	Same	Same	Same	1.4 to 3
Deschutes sandy loam, deep, 0 to 3 percent slopes.	Dz	Same	Same	Same	3 to 5
Deschutes sandy loam, deep, 3 to 7 percent slopes.	Dea	Same	Same	Same	3 to 5
Deschutes sandy loam, deep over cinders, 0 to 3 percent slopes.	Deb	Same	Same	Volcanic cinders or pumicy material; generally loose and porous.	3 to 5
Deschutes sandy loam, eroded, 7 to 12 percent slopes.	Dx	Same	Same	Basalt bedrock or cemented sedimentary material; commonly coated with lime on top.	1.4 to 3
Deschutes sandy loam, over cinders, 0 to 3 percent slopes.	Dec	Same	Same	Volcanic cinders or pumicy material; generally loose and porous.	1.3 to 3
Deschutes sandy loam, over cinders, 3 to 7 percent slopes.	Ded	Same	Same	Same	1.3 to 3
Deschutes sandy loam, over cinders, eroded, 3 to 7 percent slopes.	Del	Same	Same	Same	1.3 to 3

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Low	Rapid	Rapid	Rapid	Slight	Low	Same	Very good	Irrigated crops and pasture; range; dry-farmed rye.
Low	Rapid	Rapid	Rapid	Moderate to somewhat high.	Low	Slightly difficult.	Very good	Range; irrigated crops and pasture.
Low	Rapid	Rapid	Slow through the cemented layer; very rapid below.	Slight	Low	Easy to slightly difficult.	Very good	Range; irrigated crops and pasture.
Low	Rapid	Rapid	Same	Moderate to somewhat high.	Low	Slightly difficult.	Very good	Range; irrigated crops and pasture.
Low	Rapid	Rapid	Very rapid	High	Low	Difficult	Good	Range.
Moderate	Moderate to rapid.	Moderate to rapid.	Very slow; in places, slow or none.	Slight	Moderate	Very easy to easy.	Very good	Irrigated crops and pasture; some range.
Moderate	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Very good	Same.
Moderate	Same	Same	Same	High	Moderate	Difficult	Good	Range; irrigated hay and pasture.
Moderate	Same	Same	Same	Very high	Moderate	Very difficult.	Fair	Range.
High	Same	Same	Same	Slight to negligible.	Moderate	Very easy to easy.	Very good	Irrigated crops and pasture.
High	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Very good	Irrigated crops and pasture.
High to moderate.	Same	Same	Generally rapid.	Slight to negligible.	Moderate	Very easy to easy.	Very good	Irrigated crops and pasture.
Moderate	Same	Same	Very slow; in places, slow or none.	High	Moderate	Difficult	Good	Range; irrigated crops and pasture.
Moderate	Same	Same	Generally rapid.	Slight	Moderate	Very easy to easy.	Very good	Irrigated crops and pasture.
Moderate	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Very good	Irrigated crops and pasture; range.
Moderate to low.	Same	Same	Same	Moderate	Moderate to low.	Same	Very good	Irrigated crops and pasture.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(Feet)
Deschutes sandy loam, over semicemented sandy material, 0 to 3 percent slopes.	Deo	Light brownish-gray or grayish-brown, soft or very friable sandy loam; noncalcareous; mostly pumice.	Pale-brown or light yellowish-brown, hard or firm sandy loam; weak subangular blocky structure; slightly calcareous in lower part; mostly pumice; contains some pebbles.	Weakly to strongly cemented sandy material, mixed in many places with gravel and cobblestones; mostly highly calcareous; over sand or sand, gravel, and cobblestones.	2 to 3
Deschutes sandy loam, over semicemented sandy material, 3 to 7 percent slopes.	Des	Same	Same	Same	2 to 3
Deschutes sandy loam, over semicemented sandy material, 7 to 12 percent slopes.	Dla	Same	Same	Same	2 to 3
Deschutes sandy loam, over semicemented sandy material, eroded, 12 to 20 percent slopes.	Dlb	Same	Same	Same	1.5 to 3
Deschutes sandy loam, shallow, 0 to 3 percent slopes.	Dlc	Same	Pale-brown or light yellowish-brown, hard or firm sandy loam; slightly calcareous in lower part; mostly pumice; few rock fragments.	Basalt bedrock or cemented sedimentary material; commonly coated with lime on top or in cracks.	0.7 to 1.3
Deschutes sandy loam, shallow, 3 to 7 percent slopes.	Dle	Same	Same	Same	0.7 to 1.3
Deschutes sandy loam, shallow over cinders, 0 to 3 percent slopes.	Dlo	Same	Same	Volcanic cinders or pumicy material; generally loose and porous.	0.7 to 1.3
Deschutes sandy loam, shallow over cinders, eroded, 3 to 7 percent slopes.	Dls	Same	Same	Same	0.7 to 1.3
Deschutes sandy loam, stony, 0 to 3 percent slopes.	Dsa	Light brownish-gray or grayish-brown, soft or very friable stony sandy loam; noncalcareous; mostly pumice.	Pale-brown or light yellowish-brown, hard or firm stony sandy loam; slightly calcareous in lower part; mostly pumice; few rock fragments.	Basalt bedrock or cemented sedimentary material; commonly coated with lime on top.	1.4 to 3
Deschutes sandy loam, stony, 3 to 7 percent slopes.	Dsb	Same	Same	Same	1.4 to 3
Deschutes sandy loam, stony, 7 to 12 percent slopes.	Dsc	Same	Same	Same	1.4 to 3
Deschutes sandy loam, stony, over cinders, 3 to 7 percent slopes.	Dsd	Same	Same	Volcanic cinders or pumicy material; generally loose and porous.	1.4 to 3
Deschutes sandy loam, stony, over semicemented sandy material, 0 to 3 percent slopes.	Dse	Same	Same	Weakly to strongly cemented sandy material, mixed in many places with gravel and cobblestones; mostly highly calcareous; over sand or sand, gravel, and cobblestones.	2 to 3
Deschutes sandy loam, stony, over semicemented sandy material, 3 to 7 percent slopes.	Dsl	Same	Same	Same	2 to 3
Deschutes sandy loam, stony, over semicemented sandy material, 7 to 12 percent slopes.	Dso	Same	Same	Same	2 to 3

