

**USDA** United States  
Department of  
Agriculture

Natural Resources  
Conservation  
Service

In cooperation with  
Montana Agricultural  
Experiment Station

# Soil Survey of Liberty County, Montana Part I





# How to Use This Soil Survey

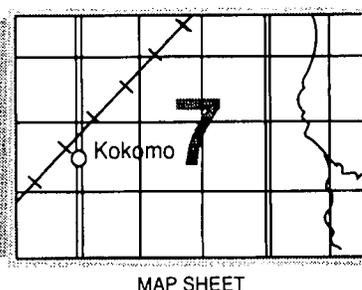
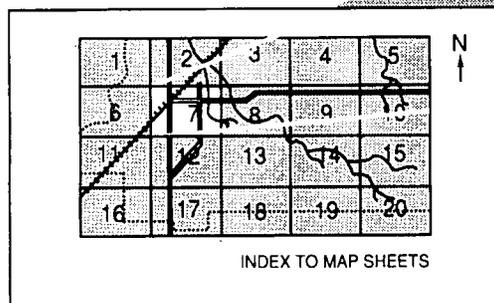
This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the detailed soil map units and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

## Detailed Soil Maps

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

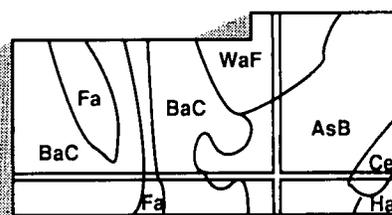
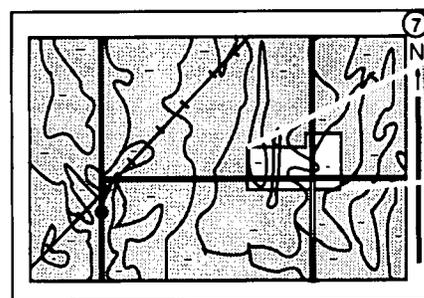
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

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



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

A **State Soil Geographic Data Base (STATSGO)** is available for this survey area. This



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

data base consists of a soils map at a scale of 1:250,000 along with groups of associated soils. It replaces the general soils map published in older surveys. This map and its data base can be useful for planning multi-county areas and map output can be tailored for specific use. For more information about the State Soil Geographic Data Base for this survey area, or for any portion of Montana, contact your local Natural Resources Conservation Service office.

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

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service and the Montana Agricultural Experiment Station. It is part of the technical assistance furnished to the Liberty County Conservation District.

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

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**Cover:** In the foreground is an area of Tamaneen complex, 2 to 8 percent slopes. In the background are the Sweetgrass Hills.

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

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# Foreword

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

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

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

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

Shirley Gammon  
State Conservationist  
Natural Resources Conservation Service



# Soil Survey of Liberty County, Montana

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Fieldwork by Rusty Dowell, Calvin Sibley, Glenn Stanisewski, and Thomas J. Weber,  
Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service,  
in cooperation with  
the Montana Agricultural Experiment Station

## How This Survey Was Made

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

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientists to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the

soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

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

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of

management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

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

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

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

## General Nature of the Survey Area

This soil survey updates an older survey, "Soil Survey (Reconnaissance) of the Northern Plains of Montana." It provides additional information and has larger maps, which show the soils in greater detail.

Liberty County is in the north-central part of Montana, bordered by Canada to the north, Hill County to the east, Chouteau and Pondera Counties to the south, and Toole County to the west (fig. 1). Liberty County has a land area of about 926,100 acres or 1,447 square miles. Chester, the county seat, is in the central part of the county.

About 65 percent of the survey area is used as cropland, 34 percent as rangeland, and 1 percent is woodland. The principal crops are winter wheat, spring wheat, and barley. The main economic enterprises are growing small grains and raising beef cattle.

Elevation ranges from 2,750 feet to 6,958 feet. The average annual precipitation ranges from 10 to

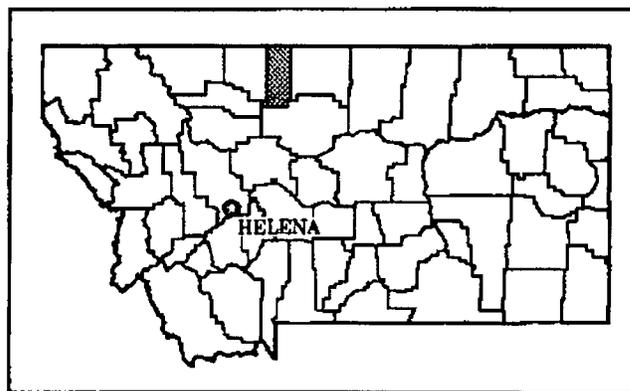


Figure 1. - Location of Liberty County in Montana.

14 inches for most of the survey area, with the Sweetgrass Hills receiving up to 28 inches. The average annual temperature ranges from 38 to 45 degrees F. The growing season ranges from 90 to 125 days.

## History

Archaeological investigations in Liberty County have produced artifacts dating from 750 A.D. to 10,000 B.C. Early humans hunted from the breaks of the Marias River to the Sweetgrass Hills.

Members of the Lewis and Clark expedition were the first white people recorded to have been in the Liberty County area. In a July 1806 journal entry, Captain Lewis writes of his camp by the Marias River. Fur trappers, traders, and prospectors soon followed the Lewis and Clark expedition. At least two trading posts were active in the 1860's along the Marias River in what is now southern Liberty County. In 1874, the U.S.-Canadian boundary line was surveyed across northern Montana, and a military camp was temporarily established at the foot of Mount Royal in the Sweetgrass Hills.

By the 1880's, the once vast herds of buffalo were gone. Cattle and sheep ranchers moved in to take advantage of the open range and abundant grass.

Jim Hill's Great Northern Railroad was laid through Liberty County in 1891, setting the stage for homesteading. The Homestead Act of 1909 opened the northern Great Plains to settlement. Between 1910 and 1918, the Liberty County area was transformed, with homesteads on virtually every half-section of land.

Liberty County was formally created from Hill and Chouteau Counties on November 4, 1919, and Chester was chosen as the county seat. There were 21 post offices in Liberty County during the early homesteading days. Homesteaders who stayed on their land through drought and long cold winters

formed the basis for the farming and ranching economy prevalent in the area today.

## Industry, Transportation, and Recreation

The principal industries in Liberty County are farming and ranching. Nonirrigated farming predominates, with a limited extent of irrigated farming. Spring wheat, winter wheat, and barley are the leading crops; alfalfa hay, grass hay, and oats are also grown. Most of the small grain produced is marketed through local elevators and shipped by rail or truck to terminal markets east and west. Cattle are marketed at public stockyards in northern Montana or sold directly off the ranch. Chester and Joplin are the distribution points for businesses dealing in farm machinery, automobiles and trucks, construction equipment, and related services.

U.S. Highway 2 runs east-west through Liberty County and is the main arterial across northern Montana. State Highway 223 runs south from Chester and connects with U.S. Highway 87 at Fort Benton. Numerous other secondary roads provide good vehicle traffic throughout the rest of the county. The main railroad line runs east-west adjacent to U.S. Highway 2 through the center of the county. Burlington Northern Railroad serves Liberty County with freight service, making stops at grain terminals in Lothair, Tiber, Chester, and Joplin. Amtrak makes scheduled stops in Shelby and Havre, Montana.

## Physiography, Relief, and Drainage

Liberty County is in the northern glaciated plains region of Montana. In the recent geological past, a sheet of glacial ice of Wisconsin age covered northern Montana as far south as the present-day course of the Missouri River. The ice sheet, estimated to have been over 1,000 feet thick, left a mantle of glacial till as it retreated northward. The glacial till mantle overlying bedrock now averages 20 to 100 feet in thickness in Liberty County. Bedrock beneath the till plain is alternating sandstone and shale from marine sediments laid down during the late Cretaceous Period over 65 million years ago. The Sweetgrass Hills are a complex of igneous intrusions. These rocks are similar in age and composition to those in the Judith and Moccasin Mountains north of Lewistown, and to those in the Little Rocky Mountains south of Chinook. These intrusions occurred when magma pushed up into the sedimentary bedrock during a period of activity approximately 50 million years ago. The sedimentary rock subsequently eroded, leaving the more resistant igneous rock exposed. The two

major physiographic features influencing local topography are the Marias River and the Sweetgrass Hills. All the major tributaries in Liberty County north of the Marias River originate in the Sweetgrass Hills. Cottonwood Creek and Eagle Creek drain most of the land in the western half of Liberty County south of the Sweetgrass Hills to the Marias River. Sage and Little Sage Creeks and Obrien Coulee are the major drainages in the eastern part of the county, flowing eastward into Hill County before joining and draining into the Marias River. The Pondera, Basin, and Dugout Coulees are the major drainages entering the Marias River from the south. In Liberty County, elevation ranges from about 2,750 feet along the Marias River, to 6,958 feet atop Mount Brown in the Sweetgrass Hills. The entire county is in the Missouri River drainage area.

The Marias River headwaters are in the Rocky Mountains. It flows eastward through the southern part of Liberty County into Hill County before changing course to flow south and join the Missouri River near Loma, Montana. The Marias is impounded by Tiber Dam in the southwest part of the county, creating 13,000 acre Lake Elwell (Tiber Reservoir).

## Natural Resources

Soil is the most important natural resource in the survey area. The chief industries are the production of small grains and livestock grazing. Soil blowing, erosion by water, saline seep, and loss of soil organic matter are the major soil conservation concerns in Liberty County. Surface and subsurface water in Liberty County is used for domestic, agricultural, industrial, and recreational purposes. The town of Chester obtains its domestic water supply from Tiber Reservoir. The community of Joplin obtains its domestic water supply from Fresno Reservoir on the Milk River in Hill County. A water line running eastward from a spring at Big Sage Creek in the Sweetgrass Hills provides domestic water to farms in the northeastern part of the county.

In addition to Tiber Reservoir, there are over 25 reservoirs in Liberty County; each store 50 acre-feet or more of water. Numerous smaller stockponds, springs, and dugouts provide water for livestock. Groundwater aquifers in Liberty County include buried preglacial and glacial channel deposits, the Judith River formation, and the Virgille sandstone member of the Eagle formation. Ground water is extracted from glacial deposits at depths ranging from 10 to 150 feet. In eastern Liberty County, wells ranging from 150 to 225 feet below the surface into the Judith River formation have yields between 5 and 50 gallons per

minute (gpm). Wells drilled into the Virgille sandstone yield 5 to 75 gpm at depths between 200 and 450 feet below the surface. Unconfined ground water sources are subject to contamination from soluble salts inherent in the glacial till and bedrock. Natural gas was discovered near the town of Whitlash in 1918. Since that time, oil and gas fields have been developed at Whitlash, Bears Den, Utopia, Flat Coulee, Keith Block, and Laird Creek. Past exploration has revealed quantities of iron, gold, lead, zinc, and fluorite in the Sweetgrass Hills. Development of a gold mine is currently under consideration.

## Geology and Geomorphology

Liberty County is characterized by a wide variety of geomorphic features ranging from the steep sided Sweetgrass Hills to gently rolling glacial topography. The Marias River flows across the southern part of the county and has several tributaries which drain the area. Throughout the county, Pleistocene glacial deposits make up the majority of the surface materials, with the exception of the intrusive rocks of the Sweetgrass Hills and limited outcrops of sedimentary rocks in the plains. The sedimentary bedrock has a regional dip of about one percent to the east. The uplift of the Sweetgrass Hills in the northwest corner of the county brought older sedimentary formations of Jurassic and Mississippian age to the surface.

The stratigraphic sequence of rocks exposed in Liberty County ranges from Mississippian age, 325 million years old, to Quaternary deposits which are less than two million years old. These are described in the following paragraphs in order from oldest to youngest.

The oldest rocks, the Madison Limestone of Mississippian age, are located at a small outcrop on the flanks of East Butte in the northwest corner of the county. This limestone is blue-gray in color, has distinct bedding and has been metamorphosed locally. Unconformably overlying the Madison is the Jurassic-aged Ellis Formation, which consists of dark-gray limestone, black shale, and calcareous sandstone.

Within the county, the majority of the bedrock underlying the glacial deposits are Cretaceous-aged sedimentary deposits, formed 65 to 135 million years ago. These strata are characterized by alternating sequences of marine and continental material deposited as the vast inland sea that covered the area repeatedly advanced and regressed. The oldest is the Kootenai Formation of the Lower Cretaceous Period. It is composed of red and green mudstone and

siltstone interbedded with medium- to coarse-grained sandstone. The only outcrop in the county is near the top of East Butte. Typical soils derived from this formation include Perma and Whitlash.

The Kootenai is overlain by the Colorado Group of the Lower Cretaceous. This sedimentary strata was deposited during the last stages of an extensive marine invasion from the southeast. It is composed of dark gray to black marine shale interbedded with thin bentonite beds which weather to a bright yellow, and of lenses of sandstone and concretionary limestone. Marine invertebrate fossils and shark teeth are in many of the shale beds. The Colorado Group is more than 2,000 feet thick and is exposed in the southwest portion of the county along the banks of the Marias River and on the flanks of East Butte. Typical soils derived from this formation include Wayden, Barkof, and Yawdim.

The remainder of the Upper Cretaceous-aged sediments belong to the Montana Group. As the sea gradually withdrew, the oldest formation within the Montana Group, the Telegraph Creek Formation, was deposited as continental and brackish-water sediments. The formation is an interbedded sequence of thinly to coarsely laminated, fine-grained, buff to gray calcareous sandstone and gray sandy shale. The Telegraph Creek formation averages about 150 feet thick and occurs in a thin band a few miles wide along the Marias and Pondera Creek valleys. Typical soils derived from this formation include Cabbart, Yawdim, and Yamacall.

Following complete withdrawal of the inland sea, the predominantly continental Eagle Formation was deposited. The formation is separated into the upper member and the lower Virgelle Sandstone. The Virgelle Sandstone is a grayish-buff to yellow, massive to crossbedded, friable sandstone deposit. It is an average of 85 feet thick and often forms bold cliffs exhibiting concretions of ferruginous and calcareous sandstone and hematite nodules. Fragments of petrified wood are also found throughout the Virgelle Sandstone. This lower member of the Eagle Formation is considered an excellent source of drinking water for much of north central Montana. The upper member of the Eagle Formation is up to 150 feet thick and is composed of alternating and interfingering beds of shale, carbonaceous shale, mudstone, siltstone, and crossbedded sandstone. This sequence indicates the return of a fluctuating marginal-marine depositional environment. The majority of this upper member consists of buff, gray, and brownish-purple mudstone lenses up to 12 feet thick. Many of the shale beds are carbonaceous and contain fossil plant fragments. Fossilized wood is in

the massive sandstone portions of the formation. Rounded ironstone concretions are common in the lower portions of this member. Both the Virgelle and Upper Eagle members comprise a majority of the bedrock in the south central portion of the county and are exposed along the banks of Cottonwood, Dead Indian, and Dugout Creeks. Typical soils derived from this formation include Cabbart, Delpoint, Yamacall, and Blacksheep.

Overlying the Eagle Formation is the Claggett Shale, which indicates the complete advancement of the inland sea once again. The Claggett is chiefly dark gray with iron-stained limestone and sandstone concretions. Numerous bentonite beds up to three feet thick occur at the base of the formation. The upper portion of the formation consists of alternating shale and crossbedded platy sandstone lenses. The total thickness of the Claggett is over 400 feet, and it extends from the northwest corner to the southeast corner of the county, passing through the town of Chester. It is exposed in the valleys of Cottonwood Creek and its tributaries, as well as along the Dobie Ridge southeast of Chester. Typical soils derived from this formation include Yawdim, Marvan, and Vanda.

As the inland sea regressed once more, the continental and brackish water sediments of the Judith River Formation were deposited. It is characterized by alternating sandstone and shale lenses. The sandstone beds are massive, crossbedded, and calcareous. They often form ledges, benches, and cap rocks. The shale lenses are gray to brown and are usually less than three feet thick. They occasionally contain fossil plant matter. The maximum thickness of the Judith River formation in this county is thought to be about 600 feet; however, less than 100 feet is exposed in the creek banks in the northeast portion of the county. Typical soils derived from this formation include Cabbart, Delpoint, Yamacall, and Benz.

The Tertiary Period followed the Cretaceous Period and ranges in time from 65 to two million years ago. In the early portion of this period, the Liberty County area became tectonically active, and was characterized by the uplift of the Sweetgrass Arch and the igneous intrusion of the Sweetgrass Hills. This uplift also created the Adobe and Dobie Ridges southeast of the Sweetgrass Hills. Some smaller structural features include the Marias dome and the Lothair nose. The Marias dome is centered at the southern end of the Tiber Dam and has minor faulting associated around it. The Lothair nose is an anticline about seven miles long located southeast of the town of Lothair, adjacent to the syncline occupied by the Willow Creek arm of the Tiber Reservoir. This uplifting of the Cretaceous and older sedimentary deposits created areas for oil

and gas to migrate up and become trapped. There are several oil and gas fields in the northern portions of Liberty County. These wells are usually 2,000 to 3,000 feet deep and pump oil and gas from the Cretaceous Kootenai and the Jurassic Ellis formations, and from the Mississippian Madison limestone.

The Sweetgrass Hills consist of three major peaks and several lesser ones. West Butte and Middle (or Gold) Butte are situated in neighboring Toole County and East Butte is located in Liberty County. These peaks rise over 3,000 feet above the plains as intrusive stocks and laccoliths. Like many of the other intrusive mountains in central Montana, the Sweetgrass Hills are composed of pale-colored syenites unusually rich in sodium and potassium. Metamorphism of the pre-existing sedimentary bedrock associated with these intrusions produced some minor veins of gold, silver, and lead. These deposits were mined; however, most of the mining operations were small and played out in a few years.

Although the Sweetgrass Hills are perhaps the most striking landforms in the county, the majority of the landforms, drainage patterns, and associated soil development is the direct result of the continental glaciation during the Pinedale ice age (15,000 years ago). At several times the entire county, with the exception of the Sweetgrass Hills, was overridden by thick continental glaciers (AASHTO, 1986).

The most recent and most extensive of these is referred to as the Wisconsin-aged Laurentide Ice Sheet. As the glacier flowed around the Sweetgrass Hills, till material was deposited as lateral moraines along the flanks of the hills. Moraines consist of unsorted clay, silt, sand, and cobbles. Much of the remaining glacial material in the county was deposited as gently rolling ground moraine and is identified as two separate ages of till, the older as the Lothair till and the younger as the Pondera till.

The Lothair till covers the majority of the county, except for the till deposited by the Pondera ice tongue. The Lothair till is light tan but weathers to buff, and is unsorted with material ranging from clay-size to boulders as large as three feet in diameter. It averages 50 feet in thickness. In many locations clay- and sand-sized particles predominate and the till resembles loess. It is usually firm and compact when dry. Typical soils formed from the Lothair till include Scobey, Kevin, and Elloam.

The Pondera till covered the southwest corner of the county and extended over 15 miles down the Marias and Pondera coulee drainages. The younger Pondera till has distinctly different characteristics than the older till. It is light brown, but weathers to chocolate brown. It contains small amounts of

unsorted pebbles and cobbles that lack the manganese staining associated with the pebbles and cobbles of the older Lothair till. Knob and kettle topography is more common in the younger till, whereas the older till is more dissected. Typical soils formed from the Pondera till include Telstad, Joplin, and Hillon.

Streamlined hills called drumlins are located in the extreme northern portion of the county in a southeast-trending direction. These ellipsoidal till deposits can be stratified and are usually located in parallel groups. Their orientation is one indication of the direction of the ice movement. In many locations, layers of light-yellow to buff, even-bedded, massive silt deposits exist. This intra-till silt was deposited in temporary lakes as the ice sheet retreated. Windblown loess was deposited over the till to about 2 feet in thickness; however, most of this was subsequently eroded away and now are alluvial deposits within the stream channels, drainageways, and coulees.

As the ice sheets melted, several forms of glaciofluvial material were deposited, leaving localized deposits of silt, sand, and gravel. Some eskers and kames are located throughout the county. Eskers are sinuous ridges of stratified sand and gravel, about a mile long, 30 feet wide and 10 feet high. Kames are mound-like hills of glacial drift, composed chiefly of stratified sand and gravel. Several groups of morainal ridges occur throughout the county as well. These typically are closely spaced low ridges composed of direction of ice and melt water movement, the morainal ridges (washboard moraines) are usually oriented in groups perpendicular to the retreating glacier.

Most of the current drainages follow the coulees and outwash channels left by the glacial melt waters. Several coulees do not host streams today and are only remnants of the past environment. North of the Marias River along Highway 223 is an extensive outwash channel deposit known as the Pugsley channel. These deposits consist of poorly consolidated, scattered lenses of sand and gravel that are about 25 feet thick. Most of the pebbles in the upper four feet of the deposit have their undersides coated with caliche. This channel deposit overlies the Pondera till and is covered in most places by recently deposited alluvium.

During the past 10,000 years, after the complete melting of the last glacial advance, the majority of landforms within Liberty County have been formed by erosion rather than sedimentation. Stream valleys, mostly within the drainageways, have cut down through the glacial till and bedrock, creating a

dissected landscape. In the southern portion of the county and along the Marias River, the erosion and down-cutting is so extensive that the area is characteristic of badland topography.