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Moderate	Moderate to somewhat rapid.	Moderate to somewhat rapid.	Slow through the cemented layer; very rapid below.	Slight to negligible.	Moderate	Very easy to easy.	Very good	Irrigated crops and pasture; range.
Moderate	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Very good	Range; irrigated crops and pasture.
Moderate	Same	Same	Same	High	Moderate	Difficult	Good	Range; irrigated hay and pasture.
Moderate to low.	Same	Same	Same	Very high	Moderate to low.	Very difficult.	Fair	Range; irrigated hay and pasture.
Low	Same	Same	Very slow; in places, slow or none.	Slight to negligible.	Low	Slightly difficult.	Very good	Range; irrigated pasture and hay.
Low	Same	Same	Same	Moderate	Low	Difficult	Good	Range; irrigated pasture and hay.
Low to very low.	Same	Same	Generally rapid.	Slight to negligible.	Low	Difficult	Very good	Range; irrigated pasture and hay.
Same	Same	Same	Same	Moderate	Low	Difficult	Good	Range; irrigated pasture and hay.
Moderate	Same	Same	Very slow; in places, slow or none.	Slight	Moderate	Easy	Fair or poor.	Range; irrigated pasture and hay.
Moderate	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Fair to poor.	Range; irrigated pasture and hay.
Moderate	Same	Same	Same	High	Moderate	Difficult	Fair or poor.	Range; irrigated pasture and hay.
Moderate	Same	Same	Generally rapid.	Moderate	Moderate	Slightly difficult.	Fair or poor.	Range; irrigated pasture and hay.
Moderate	Same	Same	Slow through the cemented layer; very rapid below.	Slight	Moderate	Easy	Fair or poor.	Range.
Moderate	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Fair or poor.	Range.
Moderate	Same	Same	Same	High	Moderate	Difficult	Fair or poor.	Range.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(Feet)
Era sandy loam, 0 to 3 percent slopes.	Ea	Grayish-brown sandy loam grading to light brownish gray or brown; noncalcareous; when moist, very dark grayish brown and very friable; little pumice sand.	Brown to grayish-brown slightly hard sandy loam or light loam; noncalcareous in upper part; commonly lime-coated rock fragments in lower part.	Lime-coated basalt	2 to 3
Era sandy loam, 3 to 7 percent slopes.	Ec	Same	Same	Lime-coated basalt	2 to 3
Era sandy loam, 7 to 12 percent slopes.	Ee	Same	Same	Lime-coated basalt	2 to 3
Era sandy loam, 12 to 20 percent slopes.	Eg	Same	Same	Lime-coated basalt	2 to 3
Era sandy loam, eroded, 0 to 3 percent slopes.	Eb	Same	Same	Lime-coated basalt	1.8 to 3
Era sandy loam, eroded, 3 to 7 percent slopes.	Ed	Same	Same	Lime-coated basalt	1.8 to 3
Era sandy loam, eroded, 7 to 12 percent slopes.	Ef	Same	Same	Lime-coated basalt	1.8 to 3
Era sandy loam, eroded, 12 to 20 percent slopes.	Eh	Same	Same	Lime-coated basalt	1.8 to 3
Gem clay loam, eroded, 3 to 12 percent slopes.	Ga	Grayish-brown to dark grayish-brown or dark gray, noncalcareous clay loam; fine granular structure; when wet, very dark gray or very dark grayish brown and plastic.	Clay or heavy clay loam that is slightly lighter colored than surface soil; grades to brown with depth; very hard and dense; subangular blocky structure; lower part lighter colored than upper part and splotched with white lime.	Lime-coated basalt fragments over basalt bedrock.	2.5 to 4
Gem clay loam, eroded, 12 to 20 percent slopes.	Gb	Same	Same	Same	2 to 4
Gem clay loam, shallow, 7 to 12 percent slopes.	Gc	Same	Same	Same	1 to 1.4
Gem clay loam, shallow, eroded, 7 to 12 percent slopes.	Gd	Same	Same	Same	1 to 1.4
Gem loam, 3 to 7 percent slopes	Ge	Grayish-brown to dark grayish-brown or dark-gray, noncalcareous loam; fine granular structure; when wet, very dark gray or very dark grayish brown and plastic.	Heavy clay loam that is slightly lighter colored than surface soil; grades to brown with depth; very hard and dense; subangular blocky structure; lower part lighter colored than upper part and splotched with lime.	Same	2.5 to 4
Gem loam, 7 to 12 percent slopes	Go	Same	Same	Same	2.5 to 4
Gem loam, eroded, 7 to 12 percent slopes.	Gs	Same	Same	Same	2.2 to 4
Laidlaw sandy loam, 0 to 3 percent slopes.	La	Grayish-brown sandy loam grading to brown or light brownish gray; single grain; noncalcareous; when moist, very dark grayish brown and very friable; mostly pumice.	Pale-brown noncalcareous sandy loam; weak subangular blocky structure; gravelly loamy sand in lower part; mostly pumice.	Light-gray, splotched with yellowish brown, weakly to strongly cemented pumice flow material.	2 to 3
Laidlaw sandy loam, 3 to 7 percent slopes.	Lb	Same	Same	Same	2 to 3
Laidlaw sandy loam, 7 to 12 percent slopes.	Lc	Same	Same	Same	2 to 3
Laidlaw sandy loam, eroded, 7 to 12 percent slopes.	Ld	Same	Same	Same	2 to 3

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Moderate to high.	Moderate to rapid.	Moderate to rapid.	Very slow; in places, slow or none.	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	High	Moderate	Difficult	Good	Dry-farmed wheat; range.
Same	Same	Same	Same	Very high	Moderate	Very difficult.	Fair	Range; dry-farmed grain.
Same	Same	Same	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	High	Moderate	Difficult	Good	Dry-farmed wheat; range.
Same	Same	Same	Same	Very high	Moderate	Very difficult.	Fair	Range; dry-farmed wheat.
High	Moderate to slow.	Slow	Very slow	Moderate	High	Slightly difficult.	Fair	Dry-farmed grains; range.
High	Same	Slow	Very slow	High	High	Very difficult.	Poor to fair.	Dry-farmed grains; range.
Moderate to low.	Same	Slow	Very slow	Moderate to high.	High to moderate.	Difficult	Fair	Range.
Same	Same	Slow	Very slow	Same	Same	Difficult	Fair	Range.
High	Moderate	Slow	Very slow	Moderate	High	Easy	Good	Dry-farmed wheat.
High	Moderate	Slow	Very slow	Moderate	High	Slightly difficult.	Good	Range.
High	Moderate	Slow	Very slow	Moderate	High	Same	Good	Range.
Somewhat low to moderate.	Somewhat rapid.	Somewhat rapid.	Very slow to slow.	Slight	Low to moderate.	Very easy to easy.	Very good	Irrigated crops and pasture; range.
Same	Same	Same	Same	Moderate	Same	Slightly difficult.	Very good	Range; irrigated crops and pasture.
Same	Same	Same	Same	High	Same	Difficult	Good	Range; irrigated crops and pasture.
Same	Same	Same	Same	High	Same	Difficult	Good	Irrigated crops and pasture; range.

SOILS OF THE DESCHUTES AREA, OREGON

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(Feet)
Laidlaw sandy loam, eroded, 12 to 20 percent slopes.	Le	Same	Same	Same	1.5 to 3
Lamonta loam, 0 to 3 percent slopes.	Lf	Grayish-brown noncalcareous slightly hard loam; fine granular structure; neutral reaction; when moist, very dark brown or very dark grayish brown.	Dark-brown, brown, or dark grayish-brown, noncalcareous clay; weak prismatic structure that breaks into very hard, dense subangular blocky aggregates with a colloidal coating; lighter colored and highly calcareous in lower part.	Partly consolidated sandstone agglomerate, or cobbly and stony fluvial deposits; in places, rhyolite, basalt, or other lava.	2 to 3
Lamonta loam, 3 to 7 percent slopes.	Lh	Same	Same	Same	2 to 3
Lamonta loam, 7 to 12 percent slopes.	Lm	Same	Same	Same	2 to 3
Lamonta loam, 12 to 20 percent slopes.	Lo	Same	Same	Same	1.5 to 3
Lamonta loam, eroded, 0 to 3 percent slopes.	Lg	Same	Same	Same	1.6 to 2.8
Lamonta loam, eroded, 3 to 7 percent slopes.	Lk	Same	Same	Same	1.6 to 2.8
Lamonta loam, eroded, 7 to 12 percent slopes.	Ln	Same	Same	Same	1.6 to 2.8
Lamonta loam, eroded, 12 to 20 percent slopes.	Lp	Same	Same	Same	1.4 to 2.8
Lamonta loam, shallow, 0 to 3 percent slopes.	Lr	Same	Same	Same	1 to 1.4
Lamonta loam, shallow, 3 to 7 percent slopes.	Ls	Same	Same	Same	1 to 1.4
Lamonta loam, shallow, eroded, 3 to 7 percent slopes.	Lt	Same	Same	Same	1 to 1.4
Lamonta loam, shallow, eroded, 7 to 12 percent slopes.	Lu	Same	Same	Same	1 to 1.4
Lamonta loam, stony, 0 to 3 percent slopes.	Lv	Grayish-brown, noncalcareous, slightly hard stony loam; fine granular structure; neutral reaction; when moist, very dark brown or very dark grayish brown.	Dark-brown, brown, or dark grayish-brown, noncalcareous stony clay; weak prismatic structure that breaks into very hard, dense angular blocky aggregates with a colloidal coating; lighter colored and highly calcareous in lower part.	Same	1.4 to 3
Lamonta loam, stony, 3 to 7 percent slopes.	Lw	Same	Same	Same	1.4 to 3
Lamonta loam, stony, 7 to 12 percent slopes.	Lx	Same	Same	Same	1.4 to 3
Lamonta sandy clay loam, 0 to 3 percent slopes.	Ly	Grayish-brown, noncalcareous, hard sandy clay loam; fine granular structure; neutral reaction; when moist, very dark brown or very dark grayish brown.	Dark-brown to brown or dark grayish-brown, noncalcareous clay; weak prismatic structure that breaks into very hard, dense angular blocky aggregates with a colloidal coating; lighter colored and highly calcareous in lower part.	Same	2 to 3
Lamonta sandy clay loam, 3 to 7 percent slopes.	Lea	Same	Same	Same	3 to 3
Lamonta sandy clay loam, 7 to 12 percent slopes.	Led	Same	Same	Same	1.7 to 3