In the Marias River valley, recent alluvium forms flood plain deposits of sand and gravel with a two-foot-thick silt deposit on the surface. Most of the tributary valleys have small flood plains composed of sand and silt. The majority of these deposits are the result of streams eroding and redepositing the glacial sediments.

## Climate

Summertime in the Liberty County area generally is pleasant, with cool nights, moderately warm and sunny days, and slight to moderate breezes. Most rainfall is in the form of showers or thunderstorms, and usually occurs in the late spring or early summer months. Most summers pass with the highest temperatures failing to reach 100 degrees, and an average year will have only 15 days with maximums of 90 degrees or higher. Weather stations at Chester, Joplin, and Tiber Dam show freezing temperatures do not occur in July or August, rarely occur in June, and occur more often in May and September. Frost may occur, however, on rare occasions in low lying areas at any time of the year.

Winters are not as cold as usually expected of continental locations at this latitude, largely as a result of the "Chinook" winds for which north-central Montana is noted. While sub-zero temperatures associated with cold waves are common in the winter, these periods seldom last more than a few days at a time, and are usually terminated by southwesterly "Chinook" winds. The name "Chinook" is a loosely defined Native American term meaning "Snow Eater," and is used to describe the effect these warm winds have on the area. Changes in atmospheric pressure along the Rocky Mountain front can create strong winds and sharp temperature rises of 40 degrees or more within a period of less than 24 hours. As a result of these periodic warm winds, the ground is usually bare or nearly bare of snow for most of the winter.

At the end of this section are tables showing data on temperature and precipitation; probable dates of the first and last freezing periods in the spring and fall; and data on the length of the growing season.

Within the county, differences in the amount of precipitation are considerable. The wettest areas are located in the Sweetgrass Hills. Generally, precipitation falls in the form of snow during late fall, winter, and early spring. Rain can occur in any month,

but usually falls in the spring and early summer months. Hail is observed occasionally during summer rain squalls and thunderstorms.

Although the average annual precipitation is low enough to classify the area as semi-arid, it is important to note that about 70 percent of the annual total precipitation normally falls during the April to September growing season. It is for this reason that Liberty County is a fairly productive small-grain growing region of Montana. The combination of ideal

temperatures during the growing season, long hours of summer sunshine, and 7 to 9 inches of precipitation from May to September makes the climate favorable for dryland farming. Heavy fog seldom occurs, and is limited to about one or two days per month, lasting only a small part of the day. Although the area receives slight to moderate average windspeeds, strong or extremely strong winds of over 70 mph are not commonly observed. Normal visibility is excellent.

## Temperature and Precipitation

(Recorded in the period 1948-93 at Chester; Joplin; and Tiber Dam)

Month	Temperature (Degrees F.)						Precipitation					
	Aver- age	Aver- age	Aver- age	2 years in 10 will have	max. temp.	min. temp.	Average number of growing degree days*	Aver- age	2 years in 10 will have-	Average number of days with .10 or more	Average number total snow fall 0.10 or more	
	daily maxi- mum	daily mini- mum	more than	more than	more than	less than	days*	(in.)	Less than	More than	(in.)	(in.)
CHESTER:												
January---	26.9	0.7	13.8	55	-37	2	0.40	0.15	0.64	1	2.7	
February--	34.7	7.1	20.9	61	-28	4	0.28	0.10	0.45	0	1.9	
March-----	43.3	16.1	29.7	70	-22	23	0.45	0.16	0.74	1	1.4	
April-----	57.8	27.3	42.6	81	4	149	0.76	0.23	1.25	2	0.8	
May-----	68.4	38.2	53.3	89	20	401	1.76	0.82	2.58	4	0.0	
June-----	76.1	45.5	60.8	94	30	605	2.32	1.16	3.33	5	0.0	
July-----	83.6	49.6	66.6	98	29	815	1.52	0.45	2.44	3	0.0	
August-----	82.9	48.1	65.5	98	33	778	1.26	0.57	2.02	3	0.0	
September-	71.9	38.0	54.9	93	18	449	0.79	0.29	1.26	2	0.0	
October---	60.6	27.8	44.2	83	1	190	0.42	0.11	0.71	1	0.4	
November--	42.7	15.3	29.0	68	-20	24	0.36	0.12	0.66	1	2.2	
December--	31.2	5.3	18.2	57	-36	3	0.44	0.12	0.79	1	1.5	
Yearly:												
Average--	56.7	26.6	41.6	-	--	--	--	--	--	-	-	
Extreme--	105	-57	-	100	-42	--	--	--	--	-	-	
Total---	-	-	-	-	-	3,442	10.74	7.36	13.20	24	10.9	
JOPLIN:												
January---	24.4	3.2	13.8	54	-31	2	0.29	0.08	0.48	1	4.3	
February--	32.0	9.7	20.9	59	-23	6	0.23	0.07	0.37	0	3.3	
March-----	40.7	17.9	29.3	68	-16	25	0.40	0.15	0.66	1	2.7	
April-----	54.3	28.4	41.4	80	6	134	0.80	0.25	1.31	2	2.0	
May-----	65.8	38.6	52.2	88	21	378	1.94	0.92	2.81	4	0.3	
June-----	73.4	46.0	59.7	93	32	577	2.31	1.14	3.33	5	0.0	
July-----	81.7	50.8	66.3	98	37	716	1.42	0.44	2.23	3	0.0	
August-----	80.9	49.5	65.2	99	35	777	1.28	0.51	2.03	3	0.0	
September-	69.0	39.9	54.5	92	22	434	0.87	0.27	1.40	2	0.3	
October---	58.1	30.8	44.4	82	6	199	0.42	0.17	0.76	1	0.7	
November--	40.5	17.9	29.2	66	-15	26	0.28	0.15	0.58	1	3.2	
December--	29.5	8.3	18.9	55	-31	2	0.29	0.07	0.53	1	4.0	
Yearly:												
Average--	54.2	28.4	41.3	-	-	-	--	--	--	-	-	
Extreme--	106	-48	-	100	-35	-	--	--	--	-	-	
Total----	-	-	-	-	-	3,276	10.53	7.38	12.56	24	20.7	

Temperature and Precipitation--Continued

(Recorded in the period 1948-93 at Chester; Joplin; and Tiber Dam)

Month	Temperature (Degrees F.)						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have max. temp. more than	2 years in 10 will have min. temp. less than	Average number of growing degree days*	Average	2 years in 10 will have Less than	2 years in 10 will have More than	Average number of days with .10 or more (in.)	Average number total snow fall 0.10 or more (in.)
TIBER DAM:											
January---	29.2	5.5	17.3	58	-33	5	0.34	0.14	0.53	1	5.4
February--	37.0	11.5	24.2	63	-24	11	0.24	0.09	0.38	0	3.9
March-----	45.6	19.6	32.6	71	-19	45	0.45	0.13	0.76	1	4.1
April-----	58.8	29.8	44.3	82	7	181	0.86	0.24	1.36	2	2.3
May-----	69.9	40.3	55.1	91	23	463	1.76	0.90	2.50	4	0.0
June-----	78.0	48.1	63.1	96	34	692	2.24	1.05	3.26	5	0.0
July-----	85.6	52.0	68.8	100	40	892	1.37	0.38	2.23	3	0.0
August----	85.2	50.4	67.8	101	35	862	1.25	0.45	1.97	3	0.0
September-	73.9	40.8	57.3	95	23	524	0.86	0.24	1.39	2	0.1
October---	63.5	31.6	47.5	86	6	272	0.50	0.21	0.88	1	0.9
November--	45.2	19.1	32.2	72	-16	46	0.33	0.13	0.59	1	2.9
December--	33.8	9.9	21.8	60	-31	9	0.29	0.12	0.51	1	4.7
Yearly:											
Average--	58.8	29.9	44.3	-	-	-	-	-	-	-	-
Extreme--	107	-53	-	102	-37	-	-	-	-	-	-
Total----	-	-	-	-	-	4,004	10.49	7.90	12.78	24	24.4

## Freeze Dates in Spring and Fall

(Recorded in the period 1948-91 at Chester; Joplin; and Tiber Dam)

Probability	Temperature		
	24 degrees F or lower	28 degrees F or lower	32 degrees F or lower
CHESTER:			
Last freezing temperature in spring: January-July			
1 year in 10 later than----	May 23	May 30	June 25
2 years in 10 later than---	May 16	May 24	June 17
5 years in 10 later than---	May 4	May 14	June 3
First freezing temperature in fall: August-Dec.			
1 year in 10 earlier than--	Sept. 10	Sept. 4	Aug. 26
2 years in 10 earlier than-	Sept. 16	Sept. 9	Aug. 30
5 years in 10 earlier than-	Sept. 27	Sept. 18	Sept. 8
JOPLIN:			
Last freezing temperature in spring: January-July			
1 year in 10 later than----	May 8	May 25	June 13
2 years in 10 later than---	May 4	May 20	June 8
5 years in 10 later than---	April 26	May 10	May 28
First freezing temperature in fall: August-Dec.			
1 year in 10 earlier than--	Sept. 17	Sept. 6	Sept. 1
2 years in 10 earlier than-	Sept. 23	Sept. 11	Sept. 5
5 years in 10 earlier than-	Oct. 4	Sept. 21	Sept. 12

Freeze Dates in Spring and Fall--Continued

(Recorded in the period 1948-91 at Chester; Joplin; and Tiber Dam)

Probability	Temperature		
	24 degrees F or lower	28 degrees F or lower	32 degrees F or lower
TIBER DAM:			
Last freezing temperature in spring: January-July			
1 year in 10 later than----	May 6	May 18	June 2
2 years in 10 later than---	May 2	May 13	May 27
5 years in 10 later than---	April 24	May 3	May 16
First freezing temperature in fall: August-Dec.			
1 year in 10 earlier than--	Sept. 22	Sept. 12	Sept. 4
2 years in 10 earlier than-	Sept. 27	Sept. 17	Sept. 8
5 years in 10 earlier than-	Oct. 7	Sept. 27	Sept. 17

## Growing Season

(Recorded in the period 1948-91 at Chester; Joplin; and Tiber Dam)

Probability	Daily Minimum Temperature		
	Higher than 24 degrees F	Higher than 24 degrees F	Higher than 24 degrees F
<b>CHESTER:</b>			
9 years in 10-----	107	94	68
8 years in 10-----	115	102	77
5 years in 10-----	130	117	94
2 years in 10-----	144	133	111
1 year in 10-----	152	141	120
<b>JOPLIN:</b>			
9 years in 10-----	121	100	81
8 years in 10-----	127	107	88
5 years in 10-----	141	121	100
2 years in 10-----	154	134	112
1 year in 10-----	160	141	119
<b>TIBER DAM:</b>			
9 years in 10-----	134	119	100
8 years in 10-----	140	126	107
5 years in 10-----	152	139	121
2 years in 10-----	163	153	134
1 year in 10-----	170	160	141

# Formation and Classification of the Soils

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This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification. The classification and extent of the soils in this survey area are shown in the tables "Classification of the Soils" and "Acreage and Proportionate Extent of the Soils," which are at the end of this section.

## Formation of the Soils

Soil is a natural, three dimensional body on the earth's surface. It has properties that result from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over a period of time.

Although there are many different soils, each soil is the result of the interaction of the same five factors. These factors are the physical and chemical composition of the parent material, the effect of climate on the parent material, the kinds of plants and the organisms living in the soil, the relief of the land, and the length of time it took for the soil to form.

Within short distances the combination of these factors varies, and consequently the soils that form differ in fertility, productivity, and physical and chemical characteristics. In the following paragraphs the factors of soil formation are discussed as they relate to the soils in Liberty County.

## Climate

Climate, an active force in the formation of soils, is determined mainly by temperature and precipitation. In Liberty County, the winters are cold, springs are cool and moist, and summers are hot and dry. Gusty warm southwest winds, called Chinooks, and Arctic cold waves are a part of seasonal weather patterns. Erosion and alternate freezing and thawing break down rocks into material in which soils form. The weathered material is further broken down by chemical reactions such as solution and hydration.

The precipitation and temperature affect the kind and amount of vegetation that grows on the soil. Vegetation decays to produce organic matter in the

soil. Soils that have cool temperatures and high precipitation generally contain more organic matter and are dark in color. Soils with warm temperature and low precipitation generally contain less organic matter and are light in color.

The average annual precipitation ranges from about 10 to 14 inches on the glaciated uplands to about 15 to 24 inches in the Sweetgrass Hills. The average annual temperature ranges from 38 to 45 degrees F.

## Living Organisms

Living organisms are active in the formation of soils. Plants, animals, insects, and micro-organisms affect gains or losses in organic matter, plant nutrients in the soil, and changes in porosity and structure.

Roots, rodents, and insects penetrate the soil and alter its structure. Leaves, roots, and entire plants that remain in the surface layer are changed to humus by micro-organisms, chemicals in the soil, and by insects. Fungi and algae also contribute to the decomposition of bedrock. Animals increase porosity by burrowing through the soil and leaving open channels for the movement of water and air. Common rodents in the area are ground squirrels, badgers, prairie dogs, and rabbits.

The vegetation in the survey area consists mainly of short grasses, mid grasses, and shrubs on the plains, and of tall grasses, Douglas-fir, and lodgepole pine in the Sweetgrass Hills.

## Topography

Topography, or relief, is determined by glaciation and the age and resistance of geologic formations to erosion by wind and water. It influences soil development through its effect on drainage and runoff. On eroded uplands of this survey area, runoff water has carved deep valleys. These rugged areas contrast sharply with the smoother areas of the glaciated uplands.

On uplands, the number and distinctness of soil horizons generally decrease as the slope increases. Soils on steep slopes with rapid runoff have many

characteristics similar to those of soils formed in arid climates. Nearly level to moderately sloping soils have the characteristics of soils that are the most common in Liberty County. Examples of this general principle are the Hillon soils that are moderately steep or steep and the Telstad soils that are nearly level to moderately sloping.

## Parent Material

Most of the soils in Liberty County formed in glacial till or in glacial outwash material. Some of the soils formed in alluvium derived from mixed sources, and other soils formed in material that weathered from shale, sandstone, limestone, or igneous rocks.

The soils that formed in glacial till, such as the Telstad or Joplin series, generally are loamy, while the Scobey and Kevin series, generally are clayey. Soils that formed in interbedded sandstone and shale, such as the Cabbart and Delpoint series, are generally loamy; soils that formed in shale, such as the Yawdim series, are clayey. The soils that formed in mixed alluvium derived from glacial till, sandstone, or shale, such as the Havre series, are loamy.

Many soils in the survey area have accumulated lime, sodium, and other salts from the parent material. The salts and sodium make these soils slightly to moderately saline or alkali, and limit the amount and kind of plant cover.

## Time

The changes that take place in a soil over long periods of time are called soil genesis. Distinct horizons, or layers, develop in the soils as a result of these changes. The length of time that parent materials have been in place and exposed to climate and living organisms is generally reflected in the degree to which the soil profile has developed. The kinds and arrangement of layers are called the soil morphology, and they are described in terms of color, texture, structure, consistence, thickness, permeability, and chemistry.

Soils are classified as young to mature. The age of a soil is determined from the thickness of the A horizon, the content of clay and organic matter, the depth to which soluble material is leached, and the form and distribution of calcium carbonate and gypsum in the soil.

Young soils show very little profile development. Havre loam, a soil of the Entisol order, is an example of a young soil. It is on a flood plain adjacent to a flowing stream. The soil contains little organic matter

which to form an A horizon, it has little clay accumulation, and little translocation of carbonates within the profile.

The Evanston soil formed in parent material that is similar to that of the Havre loam but it is much older. These soils formed in alluvium on alluvial fans and stream terraces. They contain enough organic matter to have a dark colored A horizon, have a distinct clay accumulation in a Bt horizon, and nearly all of the carbonates have been leached to a depth of about 13 inches.

Many of the sloping and steep, shallow and very shallow soils appear to have been in the process of formation for about as long as some of the more developed, less sloping soils. However, erosion has removed the soil as fast as it formed. In this case the effect of time has been offset by the effect of relief.

## Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The categories are defined in the following paragraphs.

**ORDER.** Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol.)

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiborolls (*Argi*, meaning having an argillic horizon, plus *boroll*, the suborder of the Mollisols that has a cool climate).

**SUBGROUP.** Each great group has a typical subgroup. Other subgroups are intergrades or extragrades. The typical is the central concept of the

great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiborolls.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity.

Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, Typic Argiborolls.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series. An example is the Williams series.

## Classification of the Soils

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics that are outside the range of the series)

Soil name	Family or higher taxonomic class
Absher-----	Fine, montmorillonitic Typic Natriboralfs
Acel-----	Fine, montmorillonitic Mollic Eutroboralfs
Assinniboine-----	Fine-loamy, mixed Aridic Argiborolls
Attewan-----	Fine-loamy over sandy or sandy-skeletal, mixed Aridic Argiborolls
Auchard-----	Fine, mixed Typic Natriboralfs
Barkof-----	Fine, montmorillonitic, frigid Leptic Udic Haplusterts
Bearpaw-----	Fine, montmorillonitic Typic Argiborolls
Beaverell-----	Loamy-skeletal over sandy or sandy-skeletal, mixed Aridic Argiborolls
Beaverton-----	Loamy-skeletal over sandy or sandy-skeletal, mixed Typic Argiborolls
Benz-----	Fine-loamy, mixed (calcareous), frigid Aridic Ustorthents
Bigsandy-----	Fine-loamy, mixed (calcareous), frigid Typic Fluvaquents
Blacksheep-----	Loamy, mixed (calcareous), frigid, shallow Aridic Ustorthents
Brockway-----	Fine-silty, mixed, frigid Haplocalcidic Ustochrepts
Busby-----	Coarse-loamy, mixed, frigid Aridic Ustochrepts
Cabba-----	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Cabbart-----	Loamy, mixed (calcareous), frigid, shallow Aridic Ustorthents
Chinook-----	Coarse-loamy, mixed Aridic Haploborolls
Cozberg-----	Coarse-loamy, mixed Aridic Haploborolls
Creed-----	Fine, montmorillonitic Typic Natriboralfs
Daglum-----	Fine, montmorillonitic Vertic Natriborolls
Dast-----	Coarse-loamy, mixed, frigid Typic Ustochrepts
Degrad-----	Fine-loamy over sandy or sandy-skeletal, mixed Aridic Argiborolls
Delpoint-----	Fine-loamy, mixed, frigid Aridic Ustochrepts
Elloam-----	Fine, montmorillonitic Typic Natriboralfs
Elve-----	Loamy-skeletal, mixed Typic Cryochrepts
Enbar-----	Fine-loamy, mixed Cumulic Haploborolls
Ethridge-----	Fine, montmorillonitic Aridic Argiborolls
Evanston-----	Fine-loamy, mixed Aridic Argiborolls
Farnuf-----	Fine-loamy, mixed Typic Argiborolls
Ferd-----	Fine, montmorillonitic Glossic Eutroboralfs
Fortbenton-----	Fine-loamy, mixed Aridic Haploborolls
Gerdrum-----	Fine, montmorillonitic Typic Natriboralfs
Glendive-----	Coarse-loamy, mixed (calcareous), frigid Aridic Ustifluvents
Harlake-----	Fine, montmorillonitic (calcareous), frigid Aridic Ustifluvents
Havre-----	Fine-loamy, mixed (calcareous), frigid Aridic Ustifluvents
Hedstrom-----	Fine-loamy over sandy or sandy-skeletal, mixed Typic Argiborolls
Hillon-----	Fine-loamy, mixed (calcareous), frigid Aridic Ustorthents
Joplin-----	Fine-loamy, mixed Aridic Argiborolls
Kenilworth-----	Fine-loamy, mixed Aridic Argiborolls
Kevin-----	Fine-loamy, mixed Aridic Argiborolls
Kobase-----	Fine, montmorillonitic, frigid Aridic Ustochrepts
Korchea-----	Fine-loamy, mixed (calcareous), frigid Mollic Ustifluvents

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Kremlin-----	Fine-loamy, mixed Aridic Haploborolls
Lambeth-----	Fine-silty, mixed (calcareous), frigid Aridic Ustorthents
Lawther-----	Fine, montmorillonitic, frigid Udic Haplusterts
Linnet-----	Fine, montmorillonitic Ustertic Argiborolls
Lisk-----	Coarse-loamy, mixed, frigid Typic Ustochrepts
Lonna-----	Aridic Ustochrepts, Fine-silty, mixed, frigid
Marias-----	Fine, montmorillonitic, frigid Chromic Udic Haplusterts
Marmarth-----	Fine-loamy, mixed Aridic Argiborolls
Marvan-----	Fine, montmorillonitic, frigid Sodic Haplusterts
McKenzie-----	Fine, montmorillonitic, frigid Chromic Endoaquerts
Nesda-----	Sandy-skeletal, mixed Fluventic Haploborolls
Nishon-----	Fine, montmorillonitic, frigid Typic Albaqualfs
Nunemaker-----	Fine, montmorillonitic, frigid Aridic Ustochrepts
Perma-----	Loamy-skeletal, mixed Typic Haploborolls
Phillips-----	Fine, montmorillonitic Typic Eutroboralfts
Reeder-----	Fine-loamy, mixed Typic Argiborolls
Roy-----	Clayey-skeletal, mixed Typic Argiborolls
Sagedale-----	Fine, montmorillonitic, frigid Typic Ustochrepts
Savage-----	Fine, montmorillonitic Typic Argiborolls
Scobey-----	Fine, montmorillonitic Aridic Argiborolls
Sunburst-----	Fine, montmorillonitic (calcareous), frigid Aridic Ustorthents
Tamaneen-----	Fine, montmorillonitic Typic Argiborolls
Telstad-----	Fine-loamy, mixed Aridic Argiborolls
Thibadeau-----	Fine-loamy, mixed (calcareous), frigid Oxyaquic Ustifluvents
Toeny-----	Fine, montmorillonitic Typic Natriboralfts
Tinsley-----	Sandy-skeletal, mixed, frigid Typic Ustorthents
Turner-----	Fine-loamy over sandy or sandy-skeletal, mixed Typic Argiborolls
Twilight-----	Coarse-loamy, mixed, frigid Aridic Ustochrepts
Vanda-----	Fine, montmorillonitic (calcareous), frigid Aridic Ustorthents
Vida-----	Fine-loamy, mixed Typic Argiborolls
Wayden-----	Clayey, montmorillonitic (calcareous), frigid, shallow Typic Ustorthents
Weingart-----	Fine, montmorillonitic Typic Natriboralfts
Whitlash-----	Loamy-skeletal, mixed Lithic Haploborolls
Williams-----	Fine-loamy, mixed Typic Argiborolls
Winspect-----	Loamy-skeletal, mixed Typic Calciborolls
Work-----	Fine, montmorillonitic Typic Argiborolls
Yamacall-----	Fine-loamy, mixed, frigid Aridic Ustochrepts
Yawdim-----	Clayey, montmorillonitic (calcareous), frigid, shallow Aridic Ustorthents
Zahill-----	Fine-loamy, mixed (calcareous), frigid Typic Ustorthents

## Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
5A	McKenzie clay, 0 to 1 percent slope-----	1,265	0.1
12C	Beaverton gravelly loams, 2 to 8 percent slopes-----	430	*
14C	Brockway silt loam, 2 to 8 percent slopes-----	4,077	0.4
15E	Lambeth silt loam, 8 to 25 percent slopes-----	1,476	0.2
15F	Lambeth silt loam, 25 to 70 percent slopes-----	1,223	0.1
16B	Degrand fine sandy loam, 0 to 4 percent slopes-----	455	*
18E	Yawdim silty clay, 8 to 25 percent slopes-----	857	*
21E	Cabbart-Delpoint loams, 8 to 25 percent slopes-----	1,303	0.1
22F	Hillon loam, 25 to 60 percent slopes-----	18,468	2.0
23B	Acel silty clay loam, 0 to 4 percent slopes-----	540	*
24B	Farnuf loam, 0 to 4 percent slopes-----	1,782	0.2
27B	Attewan loam, 0 to 4 percent slopes-----	987	0.1
28A	Nishon clay loam, 0 to 1 percent slope-----	7,311	0.8
30B	Marvan silty clay, 0 to 4 percent slopes-----	30,324	3.3
30C	Marvan silty clay, 4 to 8 percent slopes-----	1,578	0.2
32B	Kobase silty clay loam, 0 to 4 percent slopes-----	16,893	1.8
32C	Kobase silty clay loam, 4 to 8 percent slopes-----	1,837	0.2
34A	Linnet clay, 0 to 2 percent slopes-----	395	*
35B	Assinniboine fine sandy loam, 0 to 4-----	6,737	0.7
36C	Chinook fine sandy loam, 2 to 8 percent slopes-----	2,891	0.3
37B	Evanston loam, 0 to 4 percent slopes-----	19,592	2.1
37C	Evanston loam, 4 to 8 percent slopes-----	546	*
38B	Ethridge silty clay loam, 0 to 4 percent slopes-----	19,281	2.1
39C	Lisk sandy loam, 2 to 8 percent slopes-----	147	*
39E	Lisk sandy loam, 8 to 25 percent slopes-----	322	*
41C	Reeder loam, 2 to 8 percent slopes-----	660	*
43B	Marmarth loam, 0 to 4 percent slopes-----	512	*
47B	Marias silty clay, 0 to 4 percent slopes-----	4,308	0.5
51F	Elve very cobbly loam, 25 to 60 percent slopes-----	508	*
54B	Lawther clay, 0 to 4 percent slopes-----	3,352	0.4
54C	Lawther clay, 4 to 8 percent slopes-----	787	*
58B	Lonna silty clay loam, 0 to 4 percent slopes-----	2,637	0.3
58C	Lonna silty clay loam, 4 to 8 percent slopes-----	4,536	0.5
60A	Havre clay loam, 0 to 1 percent slope-----	3,924	0.4
63B	Nunemaker silty clay loam, 0 to 4 percent slopes-----	3,742	0.4
63C	Nunemaker silty clay loam, 4 to 8 percent slopes-----	600	*
64D	Barkof clay, 4 to 15 percent slopes-----	815	*
67B	Bearpaw clay loam, 0 to 4 percent slopes-----	5,407	0.6
67C	Bearpaw clay loam, 4 to 8 percent slopes-----	1,410	0.2
69C	Vida clay loam, 2 to 8 percent slopes-----	4,487	0.5
71D	Roy complex, 8 to 15 percent slopes-----	4,250	0.4
71F	Roy gravelly clay loam, 15 to 45 percent slopes-----	1,600	0.2
72F	Zahill clay loam, 25 to 60 percent slopes-----	4,125	0.4
75C	Benz clay loam, 2 to 8 percent slopes-----	1,214	0.1
77D	Tinsley gravelly sandy loam, 4 to 15 percent slopes-----	434	*
77F	Tinsley gravelly sandy loam, 15 to 70 percent slopes-----	490	*
79B	Yamacall loam, 0 to 4 percent slopes-----	6,192	0.7
82B	Savage silty clay loam, 0 to 4 percent slopes-----	600	*
86C	Work clay loam, 2 to 8 percent slopes-----	1,843	0.2
87C	Tamaneen complex, 2 to 8 percent slopes-----	5,740	0.6
88C	Perma gravelly loam, 2 to 8 percent slopes-----	560	*
88E	Perma gravelly loam, 8 to 25 percent slopes-----	945	0.1
90A	Harlake silty clay, 0 to 1 percent slope-----	1,484	0.2
92D	Sunburst clay loam, 8 to 15 percent slopes-----	4,159	0.4
92F	Sunburst clay loam, 15 to 45 percent slopes-----	7,347	0.8
94C	Busby fine sandy loam, 2 to 8 percent slopes-----	3,736	0.4
94E	Busby fine sandy loam, 8 to 25 percent slopes-----	510	*
98C	Kremlin loam, 2 to 8 percent slopes-----	577	*
100F	Rubble land-----	1,628	0.2

\*See footnote at end of table

Acreege and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
115B	Thoeny-Elloam complex, 0 to 4 percent slopes-----	63,572	6.9
171C	Delpoint-Cabbart loams, 2 to 8 percent slopes-----	1,958	0.2
190B	Hedstrom fine sandy loam, 0 to 4 percent slopes-----	235	*
200F	Badland-----	1,514	0.2
201D	Cabba-Wayden complex, 4 to 15 percent slopes-----	2,628	0.3
201F	Cabba-Wayden-Rock outcrop complex, 15 to 60 percent slopes-----	5,440	0.6
211E	Cabbart-Yawdim complex, 8 to 25 percent slopes-----	3,011	0.3
211F	Cabbart-Yawdim-Rock outcrop complex, 25 to 70 percent slopes-----	5,129	0.6
221E	Hillon-Kevin clay loams, 8 to 25 percent slopes-----	6,231	0.7
224B	Hillon-Joplin complex, 0 to 4 percent slopes-----	14,479	1.6
224E	Hillon-Joplin loams, 8 to 25 percent slopes-----	27,716	3.0
225F	Hillon-Cabbart-Yawdim complex, 25 to 70 percent slopes-----	5,910	0.6
261C	Auchard-Williams complex, 2 to 8 percent slopes-----	2,257	0.2
271D	Beaverell-Tinsley complex, 4 to 15 percent slopes-----	1,766	0.2
272C	Attewan-Tinsley complex, 2 to 8 percent slopes-----	278	*
301C	Marvan-Vanda complex, 2 to 8 percent slopes-----	624	*
302B	Marvan clay, 0 to 4 percent slopes-----	2,649	0.3
304B	Marvan-Joplin, complex, 0 to 4 percent slopes-----	1,371	0.1
306D	Marvan-Yawdim-Cabbart complex, 4 to 15 percent slopes-----	785	*
311B	Ferd-Creed-Gerdrum complex, 0 to 4-----	30,681	3.3
321B	Kobase silty clay loam, calcareous, 0 to 4 percent-----	12,277	1.3
321C	Kobase silty clay loam, calcareous, 4 to 8 percent-----	651	*
323B	Sagedale silty clay, 0 to 4 percent slopes-----	609	*
323C	Sagedale silty clay, 4 to 8 percent slopes-----	487	*
331B	Phillips-Elloam complex, 0 to 4 percent slopes-----	20,735	2.2
351B	Kenilworth-Fortbenton fine sandy loams, 0 to 4 percent slopes-----	4,216	0.4
363B	Cozberg-Chinook fine sandy loams, 0 to 4 percent slopes-----	7,143	0.8
368C	Fortbenton-Hillon complex, 2 to 8 percent slopes-----	1,659	0.2
385B	Ethridge-Kobase complex, 0 to 4 percent slopes-----	2,118	0.2
401C	Gerdrum-Yamacall loams, 2 to 8 percent slopes-----	3,636	0.4
421C	Joplin-Hillon loams, 2 to 8 percent slopes-----	115,559	12.5
441C	Kevin-Hillon clay loams, 2 to 8 percent slopes-----	27,267	2.9
442C	Kevin-Elloam clay loams, 2 to 8 percent slopes-----	54,372	5.9
445E	Kevin-Hillon-Nishon complex, 0 to 25 percent slopes-----	2,147	0.2
471B	Marias-Kobase complex, 0 to 4 percent slopes-----	4,233	0.4
491B	Enbar-Nesda loams, 0 to 4 percent slopes-----	1,240	0.1
493B	Enbar-Bigsandy-Korchea loams, 0 to 4 percent slopes-----	6,134	0.7
503B	Telstad-Joplin loams, 0 to 4 percent slopes-----	79,684	8.6
503C	Telstad-Joplin loams, 4 to 8 percent slopes-----	9,307	1.0
512F	Elve-Rubble land complex, 25 to 60 percent slopes-----	1,815	0.2
521C	Elloam-Absher complex, 2 to 8 percent slopes-----	3,214	0.3
531C	Turner-Beaverton complex, 2 to 8 percent slopes-----	913	*
561B	Scobey-Kevin clay loams, 0 to 4 percent slopes-----	42,588	4.6
561C	Scobey-Kevin clay loams, 4 to 8 percent slopes-----	3,755	0.4
601A	Havre-Glendive, complex, 0 to 2 percent slopes-----	2,143	0.2
603B	Thibadeau loam, 0 to 4 percent slopes-----	1,320	0.1
605C	Yamacall-Havre loams, 0 to 8 percent slopes-----	17,282	1.9
631B	Nunemaker silty clay loam, calcareous, 0 to 4 percent slopes-----	5,973	0.6
631C	Nunemaker silty clay loam, calcareous, 4 to 8 percent slopes-----	565	*
661C	Twilight-Blacksheep fine sandy loams, 2 to 8 percent slopes-----	364	*
671C	Bearpaw-Vida-Nishon clay loams, 0 to 8 percent slopes-----	5,887	0.6
673B	Bearpaw-Daglum clay loams, 0 to 4 percent slopes-----	2,353	0.2
691D	Vida-Williams complex, 4 to 15 percent slopes-----	1,654	0.2
692D	Vida-Bearpaw clay loams, 4 to 15 percent slopes-----	7,461	0.8
693D	Vida-Bearpaw-Nishon clay loams, 0 to 15 percent slopes-----	6,395	0.7
695C	Vida-Zahill clay loams, 2 to 8 percent slopes-----	3,006	0.3
695E	Vida-Zahill clay loams, 8 to 25 percent slopes-----	9,240	1.0
702F	Winspect-Winspect, cool-Rock outcrop complex, 25 to 60 percent slopes-----	1,005	0.1

\*See footnote at end of table

## Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
712E	Roy-Barkof complex, 8 to 25 percent slopes-----	3,179	0.3
712F	Roy-Barkof-Rock outcrop complex, 25 to 60 percent slopes-----	5,308	0.6
723F	Zahill-Cabba complex, 15 to 45 percent slopes-----	4,032	0.4
781C	Creed-Weingart complex, 2 to 8 percent slopes-----	1,242	0.1
791B	Yamacall loam, calcareous, 0 to 4 percent slopes-----	1,119	0.1
801B	Williams-Vida complex, 0 to 4 percent slopes-----	4,414	0.5
801C	Williams-Vida complex, 4 to 8 percent slopes-----	4,158	0.4
812A	Glendive-Havre, complex, 0 to 2 percent slopes-----	1,893	0.2
882F	Perma-Whitlash gravelly loams, 25 to 70 percent slopes-----	4,952	0.5
892F	Whitlash-Rock outcrop complex, 25 to 70 percent slopes-----	3,534	0.4
952F	Dast-Rock outcrop complex, 15 to 45 percent slopes-----	992	0.1
DA	Denied access-----	3,680	0.4
M-W	Miscellaneous water-----	30	*
W	Water-----	13,090	1.4
	Total-----	926,100	100.0

\* Less than 0.1 percent.

## Soil Series and Detailed Soil Map Units

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In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each description is followed by the detailed soil map units associated with the series.

Characteristics of the soil and the material in which it formed are identified for each soil series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual". Many of the technical terms used in the descriptions are defined in "Soil Taxonomy". Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units on the detailed soil maps in Part III of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given in Part II of this survey.

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

Minor components have properties and behavioral characteristics divergent enough to affect use or to require different management. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly

indicates a feature that affects use or management. For example, rarely flooded is a phase of the Havre series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Telstad-Joplin loams, 0 to 4 percent slopes, is an example.

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

The table "Acreage and Proportionate Extent of the Soils" in Parts I and II of the manuscript gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils or miscellaneous areas.

A typical soil description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section, Part II, of this publication.

For general and detailed information about managing map units, see the following sections in Part II of this publication:

- "Range" section
- "Agronomy" section
- "Recreation" section
- "Wildlife Habitat" section
- "Engineering" and "Soil Properties" sections

### **Absher Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Moderately well drained

*Permeability:* Very slow (less than 0.06 inch/hour)

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 2 to 4 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic Natriboralfs

### **Typical Pedon**

Absher clay loam, in an area of Elloam-Absher complex, 2 to 8 percent slopes, in a rangeland area; 1,300 feet east and 1,100 feet north of the southwestern corner of sec. 29, T. 31 N., R. 7 E.

E—0 to 1 inch; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; thin vesicular crust with weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; slightly alkaline; abrupt wavy boundary.

Btn1—1 to 4 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky structure; hard, very firm, sticky and plastic; common distinct clay films on faces of peds; moderately alkaline; clear wavy boundary.

Btn2—4 to 7 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium angular blocky structure; hard, very firm, sticky and plastic; common distinct clay films on faces of peds; moderately alkaline; clear wavy boundary.

Btknyz—7 to 15 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, firm, sticky and plastic; disseminated lime; common fine nests of gypsum and other salts; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkyz1—15 to 42 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; disseminated lime; common fine nests of gypsum and other salts; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bkyz2—42 to 60 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; hard, very firm, sticky and plastic; disseminated lime; common fine nests of gypsum and other salts; strongly effervescent; strongly alkaline.

### **Range in Characteristics**

*Depth to the Btnyz horizon:* 6 to 15 inches

*E horizon*

Hue: 2.5Y, 10YR, or 7.5YR

Value: 6 or 7 dry; 3, 4, or 5 moist

Chroma: 1, 2, or 3  
 Texture: The surface layer is clay when mixed to 7 inches  
 Clay content: 40 to 55 percent  
 Electrical conductivity: 4 to 8 mmhos/cm  
 Reaction: pH 6.6 to 8.4

***Btn horizons***

Hue: 2.5Y, 7.5YR, or 10YR  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 1, 2, or 3  
 Texture: Silty clay, clay, or clay loam  
 Clay content: 35 to 60 percent  
 Content of rock fragments: 0 to 15 percent pebbles  
 Electrical conductivity: 8 to 16 mmhos/cm  
 Sodium adsorption ratio: 18 to 70  
 Reaction: pH 7.4 to 9.0

***Btknyz horizon***

Hue: 2.5Y, 10YR, or 7.5YR  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Texture: Clay loam, clay, or silty clay  
 Clay content: 35 to 50 percent  
 Content of rock fragments: 0 to 20 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Electrical conductivity: 8 to 16 mmhos/cm  
 Sodium adsorption ratio: 18 to 70  
 Gypsum content: 1 to 5 percent  
 Reaction: pH 7.9 to 9.0

***Bkyz horizons***

Hue: 2.5Y, 10YR, or 7.5YR  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay loam, silty clay, clay, or silty clay loam  
 Clay content: 35 to 50 percent  
 Content of rock fragments: 0 to 20 percent pebbles  
 Calcium carbonate equivalent: 4 to 15 percent  
 Electrical conductivity: 16 to 30 mmhos/cm  
 Sodium adsorption ratio: 18 to 70  
 Gypsum content: 1 to 5 percent  
 Reaction: pH 7.9 to 9.0

***Acel Series***

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Till plains

*Parent material:* Alluvium  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Mollic Eutroboralfs

**Typical Pedon**

Acel silty clay loam, 0 to 4 percent slopes, in an area of rangeland; 2,300 feet west and 400 feet north of the southeastern corner of sec. 10, T. 36 N., R. 6 E.

A—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate fine granular structure when moist, massive structure when dry; hard, firm, sticky and plastic; slightly alkaline; clear wavy boundary.

Bt1—5 to 12 inches; grayish brown (2.5Y 5/3) silty clay, dark grayish brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to strong fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Bt2—12 to 19 inches; grayish brown (2.5Y 5/3) silty clay, dark grayish brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to strong fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

Bk1—19 to 30 inches; grayish brown (2.5Y 5/3) silty clay, dark grayish brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine soft masses of lime; slightly effervescent; mildly alkaline; gradual wavy boundary.

Bk2—30 to 46 inches; grayish brown (2.5Y 5/3) silty clay, dark grayish brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; hard, friable, sticky and plastic; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bky—46 to 60 inches; grayish brown (2.5Y 5/3) silty clay, dark grayish brown (2.5Y 4/3) moist; massive; hard, friable, sticky and plastic; disseminated lime; common fine soft masses and threads of gypsum; strongly effervescent; moderately alkaline.

**Range in Characteristics**

*Depth to the Bk horizon:* 15 to 25 inches

**A horizon**

Hue: 2.5Y or 10YR  
Clay content: 27 to 35 percent  
Content of rock fragments: 0 to 5 percent pebbles  
Reaction: pH 6.6 to 7.8

**Bt horizons**

Hue: 2.5Y or 10YR  
Value: 4 or 5 dry; 3 or 4 moist  
Chroma: 2 or 3  
Texture: Silty clay or clay  
Clay content: 40 to 55 percent  
Content of rock fragments: 0 to 5 percent pebbles  
Reaction: pH 6.6 to 7.8

**Bk and Bky horizons**

Hue: 2.5Y or 10YR  
Value: 5 or 6 dry; 4 or 5 moist  
Chroma: 2, 3, or 4  
Texture: Clay loam, silty clay loam, or silty clay  
Clay content: 35 to 45 percent  
Content of rock fragments: 0 to 15 percent—0 to 5 percent cobbles, 0 to 15 percent pebbles  
Calcium carbonate equivalent: 5 to 15 percent  
Reaction: pH 7.9 to 9.0

**23B—Acel silty clay loam, 0 to 4 percent slopes****Setting**

*Landform:* Till plains  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Acel and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 4 percent: 0 to 1 percent  
Nishon and similar soils: 0 to 2 percent  
Marias and similar soils: 0 to 1 percent  
Nunemaker and similar soils: 0 to 1 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.4 inches

**Assinniboine Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Alluvial fans or stream terraces  
*Parent material:* Alluvium or eolian deposits  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic Argiborolls

**Typical Pedon**

Assinniboine fine sandy loam, 0 to 4 percent slopes, in an area of cropland. 1,000 feet east and 3,300 feet south of the northwest corner of sec. 31, T. 30 N., R. 7 E.

- Ap1—0 to 3 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline; abrupt smooth boundary.
- Ap2—3 to 7 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline; abrupt smooth boundary.
- Bt—7 to 15 inches; light olive brown (2.5Y 5/4) sandy clay loam, olive brown (2.5Y 4/4) moist; strong medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common distinct clay films lining interstitial pores; mildly alkaline; clear smooth boundary.
- Bk1—15 to 25 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and nonplastic; common fine soft masses of lime; strongly effervescent; moderately alkaline; clear smooth boundary.
- Bk2—25 to 43 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; slightly hard, very friable, nonsticky and nonplastic; common fine soft masses and seams of lime;

strongly effervescent; moderately alkaline; clear smooth boundary.