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Same	Same	Same	Same	High	Same	Very difficult.	Fair	Irrigated crops and pasture; range.
Moderate to somewhat high.	Moderate	Very slow or slow.	Slow	Slight	Somewhat high.	Very easy	Very good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	Moderate	Somewhat high.	Slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	High	Somewhat high.	Difficult	Good	Range; dry-farmed wheat.
Same	Moderate	Same	Slow	Very high	Somewhat high.	Very difficult.	Fair	Range.
Same	Moderate	Same	Slow	Slight	Somewhat high.	Very easy	Good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	Moderate	Somewhat high.	Slightly difficult.	Good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	High	Somewhat high.	Difficult	Fair	Range; dry-farmed wheat.
Same	Moderate	Same	Slow	Very high	Somewhat high.	Very difficult.	Fair	Range; dry-farmed wheat.
Somewhat low.	Moderate	Same	Slow	Slight	Moderate	Very easy	Very good	Range.
Same	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Range; dry-farmed wheat.
Same	Moderate	Same	Slow	Moderate	Moderate	Same	Good	Range; dry-farmed wheat.
Same	Moderate	Same	Slow	High	Moderate	Difficult	Fair	Range; dry-farmed wheat.
Moderate to somewhat high.	Moderate	Same	Slow	Slight	Somewhat high:	Easy	Very poor	Range.
Same	Moderate	Same	Slow	Moderate	Somewhat high.	Slightly difficult.	Very poor	Range.
Same	Moderate	Same	Slow	High	Somewhat high.	Difficult	Very poor	Range.
Same	Moderate to somewhat slow.	Same	Slow	Slight	Somewhat high.	Very easy	Good	Dry-farmed wheat; range.
Same	Same	Same	Slow	Slight to moderate.	Somewhat high.	Easy	Good	Range; dry-farmed wheat.
Same	Same	Same	Slow	High to moderate.	Somewhat high.	Slightly difficult.	Fair	Range; dry-farmed wheat.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	(*Feet*)
Lamonta sandy clay loam, eroded, 0 to 3 percent slopes.	Lz	Same	Same	Same	1.7 to 3
Lamonta sandy clay loam, eroded, 3 to 7 percent slopes.	Lec	Same	Same	Same	1.7 to 3
Lamonta sandy clay loam, eroded, 7 to 12 percent slopes.	Leh	Same	Same	Same	1.7 to 3
Lamonta sandy clay loam, eroded, 12 to 20 percent slopes.	Ler	Same	Same	Same	1.4 to 2.8
Lamonta sandy clay loam, shallow, 0 to 3 percent slopes.	Lev	Same	Same	Same	1 to 1.4
Lamonta sandy clay loam, shallow, 3 to 7 percent slopes.	Lsa	Same	Same	Same	1 to 1.4
Lamonta sandy clay loam, shallow, eroded, 3 to 7 percent slopes.	Lsb	Same	Same	Same	1 to 1.4
Lamonta sandy clay loam, shallow, eroded, 7 to 12 persent slopes.	Lsc	Same	Same	Same	1 to 1.4
Lamonta sandy clay loam, stony, 0 to 3 percent slopes.	Lsd	Grayish-brown, noncalcareous, hard stony sandy clay loam; fine granular structure; neutral reaction; when moist, very dark brown or very dark grayish brown.	Dark-brown, brown, or dark grayish-brown noncalcareous stony clay; weak prismatic structure that breaks into very hard, dense angular blocky aggregates with a colloidal coating; lighter colored and highly calcareous in lower part.	Same	1.7 to 3
Lamonta sandy clay loam, stony, 3 to 7 percent slopes.	Lse	Same	Same	Same	1.7 to 3
Lamonta sandy clay loam, stony, 7 to 12 percent slopes.	Lsl	Same	Same	Same	1.7 to 3
Lamonta sandy clay loam, stony, 12 to 20 percent slopes.	Lso	Same	Same	Same	1.7 to 3
Madras loam, 0 to 3 percent slopes.	Ma	Light brownish-gray to grayish-brown loam; noncalcareous; slightly hard; neutral reaction; very fine granular structure; when moist, very dark grayish brown.	Brown, hard clay loam grading to pale-brown or light yellowish-brown in lower part; subangular blocky structure; overlies white or very pale brown hardpan or caliche; noncalcareous except in lower part.	Partly consolidated tuffaceous or pumiceous sandstone or agglomerate.	1.7 to 2.5
Madras loam, 3 to 7 percent slopes.	Mc	Same	Same	Same	1.7 to 2.5
Madras loam, 7 to 12 percent slopes.	Me	Same	Same	Same	1.7 to 2.5
Madras loam, eroded, 0 to 3 percent slopes.	Mb	Same	Same	Same	1.5 to 2.5
Madras loam, eroded, 3 to 7 percent slopes.	Md	Same	Same	Same	1.5 to 2.5
Madras loam, eroded, 7 to 12 percent slopes.	Mf	Same	Same	Same	1.5 to 2.5