BC—43 to 60 inches; light brownish gray (2.5Y 6/2) fine sandy loam with stratifications of loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine soft masses and seams of lime; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 12 inches  
*Depth to the Bk horizon:* 14 to 20 inches

#### Ap horizon

Hue: 10YR or 2.5Y  
Chroma: 2 or 3  
Clay content: 5 to 15 percent  
Content of rock fragments: 0 to 25 percent pebbles  
Reaction: pH 6.1 to 7.8

#### Bt horizon

Hue: 10YR or 2.5Y  
Value: 4, 5, or 6 dry; 3, 4, or 5 moist  
Chroma: 2, 3, or 4  
Texture: Sandy clay loam or fine sandy loam  
Clay content: 18 to 30 percent  
Content of rock fragments: 0 to 15 percent pebbles  
Reaction: pH 6.6 to 7.8

#### Bk horizons

Hue: 2.5Y or 10YR  
Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Sandy loam, fine sandy loam, or sandy clay loam  
Clay content: 10 to 27 percent  
Content of rock fragments: 0 to 15 percent pebbles  
Calcium carbonate equivalent: 5 to 15 percent  
Reaction: pH 7.4 to 8.4  
Note: Some pedons have a Btk horizon.

#### BC horizon

Hue: 2.5Y or 10YR  
Value: 5, 6, or 7 dry; 4 or 5 moist  
Chroma: 2, 3, or 4  
Texture: Fine sandy loam, sandy loam, loamy fine sand, fine sand, or stratifications of these textures  
Clay content: 0 to 15 percent  
Content of rock fragments: 0 to 15 percent pebbles  
Reaction: pH 7.4 to 8.4

### 35B—Assinniboine fine sandy loam, 0 to 4 percent slopes

#### Setting

*Landform:* Alluvial fans and stream terraces  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Assinniboine and similar soils: 95 percent

#### Minor Components

Soils that have slopes more than 4 percent: 0 to 2 percent  
Assinniboine loam: 0 to 3 percent

#### Major Component Description

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium or eolian material  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 7.4 inches

#### Attewan Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour) to 21 inches; rapid below this depth (6.0 to 20.0 inches/hour)  
*Landform:* Relict stream terraces or outwash plains  
*Parent material:* Glacial outwash  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy over sandy or sandy-skeletal, mixed Aridic Argiborolls

#### Typical Pedon

Attewan loam, 0 to 4 percent slopes, in an area of cropland. 1,100 feet north and 1,600 feet west of the southeast corner of sec. 17, T. 32 N., R. 6 E.

Ap—0 to 5 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine granular

structure; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

**Bt**—5 to 13 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, friable, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

**Bk**—13 to 21 inches; pale brown (10YR 6/3) gravelly clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; 15 percent pebbles, 5 percent cobbles; many fine and medium soft masses of lime and lime coatings on coarse fragments; strongly effervescent; moderately alkaline; gradual wavy boundary.

**2C**—21 to 60 inches; yellowish brown (10YR 5/4) very gravelly loamy sand, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; loose, nonsticky and nonplastic; 40 percent pebbles, 10 percent cobbles; lime coatings on underside of coarse fragments; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 12 inches

*Depth to the Bk horizon:* 10 to 20 inches

*Depth to the 2C horizon:* 20 to 40 inches

#### *Ap horizon*

Hue: 10YR or 2.5Y

Value: 4 or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 10 to 20 percent

Content of rock fragments: 0 to 50 percent—

0 to 20 percent greater than 3-inch stones and cobbles, 0 to 30 percent less than 3-inch pebbles

Reaction: pH 6.1 to 7.8

#### *Bt horizon*

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Clay loam, sandy clay loam, or loam

Clay content: 20 to 35 percent

Content of rock fragments: 0 to 25 percent—

0 to 5 percent greater than 3-inch stones and cobbles, 0 to 20 percent less than 3-inch pebbles

Reaction: pH 6.6 to 7.8

#### *Bk horizon*

Hue: 10YR or 2.5Y

Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist

Chroma: 2, 3, 4, or 6

Texture: Loam, clay loam, silt loam, sandy clay loam, or sandy loam

Clay content: 15 to 30 percent

Content of rock fragments: 0 to 30 percent—  
0 to 5 percent stones and cobbles, 0 to 25 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

#### *2C horizon*

Hue: 2.5Y or 10YR

Value: 4, 5, or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loamy sand, sand, loamy coarse sand, or coarse sand

Clay content: 0 to 10 percent

Content of rock fragments: 35 to 75 percent—  
0 to 15 percent stones and cobbles, 35 to 60 percent pebbles

Reaction: pH 7.4 to 8.4

### **27B—Attewan loam, 0 to 4 percent slopes**

#### **Setting**

*Landform:* Relict stream terraces

*Slope:* 0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Attewan and similar soils: 95 percent

#### **Minor Components**

Soils that have slopes more than 4 percent:  
0 to 1 percent

Scobey and similar soils: 0 to 2 percent

Degrad and similar soils: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Glacial outwash

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.2 inches

## 272C—Attewan-Tinsley complex, 2 to 8 percent slopes

### Setting

#### Landform:

- Attewan—Outwash plains
- Tinsley—Outwash plains

#### Position on landform:

- Attewan—Back slopes and foot slopes
- Tinsley—Back slopes and shoulders

#### Slope:

- Attewan—2 to 8 percent
- Tinsley—2 to 8 percent

Elevation: 2,750 to 3,460 feet

Mean annual precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

### Composition

#### Major Components

Attewan and similar soils: 50 percent

Tinsley and similar soils: 40 percent

#### Minor Components

Soils that have slopes more than 8 percent:

0 to 2 percent

Vanda and similar soils: 0 to 2 percent

Soils that have slopes less than 2 percent:

0 to 2 percent

Attewan sandy loam: 0 to 2 percent

Degrad and similar soils: 0 to 2 percent

### Major Component Description

#### Attewan

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Native plant cover type: Rangeland

Flooding: None

Available water capacity: 4.2 inches

#### Tinsley

Surface layer texture: Gravelly sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Native plant cover type: Rangeland

Flooding: None

Available water capacity: 1.2 inches

## Auchard Series

Depth class: Moderately deep (20 to 40 inches)

Drainage class: Well drained

Permeability: Slow (0.06 to 0.2 inch/hour)

Landform: Till plains

Parent material: Residuum weathered from semiconsolidated shale

Slope range: 2 to 8 percent

Annual precipitation: 13 to 17 inches

Annual air temperature: 41 to 44 degrees F

Frost-free period: 90 to 110 days

**Taxonomic class:** Fine, mixed Typic Natriboralfs

### Typical Pedon

Auchard clay loam, in an area of Auchard-Williams complex, 2 to 8 percent slopes, in a rangeland area; 3,000 feet west and 700 feet south of the northeast corner of sec. 7, T. 37 N., R. 6 E.

E—0 to 2 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak very thin platy structure; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Btn—2 to 6 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong medium columnar structure parting to moderate medium prismatic structure; very hard, firm, sticky and plastic; common distinct clay films on faces of peds; moderately alkaline; clear wavy boundary.

Btkn—6 to 11 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky structure; very hard, firm, sticky and plastic; many distinct clay films on faces of peds; disseminated lime; strongly effervescent; strongly alkaline; clear wavy boundary.

Bkyz—11 to 22 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; many fine and medium soft masses of lime; common fine seams and soft masses of gypsum and other salts; strongly effervescent; strongly alkaline; clear wavy boundary.

Cr—22 to 60 inches; grayish brown (2.5Y 5/2) semiconsolidated shale, (2.5Y 4/2) moist; slightly effervescent; moderately alkaline.

### Range in Characteristics

*Depth to Btkn horizon:* 5 to 15 inches

*Depth to Bkyz horizon:* 10 to 30 inches

*Depth to Cr layer:* 20 to 40 inches

#### *E horizon*

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 10 percent  
pebbles

Reaction: pH 6.1 to 7.3

#### *Btn horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 moist

Chroma: 2 or 3

Texture: Clay or silty clay

Clay content: 40 to 50 percent

Sodium adsorption ratio: 8 to 13

Reaction: pH 7.9 to 8.4

#### *Btkn horizon*

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Silty clay loam, silty clay, or clay

Clay content: 35 to 50 percent

Electrical conductivity: 2 to 4 mmhos/cm

Sodium adsorption ratio: 13 to 30

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.9 to 9.0

#### *Bkyz horizon*

Hue: 10YR or 2.5Y

Value: 4 or 5 moist

Chroma: 2 or 3

Texture: Silty clay loam, clay loam, or silty clay

Clay content: 30 to 45 percent

Electrical conductivity: 4 to 16 mmhos/cm

Sodium adsorption ratio: 13 to 30

Calcium carbonate equivalent: 5 to 15 percent

Gypsum: 1 to 3 percent

Reaction: pH 7.9 to 9.0

## 261C—Auchard-Williams complex, 2 to 8 percent slopes

### Setting

#### *Landform:*

- Auchard—Till plains
- Williams—Till plains

#### *Position on landform:*

- Auchard—Microlows
- Williams—Microhighs

#### *Slope:*

- Auchard—2 to 8 percent
- Williams—2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Auchard and similar soils: 45 percent

Williams and similar soils: 40 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 3 percent

Daglum and similar soils: 0 to 3 percent

Cabba and similar soils: 0 to 5 percent

Soils that have slopes less than 2 percent:  
0 to 4 percent

### Major Component Description

#### Auchard

*Surface layer texture:* Clay loam

*Depth class:* Moderately deep (20 to 40 inches)

*Drainage class:* Well drained

*Dominant parent material:* Semiconsolidated shale  
residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 3.2 inches

#### Williams

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 10.5 inches

## 200F—Badland

### Composition

#### Major Components

Badland: 85 percent

**Minor Components**

Cabbart and similar soils: 0 to 5 percent  
 Delpoint and similar soils: 0 to 5 percent  
 Havre and similar soils: 0 to 3 percent  
 Lambeth and similar soils: 0 to 2 percent

**Major Component Description**

*Definition:* Steep or very steep, barren land dissected by many intermittent drainage channels

**Barkof Series**

*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Hills  
*Parent material:* Residuum weathered from shale  
*Slope range:* 4 to 45 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic, frigid Leptic Udic Haplusterts

**Typical Pedon**

Barkof clay, 4 to 15 percent slopes, in an area of rangeland; 1,600 feet north and 2,100 feet west of the southeast corner of sec. 9, T. 35 N., R. 5 E.

A—0 to 3 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to strong fine granular structure; hard, firm, sticky and plastic; slightly effervescent; mildly alkaline; clear wavy boundary.

Bss—3 to 10 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky structure; very hard, very firm, sticky and plastic; common slickensides intersecting at 45 degree angles; slightly effervescent; moderately alkaline; clear wavy boundary.

Bkss—10 to 14 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few slickensides; common fine soft masses of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bky1—14 to 22 inches; light gray (2.5Y 7/2) clay, light brownish gray (2.5Y 6/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and

plastic; many fine soft masses of lime; many fine seams of gypsum; strongly effervescent; moderately alkaline; gradual wavy boundary.  
 Bky2—22 to 26 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate very fine and fine platy structure; hard, firm, sticky and plastic; many fine soft masses of lime; many fine seams of gypsum; strongly effervescent; moderately alkaline.  
 Cr—26 to 60 inches; light brownish gray and light yellowish brown semiconsolidated shale.

**Range in Characteristics**

*Depth to the Cr horizon:* 20 to 40 inches

**A horizon**

Hue: 5Y, 2.5Y, or 10YR  
 Value: 4 or 5 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Clay content: 40 to 55 percent  
 Content of rock fragments: 0 to 30 percent—  
 0 to 15 percent greater than 3-inches, 0 to 15 percent pebbles  
 Electrical conductivity: 0 to 2 mmhos/cm  
 Reaction: pH 6.6 to 8.4

**Bss horizon**

Hue: 5Y, 2.5Y, or 10YR  
 Value: 4, 5, or 6 dry; 3, 4, or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay or silty clay  
 Clay content: 45 to 60 percent  
 Electrical conductivity: 0 to 4 mmhos/cm  
 Reaction: pH 6.6 to 8.4  
 Note: Some pedons have a Bkssy horizon

**Bkss and Bky horizons**

Hue: 5Y, 2.5Y, or 10YR  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay or silty clay  
 Clay content: 45 to 60 percent  
 Electrical conductivity: 2 to 4 mmhos/cm  
 Reaction: pH 7.4 to 9.0

**64D—Barkof clay, 4 to 15 percent slopes****Setting**

*Landform:* Hills  
*Slope:* 4 to 15 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### **Composition**

#### **Major Components**

Barkof and similar soils: 85 percent

#### **Minor Components**

Soils that have slopes more than 15 percent:

0 to 3 percent

Barkof silty clay: 0 to 1 percent

Areas of Rock outcrop: 0 to 4 percent

Wayden and similar soils: 0 to 5 percent

Sagedale and similar soils: 0 to 1 percent

Soils that have slopes less than 4 percent:

0 to 1 percent

### **Major Component Description**

*Surface layer texture:* Clay

*Depth class:* Moderately deep (20 to 40 inches)

*Drainage class:* Well drained

*Dominant parent material:* Semiconsolidated shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.0 inches

### **Bearpaw Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Till plains, hills

*Parent material:* Glacial till

*Slope range:* 0 to 8 percent

*Annual precipitation:* 15 to 19 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic Typic Argiborolls

#### **Typical Pedon**

Bearpaw clay loam, 0 to 4 percent slopes, in cropland, 1,200 feet east and 1,100 feet south of the northwest corner of sec. 18, T. 35 N., R. 4 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt—6 to 12 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate and fine subangular

blocky structure; hard, firm, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear smooth boundary.

Btk—12 to 15 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky structure; hard, firm, sticky and plastic; many distinct clay films on faces of peds; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk1—15 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and medium soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—20 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline.

### **Range in Characteristics**

*Mollic epipedon thickness:* 7 to 12 inches

*Depth to the Bk horizon:* 10 to 20 inches

#### *Ap horizon*

Value: 3, 4, or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 20 percent—

0 to 5 percent cobbles, 0 to 15 percent pebbles

Reaction: pH 6.1 to 7.8

#### *Bt horizon*

Value: 4 or 5 dry; 3 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 20 percent—

0 to 5 percent cobbles, 0 to 15 percent pebbles

Reaction: pH 6.1 to 7.8

#### *Btk horizon*

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 20 percent—

0 to 5 percent cobbles, 0 to 15 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 7.8

*Bk horizons*

Hue: 2.5Y or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay loam, silty clay loam, or clay

Clay content: 30 to 45 percent

Content of rock fragments: 0 to 20 percent—

0 to 5 percent cobbles, 0 to 15 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

**67B—Bearpaw clay loam, 0 to 4 percent slopes**

***Setting***

*Landform:* Till plains (fig. 2)

*Slope:* 0 to 4 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

***Composition***

**Major Components**

Bearpaw and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
0 to 2 percent

Nishon and similar soils: 0 to 3 percent

Daglum and similar soils: 0 to 3 percent

Vida gravelly clay loam: 0 to 2 percent

***Major Component Description***

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 8.7 inches



Figure 2. - Typical area of Bearpaw clay loam, 0 to 4 percent slopes in the foreground. This photo was taken near the town of Whitlash.

### 67C—Bearpaw clay loam, 4 to 8 percent slopes

#### Setting

*Landform:* Till plains  
*Slope:* 4 to 8 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Frost-free period:* 90 to 110 days

#### Composition

##### Major Components

Bearpaw and similar soils: 90 percent

##### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 2 percent  
 Daglum and similar soils: 0 to 2 percent  
 Vida gravelly clay loam: 0 to 2 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent

#### Major Component Description

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.7 inches

### 673B—Bearpaw-Daglum clay loams, 0 to 4 percent slopes

#### Setting

##### Landform:

- Bearpaw—Till plains
- Daglum—Till plains

##### Position on landform:

- Bearpaw—Microhighs
- Daglum—Microlows

##### Slope:

- Bearpaw—0 to 4 percent
- Daglum—0 to 4 percent

*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Frost-free period:* 90 to 110 days

#### Composition

##### Major Components

Bearpaw and similar soils: 65 percent  
 Daglum and similar soils: 30 percent

##### Minor Components

Soils that have slopes more than 4 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 2 percent  
 Vida and similar soils: 0 to 1 percent

#### Major Component Description

##### Bearpaw

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.7 inches

##### Daglum

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 7.8 inches

### 671C—Bearpaw-Vida-Nishon clay loams, 0 to 8 percent slopes

#### Setting

##### Landform:

- Bearpaw—Till plains
- Vida—Till plains
- Nishon—Closed depressions

##### Position on landform:

- Bearpaw—Back slopes and foot slopes
- Vida—Back slopes and shoulders

##### Slope:

- Bearpaw—2 to 8 percent
- Vida—2 to 8 percent
- Nishon—0 to 1 percent

*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Frost-free period:* 90 to 110 days

## **Composition**

### **Major Components**

Bearpaw and similar soils: 45 percent  
 Vida and similar soils: 35 percent  
 Nishon and similar soils: 15 percent

### **Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Daglum and similar soils: 0 to 1 percent  
 Vida, calcareous surface: 0 to 1 percent  
 Vida gravelly clay loam: 0 to 1 percent

### **Major Component Description**

#### **Bearpaw**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.7 inches

#### **Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

#### **Nishon**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Poorly drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Ponding:* long  
*Available water capacity:* 9.3 inches

### **Beaverell Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour) to  
 13 inches; rapid below this depth (6.0 to 20.0  
 inches/hour)

*Landform:* Kames and eskers

*Parent material:* Glacial outwash

*Slope range:* 4 to 15 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Loamy-skeletal over sandy or  
 sandy-skeletal, mixed Aridic Argiborolls

### **Typical Pedon**

Beaverell gravelly loam, in an area of Beaverell-Tinsley complex, 4 to 15 percent slopes, in rangeland; 2,700 feet east and 700 feet north of the southwest corner of sec. 1, T. 29 N., R. 5 E.

- A—0 to 5 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and very fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; 20 percent pebbles; mildly alkaline; clear smooth boundary.
- Bt—5 to 13 inches; grayish brown (10YR 5/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common distinct clay films on faces of peds; 35 percent pebbles; mildly alkaline; clear smooth boundary.
- 2Bk—13 to 18 inches; light gray (10YR 7/2) very gravelly loamy sand, grayish brown (10YR 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; finely disseminated lime; 40 percent pebbles, 5 percent cobbles; violently effervescent; moderately alkaline; gradual wavy boundary.
- 2C—18 to 60 inches; light brownish gray (10YR 6/2) very gravelly sand, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; 40 percent pebbles, 10 percent cobbles; strongly effervescent; moderately alkaline.

### **Range in Characteristics**

*Mollic epipedon thickness:* 7 to 14 inches and may include all or only part of the argillic horizon  
*Depth to Bk horizon:* 10 to 20 inches

#### *A horizon*

Value: 2 or 3 moist  
 Chroma: 2 or 3

Clay content: 10 to 27 percent  
 Content of rock fragments: 5 to 60 percent—0  
 to 20 percent cobbles, 5 to 40 percent pebbles  
 Reaction: pH 6.6 to 7.8

**Bt horizon**

Hue: 10YR, 7.5YR  
 Value: 3, 4, or 5 dry; 2, 3, or 4 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay loam, sandy clay loam, or loam  
 Clay content: 20 to 35 percent  
 Content of rock fragments: 35 to 60 percent—  
 0 to 15 percent cobbles, 35 to 45 percent  
 pebbles  
 Reaction: pH 6.6 to 7.8

**Bk horizon**

Hue: 10YR or 2.5Y  
 Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Loamy sand, sand, or sandy loam  
 Clay content: 0 to 15 percent  
 Content of rock fragments: 35 to 75 percent—  
 5 to 30 percent cobbles, 30 to 45 percent  
 pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

**2C horizon**

Hue: 10YR, 5YR, or 2.5Y  
 Value: 4, 5, or 6 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, 4, or 6  
 Texture: Loamy sand or sand  
 Clay content: 0 to 5 percent  
 Content of rock fragments: 35 to 80 percent—  
 5 to 30 percent cobbles and stones, 30 to 60  
 percent pebbles  
 Calcium carbonate equivalent: 2 to 10 percent  
 Reaction: pH 7.4 to 8.4

## 271D—Beaverell-Tinsley complex, 4 to 15 percent slopes

### Setting

**Landform:**

- Beaverell—Kames and eskers
- Tinsley—Kames and eskers

**Position on landform:**

- Beaverell—Back slopes and foot slopes
- Tinsley—Back slopes and shoulders

**Slope:**

- Beaverell—4 to 15 percent
- Tinsley—4 to 15 percent

*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### Composition

**Major Components**

Beaverell and similar soils: 50 percent  
 Tinsley and similar soils: 40 percent

**Minor Components**

Soils that have slopes more than 15 percent:  
 0 to 2 percent  
 Benz and similar soils: 0 to 2 percent  
 Soils that have slopes less than 4 percent:  
 0 to 3 percent  
 Attewan and similar soils: 0 to 3 percent

### Major Component Description

**Beaverell**

*Surface layer texture:* Gravelly loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glacial outwash  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.8 inches

**Tinsley**

*Surface layer texture:* Gravelly sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Excessively drained  
*Dominant parent material:* Glacial outwash  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 1.2 inches

### Beaverton Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour) to  
 15 inches; rapid below this depth (6.0 to 20.0  
 inches/hour)  
*Landform:* Relict stream terraces  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Loamy-skeletal over sandy or  
 sandy-skeletal, mixed Typic Argiborolls

**Typical Pedon**

Beaverton gravelly loam, 2 to 8 percent slopes, in rangeland; 600 feet north and 2,100 feet west of the southeast corner of sec. 20, T. 35 N., R. 4 E.