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Same	Same	Same	Slow	Slight	Somewhat high.	Very easy	Good	Dry-farmed wheat; range.
Same	Same	Same	Slow	Moderate	Somewhat high.	Easy	Good	Range; dry-farmed wheat.
Same	Same	Same	Slow	High to moderate.	Somewhat high.	Slightly difficult.	Fair	Range; dry-farmed wheat.
Same	Same	Same	Slow	Very high	Somewhat high.	Difficult	Fair to poor.	Range; dry-farmed wheat.
Somewhat low.	Same	Same	Slow	Slight	Somewhat high.	Very easy	Good	Range.
Same	Same	Same	Slow	Slight to moderate.	Somewhat high.	Easy	Good	Range.
Same	Same	Same	Slow	Same	Somewhat high.	Easy	Good	Range.
Same	Same	Same	Slow	Moderate to high.	Somewhat high.	Slightly difficult.	Fair	Range.
Moderate to somewhat high.	Same	Same	Slow	Slight	Somewhat high.	Easy	Very poor	Range.
Same	Same	Same	Slow	Slight to moderate.	Somewhat high.	Slightly difficult.	Very poor	Range.
Same	Same	Same	Slow	High to moderate.	Somewhat high.	Difficult	Very poor	Range.
Same	Same	Same	Slow	Very high	Somewhat high.	Very difficult.	Very poor	Range.
Same	Moderate	Moderate; through hardpan, very slow ranging to none or slow.	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Same	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult to easy.	Very good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	High	Moderate	Difficult	Good	Range; dry-farmed wheat.
Same	Moderate	Same	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Same	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	High	Moderate	Difficult	Good	Dry-farmed wheat; range.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(*Feet*)
Madras loam, over sandstone, 0 to 3 percent slopes.	Mg	Same	Brown, hard, light clay loam or heavy loam grading to pale brown or light yellowish brown in lower part; subangular blocky structure; overlies weakly cemented hardpan or soft caliche; noncalcareous except in lower part.	Same	1.5 to 2.5
Madras loam, over sandstone, 3 to 7 percent slopes.	Mk	Same	Same	Same	1.5 to 2.5
Madras loam, over sandstone, eroded, 0 to 3 percent slopes.	Mh	Same	Same	Same	1.5 to 2.5
Madras loam, over sandstone, eroded, 3 to 7 percent slopes.	Ml	Same	Same	Same	1.5 to 2.5
Madras loam, stony, 0 to 3 percent slopes.	Mm	Light brownish-gray to grayish-brown stony loam; noncalcareous; slightly hard; very fine granular structure; neutral reaction; when moist, very dark grayish brown.	Brown, hard stony clay loam grading to pale brown or light yellowish brown in lower part; subangular blocky structure; overlies white or very pale-brown hardpan or caliche; noncalcareous except in lower part.	Same	1.5 to 2.5
Madras loam, stony, 3 to 7 percent slopes.	Mn	Same	Same	Same	1.5 to 2.5
Madras loam, stony, 7 to 12 percent slopes.	Mo	Same	Same	Same	1.5 to 2.5
Madras loamy sand, over sandstone, 3 to 7 percent slopes.	Mp	Light brownish-gray to grayish-brown soft loamy sand; single grain; neutral reaction.	Brown, noncalcareous, hard sandy clay loam or heavy loam; subangular blocky structure; overlies weakly to strongly cemented limey sandstone or agglomerate.	Same	1.4 to 3
Madras loamy sand, over sandstone, eroded, 3 to 7 percent slopes.	Mr	Same	Same	Same	1.3 to 3
Madras sandy loam, 0 to 3 percent slopes.	Ms	Light brownish-gray to grayish-brown, soft or slightly hard sandy loam; noncalcareous; single grain; when moist, very dark grayish brown and very friable; neutral reaction.	Brown hard sandy clay loam or clay loam grading to pale brown or light yellowish brown in lower part; subangular blocky structure; overlies white or very pale brown hardpan or caliche; noncalcareous except in lower part.	Same	1.7 to 2.5
Madras sandy loam, 3 to 7 percent slopes.	Mu	Same	Same	Same	1.7 to 2.5
Madras sandy loam, 7 to 12 percent slopes.	My	Same	Same	Same	1.3 to 2.5
Madras sandy loam, deep over sandstone, 0 to 3 percent slopes.	Mea	Same	Brown hard sandy clay loam or clay loam; subangular blocky structure; overlies weakly to strongly cemented sandstone or agglomerate; noncalcareous except in lower part and cemented layer.	Same	3 to 4

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Same	Moderate	Moderate; lower part, slow.	Slow	Slight	Moderate	Very easy	Very good	Range; dry-farmed wheat.
Same	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Moderate	Same	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Same	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Moderate	Moderate; through hardpan, very slow, ranging to none or slow.	Slow	Slight	Moderate	Easy	Very poor	Range.
Same	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult.	Very poor	Range.
Same	Moderate	Same	Slow	High	Moderate	Difficult	Very poor	Range.
Low	Rapid	Moderate; through hardpan, very slow, or slow.	Slow	Moderate	Moderate to somewhat low.	Slightly difficult.	Very good	Range; dry-farmed wheat; irrigated crops and pasture.
Same	Rapid	Same	Slow	Moderate	Same	Same	Very good	Dry-farmed wheat.
Moderate	Moderate to somewhat rapid.	Moderate; through hardpan, very slow, ranging to none or slow.	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Moderate	Same	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat.
Moderate	Same	Same	Slow	High	Moderate	Difficult	Good	Range; dry-farmed wheat.
Somewhat high.	Same	Moderate; through hardpan, very slow, or slow.	Slow	Negligible	Moderate	Very easy	Very good	Dry-farmed wheat; irrigated crops.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(Feet)
Madras sandy loam, deep over sandstone, 3 to 7 percent slopes.	Meb	Same	Same	Same	3 to 4
Madras sandy loam, deep over sandstone, eroded, 3 to 7 percent slopes.	Mec	Same	Same	Same	3 to 4
Madras sandy loam, eroded, 0 to 3 percent slopes.	Mt	Same	Brown hard sandy clay loam or clay loam grading to pale brown or light yellowish brown in lower part; subangular blocky structure; overlies white or very pale brown hardpan or caliche; noncalcareous except in lower part.	Same	1.5 to 2.5
Madras sandy loam, eroded, 3 to 7 percent slopes.	Mv	Same	Same	Same	1.5 to 2.5
Madras sandy loam, eroded, 7 to 12 percent slopes.	Mz	Same	Same	Same	1.5 to 2.5
Madras sandy loam, over sandstone, 0 to 3 percent slopes.	Med	Light brownish-gray to grayish-brown, soft or slightly hard sandy loam; noncalcareous; single grain; when moist, very dark grayish brown and very friable; neutral reaction.	Brown to pale-brown hard sandy clay loam, light clay loam, or heavy loam; subangular blocky structure; overlies weakly to strongly cemented hardpan; noncalcareous except in lower part.	Same	1.4 to 3
Madras sandy loam, over sandstone, 3 to 7 percent slopes.	Meh	Same	Same	Same	1.4 to 3
Madras sandy loam, over sandstone, 7 to 12 percent slopes.	Meo	Same	Same	Same	1.4 to 3
Madras sandy loam, over sandstone, 12 to 20 percent slopes.	Mla	Same	Same	Same	1.4 to 3
Madras sandy loam, over sandstone, eroded, 0 to 3 percent slopes.	Mef	Same	Same	Same	1.4 to 3
Madras sandy loam, over sandstone, eroded, 3 to 7 percent slopes.	Mel	Same	Same	Same	1.4 to 3
Madras sandy loam, over sandstone, eroded, 7 to 12 percent slopes.	Mes	Same	Same	Same	1.4 to 3
Madras sandy loam, over sandstone, eroded, 12 to 20 percent slopes.	Mlc	Same	Same	Same	1.4 to 3
Madras sandy loam, shallow over sandstone, 0 to 3 percent slopes.	Mld	Same	Same	Same	1 to 1.4
Madras sandy loam, shallow over sandstone, 3 to 7 percent slopes.	Mle	Same	Same	Same	1 to 1.4
Madras sandy loam, shallow over sandstone, 12 to 20 percent slopes.	Moc	Same	Same	Same	1 to 1.4
Madras sandy loam, shallow over sandstone, eroded, 3 to 7 percent slopes.	Mlo	Same	Same	Same	1 to 1.4
Madras sandy loam, shallow over sandstone, eroded, 7 to 12 percent slopes.	Mls	Same	Same	Same	1 to 1.4