A—0 to 5 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and nonplastic; 25 percent gravels, 5 percent cobbles; mildly alkaline; abrupt smooth boundary.

Bt—5 to 9 inches; brown (10YR 4/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many distinct clay films on faces of peds and coarse fragments; 35 percent pebbles, 10 percent cobbles; mildly alkaline; gradual wavy boundary.

Btk—9 to 15 inches; brown (10YR 5/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many distinct clay films on faces of peds and coarse fragments; 35 percent pebbles, 10 percent cobbles; common fine soft masses of lime; strongly effervescent; mildly alkaline; clear smooth boundary.

2Bk—15 to 25 inches; pale brown (10YR 6/3) extremely gravelly loamy sand, brown (10YR 5/3) moist; single grain; loose, nonsticky and nonplastic; 50 percent pebbles, 20 percent cobbles; lime disseminated and coating coarse fragments; strongly effervescent; mildly alkaline; gradual wavy boundary.

2C—25 to 60 inches; pale brown (10YR 6/3) extremely gravelly loamy sand, brown (10YR 5/3) moist; single grain; loose, nonsticky and nonplastic; 50 percent pebbles, 20 percent cobbles; disseminated lime; slightly effervescent; mildly alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 7 to 14 inches and may include all or part of the Bt horizons

**A horizon**

Hue: 2.5Y, 10YR, or 7.5YR

Value: 4 or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 15 to 27 percent

Content of rock fragments: 5 to 60 percent—0 to 5 percent stones, 0 to 25 percent cobbles, 5 to 40 percent pebbles

Reaction: pH 6.6 to 7.8

**Bt and Btk horizons**

Hue: 2.5Y, 10YR, or 7.5YR

Value: 4 or 5 dry; 2, 3, or 4 moist

Chroma: 2 or 3

Texture: Clay loam or sandy clay loam

Clay content: 25 to 35 percent

Content of rock fragments: 35 to 60 percent—0 to 5 percent stones, 0 to 30 percent cobbles, 15 to 45 percent pebbles

Reaction: pH 6.6 to 7.8

**2Bk and 2C horizons**

Hue: 2.5Y, 10YR, or 7.5YR

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loamy sand or sand

Clay content: 0 to 10 percent

Content of rock fragments: 35 to 80 percent—0 to 10 percent stones, 0 to 35 percent cobbles, 15 to 60 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

**12C—Beaverton gravelly loams, 2 to 8 percent slopes****Setting**

*Landform:* Relict stream terraces

*Slope:* 2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Beaverton and similar soils: 85 percent

**Minor Components**

Soils that have slopes more than 8 percent: 0 to 5 percent

Tamaneen cobbly clay loam: 0 to 3 percent

Roy gravelly clay loam: 0 to 2 percent

Soils that have slopes less than 2 percent: 0 to 5 percent

**Major Component Description**

*Surface layer texture:* Gravelly loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 3.2 inches

### **Benz Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Alluvial fans  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed (calcareous),  
 frigid Aridic Ustorthents

### **Typical Pedon**

Benz clay loam, 2 to 8 percent slopes, in rangeland;  
 800 feet south and 200 feet west of the northeast  
 corner of sec. 12, T. 37 N., R. 6 E.

E1—0 to 1 inch; light brownish gray (10YR 6/2) loam,  
 dark grayish brown (10YR 4/2) moist; vesicular  
 crust; slightly hard, friable, slightly sticky and  
 mildly plastic; mildly alkaline; clear smooth  
 boundary.

E2—1 to 3 inches; light brownish gray (10YR 6/2)  
 loam, dark grayish brown (10YR 4/2) moist; weak  
 coarse subangular blocky structure; very hard,  
 firm, slightly sticky and slightly plastic; strongly  
 alkaline; clear smooth boundary.

Bk—3 to 8 inches; light brownish gray (2.5Y 6/2) clay  
 loam, dark grayish brown (2.5Y 4/2) moist; weak  
 coarse and medium subangular blocky structure;  
 very hard, very firm, sticky and plastic;  
 disseminated lime; strongly effervescent; strongly  
 alkaline; clear smooth boundary.

Bky—8 to 20 inches; grayish brown (2.5Y 5/2) clay  
 loam, dark grayish brown (2.5Y 4/2) moist; weak  
 coarse and medium subangular blocky structure;  
 very hard, very firm, sticky and plastic; many fine  
 soft masses of lime; common fine seams of  
 gypsum; strongly effervescent; strongly alkaline;  
 clear smooth boundary.

Bkyz—20 to 35 inches; light brownish gray (2.5Y 6/2)  
 clay loam, dark grayish brown (2.5Y 4/2) moist;  
 weak coarse and medium subangular blocky  
 structure; very hard, very firm, sticky and plastic;  
 common fine soft masses of lime; common fine  
 soft masses and seams of gypsum and other  
 salts; strongly effervescent; strongly alkaline;  
 gradual smooth boundary.

Byz—35 to 60 inches; light brownish gray (2.5Y 6/2)  
 loam, grayish brown (2.5Y 5/2) moist; massive;  
 hard, friable, slightly sticky and slightly plastic;  
 common fine soft masses and seams of gypsum  
 and other salts; strongly effervescent; strongly  
 alkaline.

### **Range in Characteristics**

*Content of clay in the control sec.:* 18 to 35 percent

#### *E horizons*

Hue: 2.5Y or 10YR  
 Value: 5, 6, or 7 dry; 3, 4, or 5 moist  
 Chroma: 2 or 3  
 Clay content: 27 to 35 percent  
 Electrical conductivity: 4 to 8 mmhos/cm  
 Sodium adsorption ratio: 4 to 13  
 Reaction: pH 7.4 to 9.0

#### *Bk and By horizons*

Hue: 5Y, 2.5Y, 10YR  
 Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Texture: Loam, clay loam, silt loam, or fine sandy  
 loam  
 Clay content: 18 to 35 percent  
 Electrical conductivity: 8 to 16 mmhos/cm  
 Sodium adsorption ratio: 13 to 30  
 Calcium carbonate equivalent: 5 to 15 percent  
 Gypsum content: 2 to 5 percent  
 Reaction: pH 8.5 to 9.6

### **75C—Benz clay loam, 2 to 8 percent slopes**

#### **Setting**

*Landform:* Alluvial fans  
*Slope:* 2 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### **Composition**

##### **Major Components**

Benz and similar soils: 90 percent

##### **Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 3 percent  
 Vanda and similar soils: 0 to 4 percent

### Major Component Description

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.7 inches

### Big Sandy Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Poorly drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour)  
*Landform:* Flood plains  
*Parent material:* Alluvium  
*Slope range:* 0 to 1 percent  
*Annual precipitation:* 13 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed (calcareous), frigid Typic Fluvaquents

### Typical Pedon

Big Sandy loam, in an area of Enbar-Big Sandy-Korchea loams, 0 to 4 percent slopes, in rangeland; 1,400 feet south and 2,300 feet west of the northeast corner of sec. 16, T. 35 N., R. 4 E.

A—0 to 3 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure parting to moderate fine and medium granular; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; clear wavy boundary.

C—3 to 11 inches; gray (10YR 5/1) silty clay loam consisting of stratifications of silt loam and clay loam, dark gray (10YR 4/1) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; moderately alkaline; clear wavy boundary.

Cg1—11 to 29 inches; grayish brown (2.5Y 5/2) silty clay loam consisting of stratifications of silt loam and clay loam, dark grayish brown (2.5Y 4/2) moist; common fine prominent yellowish brown (10YR 5/6) redox concentrations; massive; hard, firm, sticky and plastic; common fine soft masses of lime; strongly effervescent; strongly alkaline; gradual wavy boundary.

Cg2—29 to 60 inches; grayish brown (2.5Y 5/2) clay loam consisting of stratifications of silt loam, fine

sandy loam, and clay, dark grayish brown (2.5Y 4/2) moist; many fine prominent yellowish brown (10YR 5/6) redox concentrations; massive; hard, firm, sticky and plastic; common fine soft masses of lime; few fine soft masses and threads of gypsum; strongly effervescent; strongly alkaline.

### Range in Characteristics

*Depth to seasonal high water table:* 12 to 24 inches during the period from December to June

#### A horizon

Hue: 2.5Y or 10YR  
 Value: 3 or 4 moist  
 Chroma: 1 or 2  
 Redox concentrations: Abundance—none to few;  
   Hue—2.5Y; Value—5 or 6 dry  
 Clay content: 15 to 27 percent  
 Electrical conductivity: 2 to 4 mmhos/cm  
 Reaction: pH 7.4 to 9.0

#### C horizon

Hue: 2.5Y or 10YR  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 1 or 2  
 Redox concentrations: Abundance—none or few;  
   Hue—2.5Y; Value—5 or 6 dry  
 Texture: Loam or silty clay loam consisting of strata of silt loam, clay loam, or fine sandy loam  
 Clay content: 18 to 35 percent  
 Electrical conductivity: 2 to 4 mmhos/cm  
 Reaction: pH 7.9 to 9.0

#### Cg1 horizon

Hue: 5Y or 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 1 or 2  
 Redox concentrations: Abundance—common or many; Hue—2.5Y or 10YR; Value—5 or 6 dry, 4 or 5 moist; Chroma—4 or 6  
 Texture: Loam or silty clay loam consisting of strata of silt loam, clay loam, or fine sandy loam  
 Clay content: 18 to 35 percent  
 Electrical conductivity: 4 to 25 mmhos/cm  
 Reaction: pH 8.5 to 9.0

#### Cg2 horizon

Hue: 5Y or 2.5Y  
 Value: 5 or 6 dry, 4 or 5 moist  
 Chroma: 1 or 2  
 Redox concentrations: Abundance—common or many; Hue—2.5Y or 10YR; Value—5 or 6 dry, 4 or 5 moist; Chroma—4 or 6  
 Texture: Silt loam, silty clay loam, or clay loam

consisting of strata of silt loam, fine sandy loam, fine sand, loamy sand, or clay  
 Clay content: 15 to 35 percent  
 Electrical conductivity: 8 to 25 mmhos/cm  
 Reaction: pH 8.5 to 9.0

### ***Blacksheep Series***

*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Sedimentary plains  
*Parent material:* Residuum weathered from sandstone  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Loamy, mixed (calcareous), frigid, shallow Aridic Ustorthents

#### **Typical Pedon**

Blacksheep fine sandy loam, in an area of Twilight-Blacksheep fine sandy loams, 2 to 8 percent slopes, in cropland; 1,200 feet south and 300 feet west of the northeast corner of sec. 9, T. 37 N., R. 7 E.

- Ap—0 to 4 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10 YR 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; strongly effervescent; mildly alkaline; clear smooth boundary.
- C—4 to 18 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- Cr—18 to 60 inches; brownish yellow (10YR 6/6) semiconsolidated sandstone; mildly alkaline.

#### **Range in Characteristics**

##### *Ap horizon*

Hue: 2.5Y, 7.5YR, or 10YR  
 Value: 5, 6, or 7 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Clay content: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

##### *C horizon*

Hue: 2.5Y, 7.5YR, or 10YR  
 Value: 5, 6, or 7 dry; 5 or 6 moist  
 Chroma: 2 or 3

Texture: Very fine sandy loam, fine sandy loam, sandy loam, or loamy fine sand  
 Clay content: 5 to 15 percent  
 Calcium carbonate equivalent: 5 to 10 percent  
 Reaction: pH 7.9 to 8.4

### ***Brockway Series***

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour)  
*Landform:* Alluvial fans  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-silty, mixed, frigid Haplocalcidic Ustochrepts

#### **Typical Pedon**

Brockway silt loam, 2 to 8 percent slopes, in cropland; 1,000 feet west and 400 feet south of the northeast corner of sec. 17, T. 31 N., R. 6 E.

- Ap—0 to 4 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak fine and medium subangular blocky structure parting to weak fine and very fine granular; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bk1—4 to 8 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bk2—8 to 26 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; disseminated lime; violently effervescent; moderately alkaline; clear wavy boundary.
- Bk3—26 to 40 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime; violently effervescent; moderately alkaline; clear wavy boundary.

Bky—40 to 60 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime; common fine soft masses of gypsum; strongly effervescent; moderately alkaline.

#### Range in Characteristics

##### *Ap horizon*

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 4 or 5 moist  
Chroma: 2 or 3  
Clay content: 18 to 27 percent  
Content of rock fragments: 0 to 8 percent—  
0 to 4 percent stones, 0 to 4 percent cobbles  
Reaction: pH 7.4 to 8.4

##### *Bk1 horizon*

Hue: 10YR or 2.5Y  
Value: 6 or 7 dry; 4 or 5 moist  
Chroma: 2, 3, or 4  
Texture: Silt loam or loam  
Clay content: 18 to 27 percent  
Reaction: pH 7.4 to 8.4

##### *Bk2 and Bk3 horizon*

Hue: 10YR or 2.5Y  
Value: 6, 7, or 8 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Silt loam or silty clay loam  
Clay content: 18 to 35 percent  
Calcium carbonate equivalent: 15 to 40 percent  
Reaction: pH 7.9 to 8.4

##### *Bky horizon*

Hue: 10YR or 2.5Y  
Value: 6 or 7 dry; 5 or 6 moist  
Chroma: 2, 3, or 4  
Texture: Very fine sandy loam, silt loam, and silty clay loam (some thin silty clay layers may occur in some pedons)  
Clay content: 18 to 35 percent  
Electrical conductivity: less than 4 mmhos/cm  
Calcium carbonate equivalent: 15 to 25 percent  
Reaction: pH 7.9 to 8.4

## 14C—Brockway silt loam, 2 to 8 percent slopes

### Setting

*Landform:* Alluvial fans  
*Slope:* 2 to 8 percent

*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Brockway and similar soils: 95 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent  
Soils that have slopes less than 2 percent:  
0 to 2 percent  
Yamacall, calcareous surface: 0 to 1 percent

### Major Component Description

*Surface layer texture:* Silt loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

### Busby Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour)  
*Landform:* Alluvial fans  
*Parent material:* Alluvium or eolian deposits  
*Slope range:* 2 to 25 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Coarse-loamy, mixed, frigid Aridic Ustochrepts

### Typical Pedon

Busby fine sandy loam, 2 to 8 percent slopes, in rangeland; 900 feet east and 1,800 feet south of the northwest corner of sec. 17, T. 29 N., R. 7 E.

A—0 to 7 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine and very fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; mildly alkaline; clear smooth boundary.

Bw—7 to 14 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to weak medium subangular blocky structure; slightly hard,

very friable, slightly sticky and nonplastic; mildly effervescent; mildly alkaline; clear wavy boundary.

Bk1—14 to 29 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak medium prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; common fine soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—29 to 60 inches; light gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; many fine soft masses of lime; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Depth to the Bk horizon:* 10 to 16 inches

#### A horizon

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 3 or 4 moist  
Chroma: 2, 3, or 4  
Clay content: 10 to 18 percent  
Reaction: pH 7.4 to 8.4

#### Bw horizon

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 4 or 5 moist  
Chroma: 2, 3, or 4  
Texture: Fine sandy loam, sandy loam, or loam  
Clay content: 10 to 18 percent  
Effervescence: None to strong  
Reaction: pH 7.4 to 8.4

#### Bk horizons

Hue: 10YR, 2.5Y, or 5Y  
Value: 6 or 7 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Fine sandy loam, sandy loam  
Clay content: 10 to 18 percent  
Effervescence: Strong to violent  
Calcium carbonate equivalent: 5 to 15 percent  
Reaction: pH 7.9 to 8.4

### 94C—Busby fine sandy loam, 2 to 8 percent slopes

#### Setting

*Landform:* Alluvial fans  
*Slope:* 2 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Busby and similar soils: 95 percent

##### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent  
Tinsley and similar soils: 0 to 1 percent  
Yamacall and similar soils: 0 to 1 percent  
Chinook and similar soils: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium or eolian material  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 6.8 inches

### 94E—Busby fine sandy loam, 8 to 25 percent slopes

#### Setting

*Landform:* Alluvial fans  
*Slope:* 8 to 25 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Busby and similar soils: 95 percent

##### Minor Components

Soils that have slopes more than 25 percent:  
0 to 2 percent  
Tinsley and similar soils: 0 to 1 percent  
Yamacall and similar soils: 0 to 1 percent  
Chinook and similar soils: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium or eolian material  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 6.8 inches

## ***Cabba Series***

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Hills

*Parent material:* Residuum weathered from semiconsolidated interbedded sandstone and shale

*Slope range:* 4 to 60 percent

*Annual precipitation:* 13 to 17 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents

### **Typical Pedon**

Cabba loam, in an area of Zahill-Cabba complex, 15 to 45 percent slopes, in cropland; 2,200 feet south and 400 feet east of the northwest corner of sec. 25, T. 35 N., R. 4 E.

Ap—0 to 4 inches; grayish brown (2.5Y 5/3) loam, dark grayish brown (2.5Y 4/3) moist; weak very fine and fine granular structure; soft, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—4 to 9 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—9 to 12 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; massive parting to weak medium plates; slightly hard, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; clear wavy boundary.

Cr—12 to 60 inches; olive yellow (2.5Y 6/6) semiconsolidated interbedded sandstone and shale; strongly effervescent; moderately alkaline.

### **Range in Characteristics**

*Depth to the Cr horizon:* 10 to 20 inches

#### *Ap horizon*

Hue: 10YR or 2.5Y

Value: 3, 4, 5, or 6 dry; 3 or 4 moist

Chroma: 1, 2, 3, or 4

Clay content: 10 to 27 percent

Content of rock fragments: 0 to 60 percent—  
0 to 40 percent stones, cobbles, or boulders,  
0 to 30 percent pebbles or channers  
Electrical conductivity: 0 to 4 mmhos/cm  
Effervescence: None to violent  
Reaction: pH 7.4 to 9.0

#### *C horizons*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, 7, or 8 dry; 4, 5, 6, or 7 moist

Chroma: 1, 2, 3, 4, or 6

Texture: Loam, silt loam, clay loam, or silty clay loam

Clay content: 20 to 35 percent

Content of rock fragments: 0 to 35 percent—  
0 to 5 percent cobbles, 0 to 30 percent pebbles  
or channers

Calcium carbonate equivalent: 2 to 15 percent

Electrical conductivity: 0 to 8 mmhos/cm

Reaction: pH 7.4 to 9.0

## **201D—Cabba-Wayden complex, 4 to 15 percent slopes**

### ***Setting***

#### *Landform:*

- Cabba—Hills
- Wayden—Hills

#### *Position on landform:*

- Cabba—Back slopes
- Wayden—Foot slopes

#### *Slope:*

- Cabba—4 to 15 percent
- Wayden—4 to 15 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

### ***Composition***

#### **Major Components**

Cabba and similar soils: 45 percent  
Wayden and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 15 percent:  
0 to 3 percent  
Areas of Rock outcrop: 0 to 3 percent  
Lisk and similar soils: 0 to 2 percent  
Wayden silty clay loam: 0 to 2 percent  
Cabba fine sandy loam: 0 to 2 percent

### Major Component Description

#### Cabba

*Surface layer texture:* Loam  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Interbedded sandstone and shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.0 inches

#### Wayden

*Surface layer texture:* Silty clay  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Semiconsolidated shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 1.9 inches

### 201F—Cabba-Wayden-Rock outcrop complex, 15 to 60 percent slopes

#### Setting

##### Landform:

- Cabba—Hills
- Wayden—Hills

##### Position on landform:

- Cabba—Back slopes
- Wayden—Back slopes

##### Slope:

- Cabba—15 to 60 percent
- Wayden—15 to 60 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

#### Composition

#### Major Components

Cabba and similar soils: 40 percent  
 Wayden and similar soils: 35 percent  
 Rock outcrop: 20 percent

#### Minor Components

Soils that have slopes more than 60 percent:  
 0 to 1 percent  
 Wayden silty clay loam: 0 to 1 percent

Cabba fine sandy loam: 0 to 1 percent  
 Soils that have slopes less than 15 percent:  
 0 to 2 percent

### Major Component Description

#### Cabba

*Surface layer texture:* Loam  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Interbedded sandstone and shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.0 inches

#### Wayden

*Surface layer texture:* Silty clay  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Semiconsolidated shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 1.9 inches

#### Rock outcrop

*Definition:* Exposures of siltstone bedrock

### Cabbart Series

*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Sedimentary plains and hills  
*Parent material:* Residuum weathered from semiconsolidated interbedded sandstone and shale  
*Slope range:* 2 to 70 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Loamy, mixed (calcareous), frigid, shallow Aridic Ustorthents

#### Typical Pedon

Cabbart loam, in an area of Cabbart-Delpoint loams, 8 to 25 percent slopes, in rangeland; 4,500 feet south and 1,500 feet west of the northwest corner of sec. 22, T. 29 N., R. 5 E.

A—0 to 3 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; mildly alkaline; clear wavy boundary.

Bk1—3 to 6 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—6 to 12 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Cr—12 to 60 inches; very pale brown (10YR 7/4) semiconsolidated interbedded sandstone and shale; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Depth to the Cr horizon:* 10 to 20 inches

#### *A horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Clay content: 18 to 27 percent

Content of rock fragments: 0 to 60 percent hard fragments—0 to 20 percent cobbles, 0 to 50 percent pebbles

Electrical conductivity: 0 to 4 mmhos/cm

Reaction: pH 7.4 to 9.0

#### *Bk horizons*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam, clay loam, silt loam, silty clay loam

Clay content: 18 to 35 percent

Content of rock fragments: 0 to 45 percent—0 to 15 percent hard pebbles, 0 to 45 percent soft pebbles

Electrical conductivity: 0 to 8 mmhos/cm

Calcium carbonate equivalent: 10 to 25 percent

Reaction: pH 7.4 to 9.0

## 21E—Cabbart-Delpoint loams, 8 to 25 percent slopes

### Setting

#### *Landform:*

- Cabbart—Hills
- Delpoint—Hills

#### *Position on landform:*

- Cabbart—Shoulders and summits
- Delpoint—Back slopes and foot slopes

#### *Slope:*

- Cabbart—8 to 25 percent
- Delpoint—8 to 15 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Cabbart and similar soils: 50 percent

Delpoint and similar soils: 35 percent

#### Minor Components

Soils that have slopes more than 25 percent:  
0 to 3 percent

Areas of Rock outcrop: 0 to 2 percent

Benz and similar soils: 0 to 2 percent

Soils that have slopes less than 8 percent:  
0 to 3 percent

Yamacall and similar soils: 0 to 2 percent

Lambeth and similar soils: 0 to 3 percent

### Major Component Description

#### Cabbart

*Surface layer texture:* Loam

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Interbedded sandstone and shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 2.1 inches

#### Delpoint

*Surface layer texture:* Loam

*Depth class:* Moderately deep (20 to 40 inches)

*Drainage class:* Well drained

*Dominant parent material:* Interbedded sandstone and shale residuum

*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.1 inches

### **211E—Cabbart-Yawdim complex, 8 to 25 percent slopes**

#### **Setting**

*Landform:*

- Cabbart—Hills
- Yawdim—Hills

*Position on landform:*

- Cabbart—Back slopes and shoulders
- Yawdim—Back slopes and shoulders

*Slope:*

- Cabbart—8 to 25 percent
- Yawdim—8 to 25 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Cabbart and similar soils: 50 percent

Yawdim and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 25 percent:

0 to 2 percent

Areas of Rock outcrop: 0 to 2 percent

Benz and similar soils: 0 to 1 percent

Soils that have slopes less than 8 percent:

0 to 3 percent

Lambeth and similar soils: 0 to 1 percent

Delpoint and similar soils: 0 to 1 percent

#### **Major Component Description**

##### **Cabbart**

*Surface layer texture:* Loam

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Interbedded sandstone and shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 2.1 inches

##### **Yawdim**

*Surface layer texture:* Silty clay

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Semiconsolidated shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 2.0 inches

### **211F—Cabbart-Yawdim-Rock outcrop complex, 25 to 70 percent slopes**

#### **Setting**

*Landform:*

- Cabbart—Hills
- Yawdim—Hills

*Position on landform:*

- Cabbart—Back slopes and shoulders
- Yawdim—Back slopes and shoulders

*Slope:*

- Cabbart—25 to 70 percent
- Yawdim—25 to 70 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Cabbart and similar soils: 40 percent

Yawdim and similar soils: 35 percent

Rock outcrop: 20 percent

#### **Minor Components**

Benz and similar soils: 0 to 1 percent

Soils that have slopes less than 25 percent:

0 to 1 percent

Yamacall and similar soils: 0 to 1 percent

Lambeth and similar soils: 0 to 1 percent

Delpoint and similar soils: 0 to 1 percent

#### **Major Component Description**

##### **Cabbart**

*Surface layer texture:* Loam

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Interbedded sandstone and shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 2.1 inches

##### **Yawdim**

*Surface layer texture:* Silty clay

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Semiconsolidated shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 2.0 inches

### Rock outcrop

*Definition:* Exposures of siltstone bedrock

## Chinook Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour)

*Landform:* Alluvial fans or stream terraces

*Parent material:* Alluvium or eolian deposits

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Coarse-loamy, mixed Aridic Haploborolls

### Typical Pedon

Chinook fine sandy loam, 2 to 8 percent slopes, in cropland. 1,200 feet west and 1,300 feet north of the southeast corner of sec. 3, T. 29 N., R. 4 E.

Ap—0 to 6 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium and coarse subangular blocky structure parting to moderate very fine and fine granular; soft, very friable, nonsticky and nonplastic; mildly alkaline; abrupt wavy boundary.

Bw1—6 to 10 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline; clear smooth boundary.

Bw2—10 to 17 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; neutral; clear smooth boundary.

Bk1—17 to 27 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few

fine soft masses and threads of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—27 to 38 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine soft masses and threads of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk3—38 to 60 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; disseminated lime; strongly effervescent; moderately alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches

*Depth to the Bk horizon:* 10 to 24 inches

#### A horizon

Hue: 10YR or 2.5Y

Value: 2 or 3 moist

Chroma: 2 or 3

Clay content: 5 to 18 percent

Content of rock fragments: 0 to 35 percent pebbles

Reaction: pH 6.6 to 8.4

#### Bw horizons

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 3, 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Fine sandy loam or sandy loam

Clay content: 5 to 18 percent and more than 50 percent medium, fine, and coarser sand

Content of rock fragments: 0 to 15 percent pebbles

Reaction: pH 6.6 to 9.0

#### Bk1 horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Fine sandy loam or sandy loam

Clay content: 5 to 18 percent and more than 50 percent medium, fine, and coarser sand.

Content of rock fragments: 0 to 15 percent pebbles

Calcium carbonate equivalent: 3 to 12 percent

Reaction: pH 7.4 to 9.0

#### Bk2 and Bk3 horizons

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Fine sandy loam or sandy loam  
 Clay content: 5 to 18 percent and more than 50 percent medium, fine, and coarser sand  
 Content of rock fragments: 0 to 15 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent—few and common masses and threads of lime  
 Reaction: pH 7.4 to 9.0

### 36C—Chinook fine sandy loam, 2 to 8 percent slopes

#### Setting

*Landform:* Alluvial fans and stream terraces  
*Slope:* 2 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Chinook and similar soils: 95 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 1 percent  
 Tinsley and similar soils: 0 to 1 percent  
 Soils that have slopes less than 2 percent:  
 0 to 1 percent  
 Cozberg and similar soils: 0 to 1 percent  
 Fortbenton and similar soils: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium or eolian material  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 7.3 inches

#### Cozberg Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour) to 30 inches, rapid below this depth (6.0 to 20.0 inches/hour)

*Landform:* Alluvial fans  
*Parent material:* Alluvium or eolian deposits  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Coarse-loamy, mixed Aridic Haploborolls

#### Typical Pedon

Cozberg fine sandy loam, in an area of Cozberg-Chinook fine sandy loams, 0 to 4 percent slopes, in cropland, 200 feet north and 200 feet east of the southwest corner of sec. 30, T. 30 N., R. 4 E.

- Ap—0 to 4 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine and very fine granular structure; soft, very friable, nonsticky and nonplastic; neutral; abrupt wavy boundary.
- Bw1—4 to 8 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; neutral; gradual smooth boundary.
- Bw2—8 to 16 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline; clear smooth boundary.
- Bk1—16 to 19 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine soft filaments and soft masses of lime; violently effervescent; mildly alkaline; clear smooth boundary.
- Bk2—19 to 30 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine soft filaments and soft masses of lime; violently effervescent; moderately alkaline; abrupt wavy boundary.
- 2C—30 to 60 inches; grayish brown (2.5Y 5/2) gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; 30 percent pebbles; strongly effervescent; moderately alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 7 to 14 inches

*Depth to the Bk horizon:* 16 to 28 inches

*Depth to the 2C horizon:* 20 to 40 inches

**A horizon**

Value: 2 or 3 moist

Chroma: 2 or 3

Clay content: 10 to 20 percent

Content of rock fragments: 0 to 10 percent  
pebbles

Reaction: pH 6.6 to 7.8

**Bw horizons**

Value: 3 or 4 moist

Chroma: 2 or 3

Texture: Fine sandy loam, very fine sandy loam,  
or sandy loam

Clay content: 10 to 18 percent

Content of rock fragments: 0 to 15 percent

Reaction: pH 6.6 to 7.8

**Bk horizons**

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 3 or 4

Texture: Fine sandy loam, sandy loam, or very  
fine sandy loam

Clay content: 10 to 18 percent

Content of rock fragments: 0 to 15 percent

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

**2C horizon**

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loamy sand, sand, loamy coarse sand,  
or coarse sand

Clay content: 0 to 10 percent

Content of rock fragments: 0 to 35 percent  
pebbles

Reaction: pH 7.4 to 8.4

### **363B—Cozberg-Chinook fine sandy loams, 0 to 4 percent slopes**

**Setting****Landform:**

- Cozberg—Alluvial fans
- Chinook—Alluvial fans

**Position on landform:**

- Cozberg—Foot slopes
- Chinook—Foot slopes

**Slope:**

- Cozberg—0 to 4 percent
- Chinook—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Cozberg and similar soils: 50 percent

Chinook and similar soils: 40 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
0 to 2 percent

Tinsley and similar soils: 0 to 2 percent

Duneland and blowout areas: 0 to 2 percent

Chinook loamy sand: 0 to 2 percent

Busby and similar soils: 0 to 2 percent

**Major Component Description****Cozberg**

*Surface layer texture:* Fine sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium or eolian  
material

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 5.9 inches

**Chinook**

*Surface layer texture:* Fine sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium or eolian  
material

*Flooding:* None

*Available water capacity:* 7.3 inches

**Creed Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Alluvial fans or stream terraces

*Parent material:* Alluvium

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic Natriboralfs

### Typical Pedon

Creed loam, in an area of Ferd-Creed-Gerdrum complex, 0 to 4 percent slopes, in cropland. 3,200 feet east and 100 feet north of the southwest corner of sec. 10, T. 30 N., R. 7 E.

- Ap—0 to 5 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure parting to weak fine granular; slightly hard, very friable, nonsticky and slightly plastic; mildly alkaline; abrupt smooth boundary.
- E—5 to 6 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak thin platy structure parting to weak fine granular; slightly hard, very friable, nonsticky and slightly plastic; mildly alkaline; abrupt smooth boundary.
- Btn—6 to 10 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure; hard, firm, very sticky and plastic; common distinct clay films on faces of peds; moderately alkaline; clear smooth boundary.
- Btkn—10 to 12 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; strong coarse prismatic structure; hard, firm, very sticky and plastic; common distinct clay films on faces of peds; few fine soft filaments of lime; strongly effervescent; strongly alkaline; clear smooth boundary.
- Bk1—12 to 16 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common medium soft filaments of lime; strongly effervescent; strongly alkaline; gradual wavy boundary.
- Bk2—16 to 31 inches; light yellowish brown (2.5Y 6/3) silty clay loam, olive brown (2.5Y 4/3) moist; weak medium prismatic structure; hard, firm, sticky and slightly plastic; many large soft masses of lime; strongly effervescent; strongly alkaline; gradual wavy boundary.
- Byz—31 to 60 inches; light yellowish brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) moist; weak thin platy structure; slightly hard, firm, slightly sticky and slightly plastic; few to common fine seams of gypsum and other salts; strongly effervescent; moderately alkaline.

### Range in Characteristics

Depth to the Btkn horizon: 10 to 20 inches

Depth to the Byz horizon: 22 to 36 inches

### Ap horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 2 or 3

Clay content: 20 to 27 percent

Reaction: pH 6.1 to 8.4

### E horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, 6, or 7 moist

Chroma: 2 or 3

Texture: Loam, sandy loam, sandy clay loam, clay loam, or silty clay loam

Clay content: 20 to 35 percent

Reaction: pH 6.1 to 8.4

### Btn and Btkn horizons

Hue: 10YR, 2.5Y, or 5Y

Value: 4, 5, or 6 dry; 3, 4, or 5 moist

Chroma: 2 or 3

Texture: Clay loam, silty clay loam, clay, or silty clay

Clay content: 35 to 55 percent

Electrical conductivity: 2 to 4 mmhos/cm

Sodium adsorption ratio: 8 to 13

Reaction: pH 7.4 to 9.0

### Bk and Byz horizons

Hue: 10YR, 2.5Y, or 5Y

Value: 4, 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Silty clay loam, clay loam, sandy clay loam, loam, or clay

Clay content: 25 to 45 percent

Calcium carbonate equivalent: 5 to 15 percent

Electrical conductivity: 4 to 16 mmhos/cm

Sodium adsorption ratio: 13 to 20

Gypsum content: 0 to 2 percent

Reaction: pH 7.9 to 9.0

## 781C—Creed-Weingart complex, 2 to 8 percent slopes

### Setting

#### Landform:

- Creed—Alluvial fans and stream terraces
- Weingart—Alluvial fans and stream terraces

#### Position on landform:

- Creed—Microhighs
- Weingart—Microlows

#### Slope:

- Creed—2 to 8 percent
- Weingart—2 to 8 percent

*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Creed and similar soils: 50 percent  
 Weingart and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Chinook fine sandy loam: 0 to 2 percent  
 Yawdim and similar soils: 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 3 percent

### **Major Component Description**

#### **Creed**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.5 inches

#### **Weingart**

*Surface layer texture:* Clay loam  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Semiconsolidated shale  
 residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 2.6 inches

### **Daglum Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained or moderately well  
 drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Till plains  
*Parent material:* Glacial till  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic Vertic  
 Natriborolls

### **Typical Pedon**

Daglum clay loam, in an area of Bearpaw-Daglum clay loams, 0 to 4 percent slopes, in cropland; 1,400 feet south and 800 feet east of the northwest corner of sec. 7, T. 37 N., R. 4 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, firm, sticky and slightly plastic; neutral; clear smooth boundary.

A—6 to 12 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

E—12 to 14 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure parting to weak thin platy; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Btn—14 to 25 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak coarse columnar structure parting to moderate fine and medium prismatic; very hard, very firm, sticky and plastic; common distinct clay films on faces of peds; neutral; clear smooth boundary.

Btkn—25 to 29 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common distinct clay films on faces of peds; few large soft seams of lime; strongly effervescent; strongly alkaline; abrupt wavy boundary.

Bk—29 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; many medium soft masses and seams of lime; violently effervescent; strongly alkaline.

### **Range in Characteristics**

#### *A horizon*

Hue: 10YR  
 Value: 3, 4, or 5 dry; 2 or 3 moist  
 Chroma: 2  
 Clay content: 27 to 35 percent  
 Reaction: pH 6.1 to 7.8

*E horizon*

Hue: 10YR or 2.5Y  
 Value: 4, 5, 6 or 7 dry; 3, 4, or 5 moist  
 Chroma: 1 or 2  
 Texture: Fine sandy loam, loam, silt loam, clay loam, or silty clay loam  
 Clay content: 27 to 35 percent  
 Reaction: pH 6.1 to 7.8

*Btn and Btkn horizons*

Hue: 10YR or 2.5Y  
 Value: 3, 4, 5, or 6 dry; 2, 3, 4, or 5 moist  
 Chroma: 2 or 3  
 Texture: Clay, silty clay, silty clay loam, or clay loam  
 Clay content: 35 to 60 percent  
 Reaction: pH 6.6 to 9.0  
 Other features: Some pedons have gypsum accumulation in the B and C horizons; some pedons have a Bk horizon

*Bk horizon*

Hue: 2.5Y or 5Y  
 Value: 5, 6, or 7 dry; 3, 4, 5, or 6 moist  
 Chroma: 1, 2, 3, or 4  
 Texture: Clay loam, silty clay, silty clay loam, or clay  
 Clay content: 35 to 60 percent  
 Calcium carbonate equivalent: 5 to 15 percent  
 Electrical conductivity: 8 to 16 mmhos/cm  
 Reaction: pH 7.9 to 9.0

**Dast Series**

*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour)  
*Landform:* Hills  
*Parent material:* Sandstone  
*Slope range:* 15 to 45 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Coarse-loamy, mixed, frigid Typic Ustochrepts

**Typical Pedon**

Dast sandy loam, in an area of Dast-Rock outcrop complex, 15 to 45 percent slopes, in rangeland; 1,600 feet east and 600 feet south of the northeast corner of sec. 16, T. 35 N., R. 5 E.

A—0 to 3 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; medium fine granular

structure; slightly hard, very friable, nonsticky and nonplastic; disseminated lime; slightly effervescent; mildly alkaline; clear smooth boundary.

Bw1—3 to 10 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky and nonplastic; disseminated lime; slightly effervescent; moderately alkaline; gradual wavy boundary.

Bw2—10 to 18 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; moderate medium subangular structure; slightly hard, friable, nonsticky and nonplastic; disseminated lime; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk—18 to 26 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; many fine soft masses of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

Cr—26 to 60 inches; very pale brown (10YR 7/4) semiconsolidated sandy sedimentary beds.

**Range in Characteristics**

*Depth to bedrock:* 20 to 40 inches

*A horizon*

Hue: 10YR or 2.5Y  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Clay content: 2 to 18 percent  
 Content of rock fragments: 0 to 15 percent pebbles  
 Reaction: pH 7.4 to 8.4

*Bw1 horizon*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Fine sandy loam, sandy loam, or loam  
 Clay content: 2 to 18 percent  
 Content of rock fragments: 0 to 15 percent pebbles  
 Reaction: pH 7.4 to 8.4

*Bw2 horizon*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Fine sandy loam, sandy loam, or loam  
 Clay content: 2 to 18 percent  
 Content of rock fragments: 0 to 15 percent pebbles

Reaction: pH 7.4 to 8.4

*Bk horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Fine sandy loam, sandy loam, or loam

Clay content: 2 to 18 percent

Content of rock fragments: 0 to 15 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

**952F—Dast-Rock outcrop complex, 15 to 45 percent slopes**

**Setting**

*Landform:* Hills

*Position on landform:* Back slopes

*Slope:* 15 to 45 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

**Composition**

**Major Components**

Dast and similar soils: 60 percent

Rock outcrop: 30 percent

**Minor Components**

Soils that have slopes less than 15 percent:  
0 to 1 percent

Soils that have slopes more than 45 percent:  
0 to 1 percent

Blacksheep and similar soils: 0 to 1 percent

Lisk and similar soils: 0 to 1 percent

Zahill and similar soils: 0 to 1 percent

**Major Component Description**

**Dast**

*Surface layer texture:* Sandy loam

*Depth class:* Moderately deep (20 to 40 inches)

*Drainage class:* Well drained

*Dominant parent material:* Sandstone residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 3.3 inches

**Rock outcrop**

*Definition:* Exposures of sandstone bedrock

**Degrad Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour) to 35 inches; rapid below this depth (6.0 to 20.0 inches/hour)

*Landform:* Relict stream terraces

*Parent material:* Alluvium

*Slope range:* 0 to 4 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy over sandy or sandy-skeletal, mixed Aridic Argiborolls

**Typical Pedon**

Degrad fine sandy loam, 0 to 4 percent slopes, in cropland, 700 feet north and 300 feet west of the southeast corner of sec. 33, T. 31 N., R. 6 E.

Ap—0 to 5 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline; clear wavy boundary.

Bt1—5 to 12 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure; hard, friable, slightly sticky and nonplastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

Bt2—12 to 18 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; hard, friable, slightly sticky and nonplastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

Bk1—18 to 28 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure; hard, friable, nonsticky and nonplastic; common fine and medium soft masses of lime; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bk2—28 to 35 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many fine and medium soft masses of lime; strongly effervescent; strongly alkaline; clear wavy boundary.

2C—35 to 60 inches; light brownish gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist;

single grain; loose, nonsticky and nonplastic; slightly effervescent; moderately alkaline.