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Same	Same	Same	Slow	Moderate	Moderate	Easy to slightly difficult.	Very good	Dry-farmed wheat; irrigated crops.
Same	Same	Same	Slow	Moderate	Moderate	Same	Very good	Dry-farmed wheat; range; irrigated crops.
Moderate	Same	Moderate; through hardpan, very slow, ranging to none or slow.	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Moderate	Same	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat.
Moderate	Same	Same	Slow	High	Moderate	Difficult	Good	Dry-farmed wheat; range.
Moderate	Same	Moderate; through hardpan, very slow or slow.	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; irrigated crops and pasture; range.
Moderate	Same	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Same.
Moderate	Same	Same	Slow	High	Moderate	Difficult	Good	Range; dry-farmed wheat.
Moderate	Same	Same	Slow	Very high	Moderate	Very difficult.	Fair	Range; dry-farmed wheat.
Moderate	Same	Same	Slow	Slight	Moderate	Very easy	Very good	Dry-farmed wheat.
Moderate	Same	Same	Slow	Moderate	Moderate	Slightly difficult.	Very good	Dry-farmed wheat; range.
Moderate	Same	Same	Slow	High	Moderate	Difficult	Good	Dry-farmed wheat; range.
Moderate	Same	Same	Slow	Very high	Moderate	Very difficult.	Fair	Range.
Low	Same	Same	Slow	Slight	Moderate to low.	Easy to slightly difficult.	Very good	Range; irrigated crops and pasture; dry-farmed grains.
Low	Same	Same	Slow	Moderate	Same	Difficult	Very good	Dry-farmed grains; range.
Low	Same	Same	Slow	Very high	Same	Very difficult.	Fair	Range.
Low	Same	Same	Slow	Moderate	Same	Difficult	Very good	Range; dry-farmed grain.
Low	Same	Same	Slow	High	Same	Difficult to very difficult.	Good	Range.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(Feet)
Madras sandy loam, stony, over sandstone, 0 to 3 percent slopes.	Mod	Light brownish-gray to grayish-brown, soft or slightly hard stony sandy loam; noncalcareous; single grain; when moist, very dark grayish brown and very friable; neutral reaction.	Brown to pale-brown hard sandy clay loam, or clay loam; stony; subangular blocky structure; overlies weakly to strongly cemented hardpan; noncalcareous except in lower part.	Partly consolidated tuffaceous or pumiceous sandstone or agglomerate; stony.	1.4 to 3
Madras sandy loam, stony, over sandstone, 3 to 7 percent slopes.	Moe	Same	Same	Same	1.4 to 3
Madras sandy loam, stony, over sandstone, 7 to 12 percent slopes.	Mol	Same	Same	Same	1.4 to 3
Madras sandy loam, stony, over sandstone, 12 to 20 percent slopes.	Mos	Same	Same	Same	1.4 to 3
Metolius sandy loam, 0 to 3 percent slopes.	Mta	Light brownish-gray to grayish-brown noncalcareous sandy loam; contains light yellowish-brown or very pale brown pumice sand; when moist, very dark grayish brown and very friable.	Pale-brown to light brownish-gray slightly hard sandy loam; contains pumice similar to that in surface soil; generally calcareous below 23 inches.	Stratified sandy loam, loamy sand, or gravelly sandy material; calcareous.	3 to 5+
Metolius sandy loam, 3 to 7 percent slopes.	Mtd	Same	Same	Same	3 to 5+
Metolius sandy loam, 7 to 12 percent slopes.	Mts	Same	Same	Same	3 to 5+
Metolius sandy loam, eroded, 0 to 3 percent slopes.	Mtc	Same	Same	Same	3 to 5+
Metolius sandy loam, eroded, 3 to 7 percent slopes.	Mte	Same	Same	Same	3 to 5+
Metolius sandy loam, terrace position, 0 to 3 percent slopes.	Mtl	Same	Same	Same	3 to 5+
Metolius sandy loam, terrace position, 3 to 7 percent slopes.	Mto	Same	Same	Same	3 to 5+
Odin clay loam, 0 to 3 percent slopes.	Oa	Light brownish-gray or gray noncalcareous clay loam containing pumice sand; when wet, very dark grayish brown, sticky, and plastic; neutral.	Light brownish-gray or gray heavy clay loam containing pumice sand; massive or weak subangular blocky structure; when wet, dark grayish brown, sticky, and plastic; generally noncalcareous.	Partly consolidated pumice or tuffaceous sandstone or basalt.	3 to 4
Odin clay loam, 3 to 7 percent slopes.	Ob	Grayish-brown, noncalcareous clay loam containing pumice; when wet, very dark grayish brown, sticky, and plastic; neutral.	Grayish-brown clay loam; in places calcareous and moderately to strongly alkaline in lower subsoil.	Stratified sandy or gravelly alluvial material.	5+

See footnotes at end of table.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Moderate	Moderate	Same	Slow	Slight	Moderate	Easy	Very poor	Range.
Moderate	Moderate	Same	Slow	Moderate	Moderate	Slightly difficult.	Very poor	Range.
Moderate	Moderate	Same	Slow	High	Moderate	Difficult	Very poor	Range.
Moderate	Moderate	Same	Slow	Very high	Moderate	Very difficult.	Very poor	Range.
Moderate to somewhat high.	Somewhat rapid.	Somewhat rapid.	Variable, generally rapid.	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	Moderate	Moderate	Easy to slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	High	Moderate	Difficult	Good	Dry-farmed wheat; range.
Same	Same	Same	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	Moderate	Moderate	Easy to slightly difficult.	Very good	Dry-farmed wheat; range.
Same	Same	Same	Same	Slight	Moderate	Very easy	Very good	Dry-farmed wheat; range; irrigated orchards.
Same	Same	Same	Same	Moderate	Moderate	Easy to slightly difficult.	Very good	Same.
Very high	Slow except in areas that have a high water table.	Slow except in areas that have a high water table.	Slow except in areas that have a high water table.	Negligible	Moderate	Very easy	Good to fair.	Irrigated grains, alsike clover, and pasture; dry-farmed wheat.
Very high	Same	Same	Same	Moderate	Moderate	Easy	Good	Range.

SOILS OF THE DESCHUTES AREA, OREGON:

Soil or land type	Map symbol	Soil Profile			Depth [1]
		Surface soil	Subsoil	Underlying material	
					(Feet)
Odin sandy loam, 0 to 3 percent slopes.	Oc	Light brownish-gray to light-gray, noncalcareous, friable sandy loam; when moist, very dark grayish brown; neutral; contains much pumice sand.	Light brownish-gray firm to friable sandy clay loam or clay loam; subangular blocky structure; when wet, dark grayish brown; generally few very dark gray iron and manganese stains; generally noncalcareous.	Partly consolidated pumiceous or tuffaceous sandstone; stratified.	3 to 4
Redmond clay loam, 0 to 3 percent slopes.	Ra	Light brownish-gray to grayish-brown, noncalcareous light clay loam; when moist, very dark grayish brown; contains pumice sand.	Pale-brown to light yellowish-brown or light brownish-gray, hard clay loam; subangular blocky structure; when moist, dark grayish-brown; contains pumice sand; noncalcareous except in lower part.	Basalt bedrock or partly consolidated sandstone or agglomerate.	2.5 to 3.5
Redmond loam, 0 to 3 percent slopes.	Rb	Light brownish-gray to grayish-brown noncalcareous loam; when moist, very dark grayish brown; contains much pumice sand.	Pale-brown to light yellowish-brown or light brownish-gray, hard, light clay loam; subangular blocky structure; much pumice sand; noncalcareous except in lower part.	Same	2.5 to 3.5
Redmond sandy loam, 0 to 3 percent slopes.	Rc	Light brownish-gray to grayish-brown noncalcareous sandy loam; when moist, very dark grayish brown and very friable; contains much pumice.	Pale-brown or light yellowish-brown heavy loam or light clay loam; subangular blocky structure; contains much pumice; noncalcareous except in lower part.	Same	2.5 to 3.5
Redmond sandy loam, 3 to 7 percent slopes.	Rd	Same	Same	Same	2.5 to 3.5
Redmond sandy loam, deep, 0 to 3 percent slopes.	Re	Same	Same	Same	3 to 5
Riverwash	Rk	Loose sand, gravel, and stones.	Loose sand, gravel, and stones.	Variable	Variable
Rough broken land, Era and Deschutes soil materials, 12 to 50 percent slopes.	Ro	Variable	Variable	Variable	Variable
Rough stony land, Agency and Deschutes soil materials, 12 to 60 percent slopes.	Rs	Variable; stony	Variable	Variable	Variable
Scabland, 0 to 3 percent slopes	Sa	Variable	Variable	Variable	Variable
Scabland, 3 to 12 percent slopes	Sb	Variable	Variable	Variable	Variable
Volcanic ash, 0 to 3 percent slopes	Vo	Light-gray or white glassy or pumiceous loose loamy sand, sand, or sandy loam.	Same as surface soil but slightly firmer.	Pale-brown fine sandy loam containing weakly cemented aggregates.	4+

[1] Depth is the distance from the surface to bedrock, cemented layer, or other material that seriously impedes the penetration of roots, air, and moisture. It also refers to depth to loose gravel and other coarse-textured material. It does not refer to the depth to fine-textured or clayey layers. 5+ means 5 feet or more.

[2] The water-holding capacity refers to the quantity of water that a soil at field moisture capacity holds available to plants within the normal root zone. Field moisture content is approximately the moisture content of a well-drained soil 2 or 3 days after thorough wetting.

[3] Drainage through the soil refers to the rate of the downward movement of water through the soil. Unless otherwise stated, the water table is assumed to be so far below the surface that it does not interfere with drainage through the soil.