### Range in Characteristics

*Depth to the 2C horizon:* 20 to 40 inches

#### *Ap horizon*

Hue: 10YR or 2.5Y  
 Value: 4 or 5 dry; 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 10 to 20 percent  
 Content of rock fragments: 0 to 15 percent—  
 0 to 5 percent cobbles, 0 to 10 percent  
 pebbles  
 Reaction: pH 6.6 to 7.8

#### *Bt horizons*

Hue: 10YR or 2.5Y  
 Value: 4 or 5 dry; 3 or 4 moist  
 Chroma: 2 or 3  
 Texture: Clay loam or sandy clay loam  
 Clay content: 20 to 35 percent (sand content 35  
 to 55 percent)  
 Content of rock fragments: 0 to 15 percent—  
 0 to 5 percent cobbles, 0 to 10 percent  
 pebbles  
 Reaction: pH 6.6 to 8.4

#### *Bk horizons*

Hue: 10YR or 2.5Y  
 Value: 6 or 7 dry; 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Texture: Sandy clay loam, loam, or clay loam  
 Clay content: 15 to 30 percent  
 Content of rock fragments: 0 to 15 percent—  
 0 to 5 percent cobbles, 0 to 10 percent  
 pebbles  
 Electrical conductivity: Less than 4 mmhos/cm  
 Calcium carbonate equivalent: 15 to 40 percent  
 Reaction: pH 7.4 to 9.0

#### *2C horizons*

Hue: 10YR or 2.5Y  
 Value: 5, 6, or 7 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Texture: Sand, coarse sand, fine sand, or loamy  
 sand  
 Clay content: 0 to 5 percent  
 Content of rock fragments: 0 to 35 percent—  
 0 to 5 percent cobbles, 0 to 30 percent  
 pebbles  
 Calcium carbonate equivalent: 8 to 15 percent  
 Reaction: pH 7.9 to 8.4

## 16B—Degrand fine sandy loam, 0 to 4 percent slopes

### Setting

*Landform:* Relict stream terraces  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Degrad and similar soils: 95 percent

#### Minor Components

Soils that have slopes less than 4 percent:  
 0 to 2 percent  
 Tinsley and similar soils: 0 to 1 percent  
 Evanston and similar soils: 0 to 1 percent  
 Degrand sandy loam: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 6.0 inches

### Delpoint Series

*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Hills or sedimentary plains  
*Parent material:* Residuum weathered from  
 semiconsolidated interbedded sandstone and  
 shale  
*Slope range:* 2 to 15 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed, frigid Aridic  
 Ustochrepts

#### Typical Pedon

Delpoint loam, in an area of Delpoint-Cabbart loams, 2 to 8 percent slopes, in an area of cropland;

1,400 feet north and 100 feet west of the southeast corner of sec. 33, T. 28 N., R. 7 E.

**Ap**—0 to 5 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure parting to moderate fine and very fine granular; soft, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; abrupt smooth boundary.

**Bw**—5 to 13 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; abrupt smooth boundary.

**Bk1**—13 to 19 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine soft masses of lime; strongly effervescent; strongly alkaline; clear smooth boundary.

**Bk2**—19 to 25 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine soft masses and seams of lime; violently effervescent; strongly alkaline; clear smooth boundary.

**Cr**—25 to 60 inches; grayish brown (2.5Y 5/2) and olive gray (2.5Y 4/2) semiconsolidated interbedded sandstone and shale, dark grayish brown (2.5Y 4/2) and dark olive gray (2.5Y 3/2) moist; thin discontinuous iron oxide mottling; strongly effervescent; strongly alkaline.

#### Range in Characteristics

*Depth to the Bk horizon:* 10 to 16 inches

*Depth to the Cr horizon:* 20 to 40 inches

#### A horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Clay content: 18 to 27 percent

Content of rock fragments: 0 to 5 percent pebbles

Effervescence: None to strong

Reaction: pH 7.4 to 8.4

#### Bw horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loam, clay loam, or silty clay loam

Clay content: 18 to 35 percent clay

Content of rock fragments: 0 to 15 percent pebbles

Effervescence: None to violent

Reaction: pH 7.9 to 8.4

#### Bk horizons

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam, sandy loam, clay loam, or silty clay loam

Clay content: 18 to 35 percent clay

Content of rock fragments: 0 to 15 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Effervescence: Strong or violent

Reaction: pH 7.9 to 8.4

## 171C—Delpoint-Cabbart loams, 2 to 8 percent slopes

### Setting

#### Landform:

- Delpoint—Sedimentary plains
- Cabbart—Sedimentary plains

#### Position on landform:

- Delpoint—Foot slopes
- Cabbart—Back slopes

#### Slope:

- Delpoint—2 to 8 percent
- Cabbart—2 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Delpoint and similar soils: 50 percent

Cabbart and similar soils: 40 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent

Areas of Rock outcrop: 0 to 2 percent

Benz and similar soils: 0 to 2 percent

Soils that have slopes less than 2 percent:  
 0 to 2 percent  
 Yamacall and similar soils: 0 to 1 percent  
 Lambeth and similar soils: 0 to 1 percent

### **Major Component Description**

#### **Delpoint**

*Surface layer texture:* Loam  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Interbedded sandstone  
 and shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.1 inches

#### **Cabbart**

*Surface layer texture:* Loam  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Interbedded sandstone  
 and shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.1 inches

#### **DA—Denied access**

### **Composition**

#### **Major Components**

Denied access: 100 percent

### **Major Component Description**

*Definition:* Areas where mapping access was denied  
 by landowner

#### **Elloam Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Till plains  
*Parent material:* Glacial till  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic  
 Natriboralfs

#### **Typical Pedon**

Elloam clay loam, in an area of Phillips-Elloam complex, 0 to 4 percent slopes, in rangeland; 1,900 feet north and 100 west feet of the southeast corner of sec. 28, T. 28 N., R. 7 E.

E—0 to 2 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; moderate thin and very thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Btn1—2 to 5 inches; grayish brown (10YR 5/2) clay, dark brown (10YR 4/3) moist; moderate medium and fine columnar structure parting to strong medium subangular blocky; very hard, firm, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

Btn2—5 to 9 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, firm, sticky and plastic; common distinct clay films on faces of peds; strongly alkaline; clear wavy boundary.

Bkn—9 to 15 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium, soft masses and soft seams of lime; strongly effervescent; strongly alkaline; clear smooth boundary.

Bknyz—15 to 32 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; strong medium angular blocky structure; very hard, firm, sticky and plastic; common fine and medium, soft masses, soft filaments, and soft seams of lime; common fine and medium soft masses and soft seams of gypsum and other salts; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bnyz—32 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; common fine and medium soft masses and soft seams of gypsum and other salts; strongly effervescent; strongly alkaline.

#### **Range in Characteristics**

*Depth to the Bkn horizon:* 8 to 18 inches

#### *E horizon*

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 20 to 27 percent, 30 to 45 percent where mixed to 7 inches and textures are clay loam or clay

Content of rock fragments: 0 to 30 percent—0 to trace stones, 0 to 5 percent cobbles, 0 to 25 percent pebbles.

Electrical conductivity: 0 to 2 mmhos/cm

Reaction: pH 6.1 to 7.8

Other features: The surface layer is crusted in the natural state and is also crusted where cultivated

*Btn1 and Btn2 horizons*

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 3, 4, or 5 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 35 to 55 percent

Structure: Strong or medium columnar, prismatic or blocky

Content of rock fragments: 0 to 15 percent—0 to trace cobbles, 0 to 15 percent pebbles

Sodium adsorption ratio: 8 to 25

Electrical conductivity: 2 to 8 mmhos/cm

Reaction: pH 6.6 to 9.0

Other features: Pedons that have less than 15 percent ESP have more exchangeable Mg plus sodium than calcium, plus exchange acidity at pH 8.2

*Bkn horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 30 to 45 percent

Content of rock fragments: 0 to 15 percent—0 to trace cobbles, 0 to 15 percent pebbles

Sodium adsorption ratio: 13 to 25

Electrical conductivity: 4 to 8 mmhos/cm

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.9 to 9.0

*Bknyz horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 1, 2, or 3

Texture: Loam or clay loam

Clay content: 25 to 40 percent

Content of rock fragments: 0 to 15 percent—0 to trace cobbles, 0 to 15 percent pebbles

Sodium adsorption ratio: 13 to 25

Electrical conductivity: 8 to 16 mmhos/cm

Calcium carbonate equivalent: 5 to 10 percent

Reaction: pH 7.9 to 9.0

*Bnyz horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 1, 2, or 3

Texture: Loam or clay loam

Clay content: 25 to 40 percent

Content of rock fragments: 0 to 15 percent—0 to trace cobbles, 0 to 15 percent pebbles

Sodium adsorption ratio: 13 to 25

Electrical conductivity: 8 to 16 mmhos/cm

Bulk density: 1.7 to 1.9 grams/cc

Reaction: pH 7.9 to 9.0

**521C—Elloam-Absher complex, 2 to 8 percent slopes**

***Setting***

*Landform:*

- Elloam—Till plains
- Absher—Till plains

*Position on landform:*

- Elloam—Microhighs
- Absher—Microlows

*Slope:*

- Elloam—2 to 8 percent
- Absher—2 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

***Composition***

**Major Components**

Elloam and similar soils: 60 percent

Absher and similar soils: 35 percent

**Minor Components**

Soils that have slopes more than 8 percent: 0 to 1 percent

Areas of shale and sandstone outcrops: 0 to 1 percent

Soils that have slopes less than 2 percent: 0 to 2 percent

Theony and similar soils: 0 to 1 percent

***Major Component Description***

**Elloam**

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 6.4 inches

### **Absher**

*Surface layer texture:* Clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Moderately well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 3.8 inches

### **Elve Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Somewhat excessively drained

*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour)

*Landform:* Mountains

*Parent material:* Colluvium

*Slope range:* 25 to 60 percent

*Annual precipitation:* 20 to 24 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Loamy-skeletal, mixed Typic Cryochrepts

### **Typical Pedon**

Elve very cobbly loam, 25 to 60 percent slopes, in woodland. 1,000 feet east and 300 feet north of the southwest corner of sec. 13, T. 36 N., R. 4 E.

A—0 to 3 inches; dark grayish brown (10YR 4/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent pebbles, 10 percent cobbles; neutral; clear wavy boundary.

Bw1—3 to 11 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 20 percent pebbles, 20 percent cobbles; neutral; gradual wavy boundary.

Bw2—11 to 19 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 4/3) moist; moderate

fine subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; 15 percent pebbles, 25 percent cobbles; neutral; gradual wavy boundary.

Bw3—19 to 26 inches; light yellowish brown (10YR 6/4) extremely cobbly sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure parting to moderate fine granular; soft, very friable, nonsticky and slightly plastic; 30 percent pebbles, 35 percent cobbles; neutral; gradual wavy boundary.

C—26 to 60 inches; strong brown 7.5YR 5/6) extremely cobbly sandy loam, strong brown (7.5YR 4/6) moist; massive; soft, very friable, nonsticky and slightly plastic; 30 percent pebbles, 40 percent cobbles; neutral.

### **Range in Characteristics**

#### *A horizon*

Hue: 7.5YR or 10YR

Value: 4, 5, 6, or 7 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Clay content: 10 to 20 percent

Content of rock fragments: 35 to 60 percent—  
15 to 30 percent cobbles and stones, 20 to  
30 percent pebbles

Reaction: pH 5.1 to 6.5

#### *Bw horizons*

Hue: 7.5YR or 10YR

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, 4, or 6

Texture: Loam or sandy loam

Clay content: 10 to 20 percent

Content of rock fragments: 60 to 85 percent—  
35 to 40 percent cobbles and stones, 25 to  
45 percent pebbles

Reaction: pH 5.1 to 6.5

#### *C horizon*

Hue: 7.5YR or 10YR

Value: 6, 7, or 8 dry; 4 or 5 moist

Chroma: 3, 4, or 6

Texture: Sandy loam or loam

Clay content: 10 to 20 percent

Content of rock fragments: 60 to 85 percent—  
25 to 40 percent cobbles and stones, 35 to  
45 percent pebbles

Reaction: pH 5.1 to 6.5

**51F—Elve very cobbly loam, 25 to 60 percent slopes**

**Setting**

*Landform:* Mountains (fig. 3)  
*Slope:* 25 to 60 percent  
*Elevation:* 5,200 to 6,958 feet  
*Mean annual precipitation:* 20 to 24 inches  
*Frost-free period:* 90 to 110 days

**Composition**

**Major Components**

Elve and similar soils: 90 percent

**Minor Components**

Soils that have slopes less than 25 percent:  
 0 to 2 percent  
 Soils that have slopes more than 60 percent:  
 0 to 1 percent  
 Areas of Rock outcrop: 0 to 2 percent

Areas of rubble land: 0 to 3 percent  
 Soils with thin layers of ash: 0 to 1 percent  
 Soils moderately deep to rock: 0 to 1 percent

**Major Component Description**

*Surface layer texture:* Very cobbly loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Somewhat excessively drained  
*Dominant parent material:* Colluvium  
*Native plant cover type:* Forest land  
*Flooding:* None  
*Available water capacity:* 2.7 inches

**512F—Elve-Rubble land complex, 25 to 60 percent slopes**

**Setting**

*Landform:* Mountains  
*Position on landform:* Back slopes  
*Slope:* 25 to 60 percent  
*Elevation:* 5,200 to 6,958 feet



Figure 3. - Typical area of Elve very cobbly loam, 25 to 60 percent slopes in a woodland area in the Sweetgrass Hills.

*Mean annual precipitation:* 20 to 24 inches

*Frost-free period:* 90 to 110 days

### **Composition**

#### **Major Components**

Elve and similar soils: 50 percent

Rubble land: 40 percent

#### **Minor Components**

Soils that have slopes less than 25 percent:

0 to 2 percent

Soils that have slopes more than 60 percent:

0 to 2 percent

Areas of Rock outcrop: 0 to 3 percent

Elve stony loam: 0 to 1 percent

Soils moderately deep to rock: 0 to 1 percent

Soils with thin layers of ash: 0 to 1 percent

### **Major Component Description**

#### **Elve**

*Surface layer texture:* Very cobbly loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Somewhat excessively drained

*Dominant parent material:* Colluvium

*Native plant cover type:* Forest land

*Flooding:* None

*Available water capacity:* 2.7 inches

#### **Rubble land**

*Definition:* Areas with more than 90 percent of the surface covered by stones and boulders, supporting little or no vegetation.

### **Enbar Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Somewhat poorly drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Flood plains

*Parent material:* Alluvium

*Slope range:* 0 to 4 percent

*Annual precipitation:* 13 to 19 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed Cumulic  
Haploborolls

#### **Typical Pedon**

Enbar loam, in an area of Enbar-Bigsandy-Korchea loams, 0 to 4 percent slopes, in rangeland;

1,500 feet east and 1,200 feet north of the southwest corner of sec. 17, T.37 N., R. 5 E.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

A2—3 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

A3—12 to 21 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

Bk—21 to 32 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; many fine soft masses of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg1—32 to 42 inches; gray (5Y 5/1) loam with stratifications of clay loam and sandy loam, dark gray (5Y 4/1) moist; common fine distinct yellowish brown (10YR 5/4) redox concentrations; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg2—42 to 60 inches; light gray (5Y 6/1) loam with stratifications of clay loam and sandy loam, gray (5Y 5/1) moist; many fine prominent yellowish brown (10YR 5/6) redox concentrations; massive; very hard, friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline.

### **Range in Characteristics**

*Mollic epipedon thickness:* 16 to 28 inches

*Depth to the seasonal water table:* 30 to 60 inches

#### **A horizons**

Hue: 5YR, 7.5YR, or 10YR

Value: 4 or 5 dry; 2 or 3 moist

Chroma: 1, 2, 4, or 6

Clay content: 18 to 27 percent

Content of rock fragments: 0 to 15 percent  
pebbles

Effervescence: None to strong

Reaction: pH 6.6 to 8.4

*Bk horizon*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 1 or 2  
 Texture: Loam or clay loam  
 Clay content: 18 to 30 percent  
 Content of rock fragments: 0 to 15 percent  
 pebbles  
 Effervescence: Strong or violent  
 Calcium carbonate equivalent: 5 to 10 percent  
 Reaction: pH 7.9 to 8.4

*Cg horizons*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 0, 1, or 2  
 Redoximorphic features: Few to many, 10YR 3/4,  
 10YR 5/4, 10YR 5/6, 10YR 6/6  
 Texture: Loam with stratification of sandy loam,  
 silty clay loam, and clay loam  
 Clay content: 18 to 27 percent  
 Content of rock fragments: 0 to 15 percent  
 pebbles  
 Effervescence: Strong or violent  
 Calcium carbonate equivalent: 5 to 10 percent  
 Reaction: pH 7.9 to 8.4

### 493B—Enbar-Bigsandy-Korchea loams, 0 to 4 percent slopes

#### Setting

*Landform:*

- Enbar—Flood plains
- Bigsandy—Flood plains
- Korchea—Flood plains

*Position on landform:*

- Enbar—Foot slopes
- Bigsandy—Toe slopes
- Korchea—Foot slopes

*Slope:*

- Enbar—0 to 4 percent
- Bigsandy—0 to 1 percent
- Korchea—0 to 4 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 19 inches

*Frost-free period:* 90 to 110 days

#### Composition

#### Major Components

Enbar and similar soils: 40 percent  
 Bigsandy and similar soils: 30 percent  
 Korchea and similar soils: 20 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
 0 to 4 percent  
 Nesda and similar soils: 0 to 3 percent  
 Bigsandy sandy loam: 0 to 2 percent  
 Areas supporting cottonwoods: 0 to 1 percent

#### Major Component Description

#### Enbar

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Somewhat poorly drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* Occasional  
*Water table:* Apparent  
*Available water capacity:* 9.8 inches

#### Bigsandy

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Poorly drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* Occasional  
*Water table:* Apparent  
*Salt affected:* Saline within 30 inches  
*Available water capacity:* 7.9 inches

#### Korchea

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* Rare  
*Available water capacity:* 10.1 inches

### 491B—Enbar-Nesda loams, 0 to 4 percent slopes

#### Setting

*Landform:*

- Enbar—Flood plains
- Nesda—Stream channels

*Slope:*

- Enbar—0 to 4 percent
- Nesda—0 to 4 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 19 inches

*Frost-free period:* 90 to 110 days

## Composition

### Major Components

Enbar and similar soils: 50 percent  
Nesda and similar soils: 40 percent

### Minor Components

Areas of riverwash: 0 to 4 percent  
Soils that have slopes less than 4 percent:  
0 to 2 percent  
Areas of cottonwood trees: 0 to 4 percent

### Major Component Description

#### Enbar

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Somewhat poorly drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* Occasional  
*Water table:* Apparent  
*Available water capacity:* 9.8 inches

#### Nesda

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* Occasional  
*Available water capacity:* 2.7 inches

### Ethridge Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Alluvial fans or stream terraces  
*Parent material:* Alluvium  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Aridic  
Argiborolls

#### Typical Pedon

Ethridge silty clay loam, 0 to 4 percent slopes, in rangeland; 2,000 feet due east of the northwest corner of sec. 26, T. 28 N., R. 3 E.

A—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist;

moderate fine granular structure; hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bt—5 to 13 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate fine subangular blocky structure; very hard, firm, sticky and plastic; many distinct clay films on faces of peds; neutral; clear smooth boundary.

Bk—13 to 30 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky structure; very hard, firm, sticky and plastic; many fine and medium soft masses of lime; violently effervescent; moderately alkaline; clear wavy boundary.

Bky—30 to 42 inches; light grayish brown (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; many fine and medium soft masses of lime; common fine irregularly shaped seams of gypsum; strongly effervescent; mildly alkaline; gradual wavy boundary.

BC—42 to 60 inches; light gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; strongly effervescent; mildly alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 14 inches and may include all or part of the Bt horizon

*Depth to the Bk horizon:* 10 to 20 inches

#### A horizon

Hue: 10YR or 2.5Y

Value: 2 or 3 moist

Chroma: 2 or 3

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 5 percent pebbles

Reaction: pH 6.1 to 7.8

#### Bt horizon

Hue: 10YR or 2.5Y

Value: 3 or 4 moist

Chroma: 2, 3, or 4

Texture: Clay, silty clay, clay loam, or silty clay loam

Clay content: 35 to 45 percent

Content of rock fragments: 0 to 5 percent pebbles

Reaction: pH 6.6 to 8.4

#### Bk horizon

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay, silty clay loam, loam, clay loam, or silty clay  
 Clay content: 25 to 45 percent  
 Content of rock fragments: 0 to 5 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

***Bky and BC horizons***

Hue: 10YR or 2.5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay loam, silt loam, or silty clay loam  
 (these textures consist of strata of finer and coarser materials)  
 Clay content: 25 to 40 percent slopes  
 Content of rock fragments: 0 to 5 percent  
 Electrical conductivity: 2 to 4 mmhos/cm  
 Gypsum content: 0 to 3 percent  
 Reaction: pH 7.4 to 8.4

**38B—Ethridge silty clay loam, 0 to 4 percent slopes*****Setting***

*Landform:* Alluvial fans and stream terraces  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

***Composition*****Major Components**

Ethridge and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 1 percent  
 McKenzie and similar soils: 0 to 1 percent  
 Marias and similar soils: 0 to 1 percent  
 Kobase, calcareous surface: 0 to 2 percent

***Major Component Description***

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

**385B—Ethridge-Kobase complex, 0 to 4 percent slopes*****Setting******Landform:***

- Ethridge—Alluvial fans
- Kobase—Alluvial fans

***Position on landform:***

- Ethridge—Foot slopes and toe slopes
- Kobase—Back slopes

***Slope:***

- Ethridge—0 to 4 percent
- Kobase—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

***Composition*****Major Components**

Ethridge and similar soils: 55 percent  
 Kobase and similar soils: 35 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 McKenzie and similar soils: 0 to 3 percent  
 Marias and similar soils: 0 to 4 percent

***Major Component Description*****Ethridge**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

**Kobase**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.7 inches

***Evanston Series***

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Alluvial fans or stream terraces

*Parent material:* Alluvium

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic  
Argiborolls

### Typical Pedon

Evanston loam, 0 to 4 percent slopes, in cropland; 50 feet west and 50 feet north of the southeast corner of sec. 34, T. 28 N., R. 3 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure over moderate medium platy structure; soft to slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

Bt—6 to 13 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; fine medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear smooth boundary.