SUMMARY OF IMPORTANT CHARACTERISTICS—Continued

Water-holding capacity [2]	Drainage through the soil [3]			Erosion hazard under irrigation	Natural fertility [4]	Ease of irrigation [5]	Workability [6]	Principal use
	Surface soil	Subsoil	Underlying material					
Very high	Somewhat rapid except in areas that have a high water table.	Same	Same	Negligible	Moderate	Very easy	Good to fair.	Irrigated crops and pasture.
High or very high.	Moderate	Moderate to somewhat slow.	Very slow; in places, slow or none.	Negligible or slight.	Moderate	Very easy	Good	Irrigated crops and pasture.
High	Moderate	Moderate	Same	Negligible	Moderate	Very easy	Very good	Irrigated crops and pasture.
Moderate to somewhat high.	Somewhat rapid.	Moderate	Same	Negligible or slight.	Moderate	Very easy	Very good	Irrigated crops and pasture.
Same	Same	Moderate	Same	Moderate	Moderate	Easy to slightly difficult.	Very good	Irrigated crops and pasture; dry-farmed wheat.
Same	Same	Moderate	Same	Negligible	Moderate	Very easy	Very good	Same.
Very low	Very rapid	Very rapid	Variable	Variable	Very low	Variable	Very poor	None.
Variable	Variable	Variable	Variable	High or very high.	Variable	Very difficult.	Fair to very poor.	Range.
Variable	Variable	Variable	Variable	Same	Variable	Very difficult.	Very poor or impossible.	Range.
Variable	Variable	Variable	Variable	Slight	Variable	Easy or slightly difficult.	Impossible	Range; irrigated pasture.
Variable	Variable	Variable	Variable	Variable	Variable	Very difficult.	Impossible	Range.
Low	Rapid	Rapid	Moderate	Slight	Very low	Easy	Very good	Range.

[4] Natural fertility is the quality that enables a soil to provide the proper elements in the proper amounts and in the proper balance to support plant growth, when other factors, such as light, temperature, and the physical condition of the soil, are favorable.

[5] Ease of irrigation refers to the relative ease or difficulty of leveling and grading the soil and distributing irrigation water.

[6] Workability refers to the relative ease or difficulty of tilling the soil and harvesting the crops.

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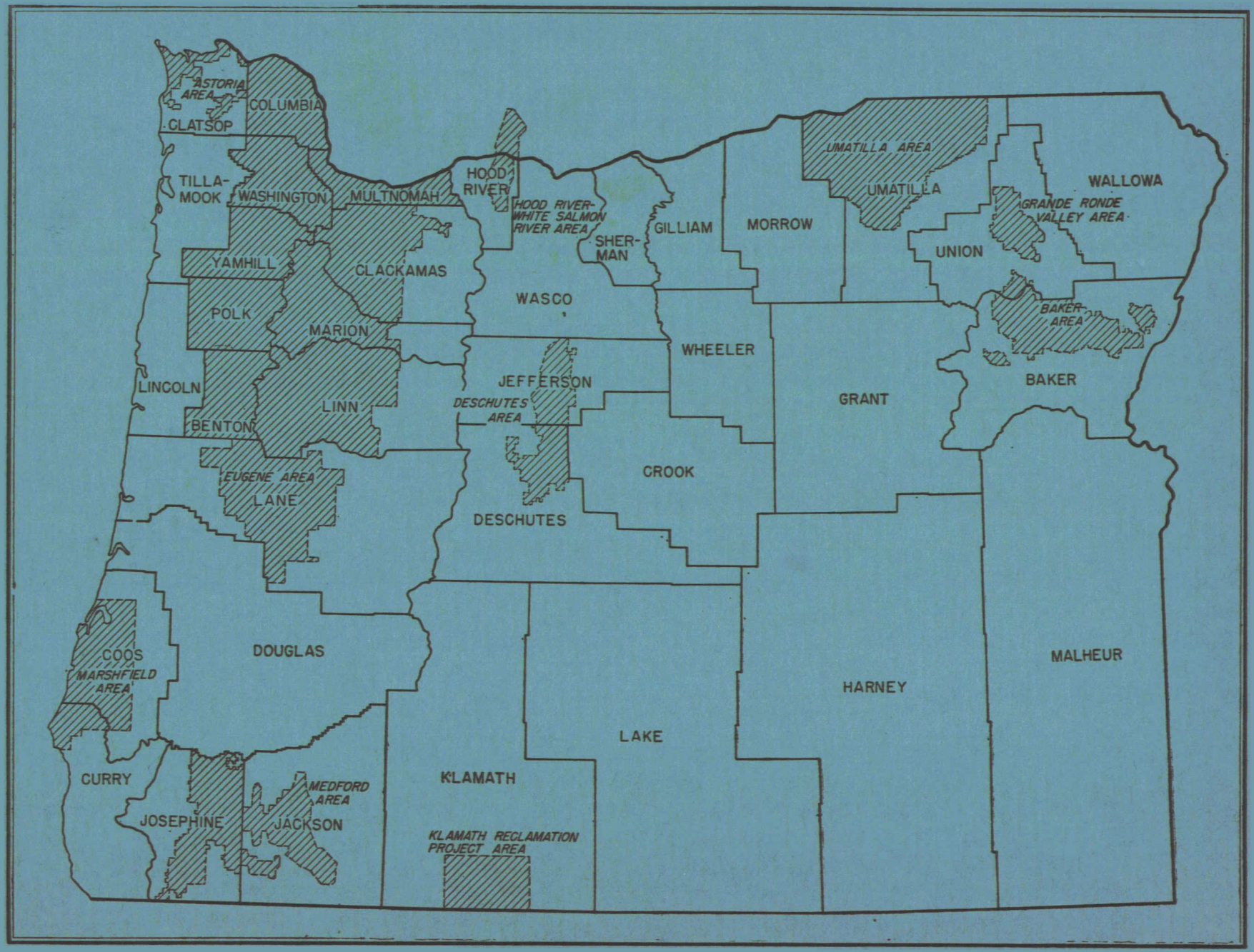

Areas surveyed in Oregon shown by shading.

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