Bk1—13 to 20 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; fine medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine disseminated soft masses of lime; strongly effervescent; mildly alkaline; gradual smooth boundary.

Bk2—20 to 33 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine irregularly shaped soft masses of lime; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk3—33 to 60 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine irregularly shaped soft masses of lime; strongly effervescent; moderately alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches

*Depth to the Bk horizon:* 8 to 16 inches

#### Ap horizon

Hue: 2.5Y through 7.5YR

Value: 3, 4, or 5 dry; 2 or 3 moist

Chroma: 2 or 3 dry and moist

Clay content: 20 to 27 percent

Reaction: pH 6.6 to 7.8

#### Bt horizon

Hue: 2.5Y through 7.5YR

Value: 3, 4, 5, or 6 dry; 3, 4, or 5 moist

Chroma: 2 through 4 dry and moist

Texture: Clay loam or loam

Clay content: 25 to 35 percent

Reaction: pH 6.6 to 7.8

#### Bk horizons

Hue: 2.5Y through 7.5YR

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 3 or 4 dry and moist

Texture: Loam, clay loam, or sandy clay loam

Clay content: 20 to 35 percent

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 9.0

## 37B—Evanston loam, 0 to 4 percent slopes

### Setting

*Landform:* Alluvial fans and stream terraces

*Slope:* 0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Evanston and similar soils: 95 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
0 to 2 percent

McKenzie and similar soils: 0 to 1 percent

Evanston and similar soils: 0 to 1 percent

Telstad and similar soils: 0 to 1 percent

### Major Component Description

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 10.0 inches

### 37C—Evanston loam, 4 to 8 percent slopes

#### Setting

*Landform:* Alluvial fans and stream terraces

*Slope:* 4 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Evanston and similar soils: 95 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 1 percent

McKenzie and similar soils: 0 to 1 percent

Soils that have slopes less than 4 percent:  
0 to 1 percent

Evanston clay loam: 0 to 1 percent

Telstad and similar soils: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 10.0 inches

#### Farnuf Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Alluvial fans or stream terraces

*Parent material:* Alluvium

*Slope range:* 0 to 4 percent

*Annual precipitation:* 13 to 17 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed Typic  
Argiborolls

#### Typical Pedon

Farnuf loam, 0 to 4 percent slopes, in rangeland; 300 feet west and 300 feet north of the southeast corner of sec. 16, T. 37 N., R. 5 E.

A—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt—6 to 11 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common distinct clay films on faces of peds; neutral; clear wavy boundary.

Bk1—11 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; mildly alkaline; gradual wavy boundary.

Bk2—16 to 30 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; mildly alkaline; gradual wavy boundary.

C—30 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches and includes all or part of the Bt horizons

*Depth to the Bk horizon:* 10 to 25 inches

#### A horizon

Hue: 2.5Y or 10YR

Value: 3, 4, or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 20 to 27 percent

Content of rock fragments: 0 to 35 percent—  
0 to 20 percent cobbles and stones, 0 to 15 percent pebbles

Reaction: pH 6.1 to 7.8

#### Bt horizon

Hue: 2.5Y, 10YR, or 7.5YR

Value: 3, 4, 5, or 6 dry; 2, 3, or 4 moist

Chroma: 2, 3, or 4

Texture: Loam, clay loam, or silty clay loam

Clay content: 25 to 35 percent

Content of rock fragments: 0 to 15 percent  
pebbles

Reaction: pH 6.1 to 7.8

Other features: Some pedons have a thin Btk horizon

**Bk horizons**

Hue: 2.5Y, 10YR, or 7.5YR  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Fine sandy loam, loam, silt loam, silty clay loam, or clay loam  
 Clay content: 20 to 30 percent  
 Content of rock fragments: 0 to 15 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

**C horizon:**

Hue: 2.5Y, 10YR, or 7.5YR  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Loam or clay loam  
 Clay content: 15 to 30 percent

*Reaction: pH 7.4 to 8.4*

**24B—Farnuf loam, 0 to 4 percent slopes**

**Setting**

*Landform:* Alluvial fans and stream terraces  
*Slope:* 0 to 4 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 13 to 17 inches  
*Frost-free period:* 90 to 110 days

**Composition**

**Major Components**

Farnuf and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 2 percent  
 Farnuf clay loam: 0 to 3 percent  
 Williams and similar soils: 0 to 3 percent

**Major Component Description**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.1 inches

**Ferd Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Alluvial fans or stream terraces  
*Parent material:* Alluvium  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Glossic Eutroboralfs

**Typical Pedon**

Ferd loam, in an area of Ferd-Creed-Gerdrum complex, 0 to 4 percent slopes, in cropland; 250 feet south and 250 feet west of the northeast corner of sec. 33, T. 28 N., R. 7 E.

- Ap—0 to 5 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate thin and medium platy structure; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.
- E/Bt—5 to 9 inches; E part (60 percent) light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist, B part (40 percent) brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate thin and medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few distinct clay films on faces of peds; mildly alkaline; abrupt smooth boundary.
- Bt—9 to 16 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; many distinct clay films on faces of peds; mildly alkaline; clear smooth boundary.
- Btk—16 to 22 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; many distinct clay films on faces of peds; few fine soft masses of lime; strongly effervescent; strongly alkaline; clear wavy boundary.
- Bk—22 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine soft masses of lime; strongly effervescent; moderately alkaline.

**Range in Characteristics***A horizon*

Hue: 10YR or 2.5Y  
 Value: 3 or 4 moist  
 Clay content: 20 to 27 percent  
 Reaction: pH 6.6 to 7.3

*E/Bt horizon*

Hue: 10YR or 2.5Y  
 Texture: Loam, clay loam, or silty clay loam  
 Clay content: 22 to 35 percent  
 Reaction: pH 6.6 to 7.8

*Bt horizon*

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry  
 Chroma: 2 or 3  
 Texture: Clay loam, silty clay loam, or clay  
 Clay content: 35 to 50 percent  
 Electrical conductivity: less than 2 mmhos/cm  
 Reaction: pH 6.6 to 8.4

*Btk and Bk horizons*

Hue: 10YR or 2.5Y  
 Value: 6 or 7 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Texture: Clay loam or silty clay loam  
 Clay content: 27 to 40 percent  
 Calcium carbonate equivalent: 5 to 15 percent  
 Sodium adsorption ratio: 0 to 13  
 Electrical conductivity: 2 to 8 mmhos/cm  
 Reaction: pH 7.9 to 9.0

**311B—Ferd-Creed-Gerdrum complex, 0 to 4 percent slopes*****Setting****Landform:*

- Ferd—Alluvial fans
- Creed—Alluvial fans
- Gerdrum—Alluvial fans

*Position on landform:*

- Ferd—Microhighs
- Creed—Microhighs
- Gerdrum—Microlows

*Slope:*

- Ferd—0 to 4 percent
- Creed—0 to 4 percent
- Gerdrum—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

***Composition*****Major Components**

Ferd and similar soils: 40 percent  
 Creed and similar soils: 35 percent  
 Gerdrum and similar soils: 20 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 1 percent  
 McKenzie and similar soils: 0 to 2 percent  
 Marvan and similar soils: 0 to 2 percent

***Major Component Description*****Ferd**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.4 inches

**Creed**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.5 inches

**Gerdrum**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 5.8 inches

***Fortbenton Series***

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour) to 28 inches; slow below this depth (0.06 to 0.2 inch/hour)  
*Landform:* Till plains

*Parent material:* Eolian deposits over till or eolian over lacustrine material

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic Haploborolls

### Typical Pedon

Fortbenton fine sandy loam, in an area of Fortbenton-Hillon complex, 2 to 8 percent slopes, in cropland; 1,200 feet west and 200 feet south of the northeast corner of sec. 5, T. 29 N., R. 4 E.

Ap—0 to 7 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate very fine and fine granular structure; slightly hard, very friable, nonsticky and slightly plastic; slightly effervescent; mildly alkaline; abrupt smooth boundary.

Bw1—7 to 14 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, nonsticky and slightly plastic; slightly effervescent; mildly alkaline; clear smooth boundary.

Bw2—14 to 28 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, nonsticky and slightly plastic; slightly effervescent; mildly alkaline; abrupt wavy boundary.

2Bk—28 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and medium soft masses of lime; strongly effervescent; moderately alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches

*Depth to the 2Bk horizon:* 15 to 30 inches

#### Ap horizon

Hue: 10YR or 2.5Y

Value: 4 or 5 dry

Chroma: 2 or 3

Clay content: 10 to 18 percent

Reaction: pH 6.6 to 7.8

#### Bw1 horizon

Hue: 10YR or 2.5Y

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Fine sandy loam or sandy loam

Clay content: 10 to 18 percent

Reaction: pH 6.6 to 7.8

#### Bw2 horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry

Chroma: 2, 3, or 4

Texture: Fine sandy loam or sandy loam

Clay content: 10 to 18 percent

Reaction: pH 6.6 to 7.8

#### 2Bk horizons

Hue: 10YR or 2.5Y

Value: 6 or 7 dry, 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay loam, silty clay loam, or silt loam

Clay content: 27 to 35 percent

Electrical conductivity: 0 to 4 mmhos/cm

Sodium adsorption ratio: 0 to 4

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.9 to 9.0

## 368C—Fortbenton-Hillon complex, 2 to 8 percent slopes

### Setting

#### Landform:

- Fortbenton—Till plains
- Hillon—Till plains

#### Position on landform:

- Fortbenton—Back slopes and foot slopes
- Hillon—Summits

#### Slope:

- Fortbenton—2 to 8 percent
- Hillon—2 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Fortbenton and similar soils: 55 percent

Hillon and similar soils: 35 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent

Soils that have slopes less than 2 percent:  
0 to 2 percent

Scobey and similar soils: 0 to 2 percent

Chinook and similar soils: 0 to 2 percent  
Fortbenton loamy sand: 0 to 2 percent

### **Major Component Description**

#### **Fortbenton**

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Eolian over till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

#### **Hillon**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 10.1 inches

### **Gerdrum Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Alluvial fans  
*Parent material:* Alluvium  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic  
Natriboralfs

#### **Typical Pedon**

Gerdrum clay loam, in an area of Ferd-Creed-Gerdrum complex, 0 to 4 percent slopes, in rangeland; 2,600 feet north and 2,400 feet west of the southeast corner of sec. 30, T. 34 N., R. 4 E.

E—0 to 3 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; abrupt clear boundary.

Btn—3 to 11 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong fine angular blocky structure; very hard, firm, sticky and plastic;

continuous distinct clay films on faces of pedis; moderately alkaline; clear smooth boundary.  
Btk—11 to 14 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate medium prismatic structure; very hard, firm, sticky and plastic; continuous distinct clay films on faces of pedis; common fine and medium soft masses of lime; strongly effervescent; strongly alkaline; clear wavy boundary.

Bknyz1—14 to 24 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and medium soft masses of lime; few fine and medium soft masses and soft seams of gypsum and other salts; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bknyz2—24 to 38 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and medium soft masses and soft seams of lime; common fine and medium soft masses and soft seams of gypsum and other salts; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bknyz3—38 to 60 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and medium soft masses and soft seams of lime; common fine and medium soft masses and soft seams of gypsum and other salts; strongly effervescent; strongly alkaline.

#### **Range in Characteristics**

*Depth to the Btk horizon:* 10 to 24 inches

*Depth to the Bknyz1 horizon:* 15 to 24 inches

#### *E horizon*

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Clay content: 20 to 27 percent

Content of rock fragments: 0 to 15 percent  
pebbles

Reaction: pH 6.6 to 7.8

#### *Btk horizon*

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay, silty clay, or silty clay loam

Clay content: 35 to 55 percent

Content of rock fragments: 0 to 10 percent  
pebbles

Structure: Fine to coarse columnar or medium or coarse blocky  
 Hardness: Extremely or very hard when dry  
 Electrical conductivity: 1 to 8 mmhos/cm  
 Sodium adsorption ratio: 10 to 20; pedons with sodium adsorption ratio of less than 13 have more exchangeable magnesium plus sodium than calcium plus exchange acidity at pH 8.2  
 Reaction: pH 7.4 to 9.0

***Btnk horizon***

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Texture: Clay, silty clay, silty clay loam, or clay loam  
 Clay content: 35 to 50 percent  
 Content of rock fragments: 0 to 10 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Electrical conductivity: 2 to 8 mmhos/cm  
 Sodium adsorption ratio: 13 to 20  
 Reaction: pH 7.4 to 9.0

***Bknyz horizons***

Hue: 10YR, 2.5Y, or 5Y  
 Value: 4, 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay loam, sandy clay loam, clay, or silty clay  
 Clay content: 30 to 50 percent  
 Content of rock fragments: 0 to 10 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Electrical conductivity: 8 to 16 mmhos/cm  
 Sodium adsorption ratio: 13 to 30  
 Gypsum content: 1 to 5 percent  
 Reaction: pH 7.9 to 9.0

**401C—Gerdrum-Yamacall loams, 2 to 8 percent slopes*****Setting******Landform:***

- Gerdrum—Alluvial fans
- Yamacall—Alluvial fans

***Position on landform:***

- Gerdrum—Microlows
- Yamacall—Microhighs

***Slope:***

- Gerdrum—2 to 4 percent
- Yamacall—2 to 8 percent

***Elevation:*** 2,750 to 3,460 feet

***Mean annual precipitation:*** 10 to 14 inches  
***Frost-free period:*** 105 to 120 days

***Composition*****Major Components**

Gerdrum and similar soils: 45 percent  
 Yamacall and similar soils: 40 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 3 percent  
 Havre, occasionally flooded: 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 3 percent  
 Marvan and similar soils: 0 to 3 percent  
 Vanda and similar soils: 0 to 3 percent

***Major Component Description*****Gerdrum**

***Surface layer texture:*** Clay loam  
***Depth class:*** Very deep (more than 60 inches)  
***Drainage class:*** Well drained  
***Dominant parent material:*** Alluvium  
***Native plant cover type:*** Rangeland  
***Flooding:*** None  
***Salt affected:*** Saline within 30 inches  
***Sodium affected:*** Sodic within 30 inches  
***Available water capacity:*** 5.8 inches

**Yamacall**

***Surface layer texture:*** Loam  
***Depth class:*** Very deep (more than 60 inches)  
***Drainage class:*** Well drained  
***Dominant parent material:*** Alluvium  
***Native plant cover type:*** Rangeland  
***Flooding:*** None  
***Available water capacity:*** 9.7 inches

***Glendive Series***

***Depth class:*** Very deep (greater than 60 inches)  
***Drainage class:*** Well drained  
***Permeability:*** Moderately rapid (2.0 to 6.0 inches/hour)  
***Landform:*** Flood plains  
***Parent material:*** Alluvium  
***Slope range:*** 0 to 2 percent  
***Annual precipitation:*** 10 to 14 inches  
***Annual air temperature:*** 43 to 45 degrees F  
***Frost-free period:*** 105 to 120 days

**Taxonomic class:** Coarse-loamy, mixed (calcareous), frigid Aridic Ustifluvents

### Typical Pedon

Glendive fine sandy loam, in an area of Havre-Glendive complex, 0 to 2 percent slopes, in rangeland; 1,000 feet east and 700 feet south of the northwest corner of sec. 25, T. 37 N., R. 6 E.

A—0 to 6 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; slightly effervescent; moderately alkaline; clear wavy boundary.

C1—6 to 24 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; clear wavy boundary.

C2—24 to 32 inches; light olive brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent; strongly alkaline; clear wavy boundary.

C3—32 to 60 inches; grayish brown (2.5Y 5/2) sandy loam that consists of stratified lenses of clay loam, and loamy sand, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; strongly effervescent; strongly alkaline.

### Range in Characteristics

#### A horizon

Hue: 10YR, 2.5Y, or 5Y  
Value: 4, 5, or 6 dry; 3, 4, or 5 moist  
Chroma: 2 or 3  
Clay content: 5 to 15 percent  
Effervescence: None to violent  
Reaction: pH 6.6 to 9.0

#### C1 horizon

Hue: 10YR, 2.5Y, or 5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Loam, silt loam, sandy loam, or fine sandy loam  
Clay content: 5 to 18 percent  
Content of rock fragments: 0 to 15 percent pebbles  
Effervescence: Slight to violent  
Calcium carbonate equivalent: 5 to 15 percent  
Reaction: pH 7.4 to 9.0

#### C2 and C3 horizons

Hue: 10YR, 2.5Y, or 5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Loam, silt loam, sandy loam, or fine sandy loam  
Clay content: 5 to 18 percent  
Content of rock fragments: 0 to 15 percent pebbles  
Effervescence: Slight to violent  
Calcium carbonate equivalent: 5 to 15 percent  
Reaction: pH 7.4 or 9.0

## 812A—Glendive-Havre complex, 0 to 2 percent slopes

### Setting

#### Landform:

- Glendive—Flood plains
- Havre—Flood plains

#### Slope:

- Glendive—0 to 2 percent
- Havre—0 to 2 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Glendive and similar soils: 50 percent  
Havre and similar soils: 35 percent

#### Minor Components

Soils that have slopes more than 2 percent: 0 to 3 percent  
Soils that have water table at 40 to 60 inches: 0 to 2 percent  
Rivra and similar soils: 0 to 2 percent  
Harlake and similar soils: 0 to 3 percent  
Areas without cottonwood trees: 0 to 3 percent

### Major Component Description

#### Glendive

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Forest land  
*Flooding:* Rare  
*Available water capacity:* 8.5 inches

**Havre**

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Forest land

*Flooding:* Rare

*Available water capacity:* 9.7 inches

**Harlake Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Flood plains

*Parent material:* Alluvium

*Slope range:* 0 to 1 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic (calcareous), frigid Aridic Ustifluvents

**Typical Pedon**

Harlake silty clay, 0 to 1 percent slope, in cropland; 3,000 feet north and 1,700 feet west of the southeast corner of sec. 4, T. 29 N., R. 5 E.

Ap—0 to 7 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to moderate very fine and fine subangular blocky; very hard, firm, sticky and plastic; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1—7 to 21 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to moderate very fine and fine subangular blocky; very hard, firm, sticky and plastic; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—21 to 38 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to moderate very fine and fine subangular blocky; very hard, firm, sticky and plastic; disseminated lime; strongly effervescent; strongly alkaline; gradual wavy boundary.

C3—38 to 60 inches; grayish brown (2.5Y 5/2) clay loam consisting of stratified layers of fine sandy loam, loam, and silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium

subangular blocky structure; hard, friable, sticky and plastic; disseminated lime; strongly effervescent; strongly alkaline.

**Range in Characteristics***Ap horizon*

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 40 to 55 percent

Effervescence: Slight or strong

Reaction: pH 6.6 to 8.4

*C1 horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 4, 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay, silty clay, or silty clay loam

consisting of stratified layers of clay, silt loam, silty clay loam, and silty clay

Clay content: 35 to 60 percent

Effervescence: Strong or violent

Reaction: pH 7.4 to 8.4

*C2 horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 4, 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay, silty clay, or silty clay loam

consisting of stratified layers of clay, silt loam, silty clay loam, and silty clay

Clay content: 35 to 60 percent

Effervescence: Strong or violent

Reaction: pH 7.4 to 8.4

*C3 horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 4, 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Silt loam, loam, clay loam, or fine sandy

loam consisting of stratified layers of silty clay loam, silt loam, and fine sandy loam

Clay content: 15 to 35 percent

Effervescence: Strong or violent

Reaction: pH 7.9 to 9.0

**90A—Harlake silty clay, 0 to 1 percent slope****Setting**

*Landform:* Flood plains

*Slope:* 0 to 1 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Harlake and similar soils: 90 percent

#### **Minor Components**

Soils that have slopes more than 1 percent:  
0 to 3 percent

Bigsandy and similar soils: 0 to 3 percent

Harlake clay loam: 0 to 2 percent

Harlake, occasionally flooded: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Silty clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* Rare

*Available water capacity:* 8.9 inches

#### **Havre Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Flood plains

*Parent material:* Alluvium

*Slope range:* 0 to 4 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed (calcareous),  
frigid Aridic Ustifluvents

#### **Typical Pedon**

Havre clay loam, 0 to 1 percent slope, in cropland;  
2,100 feet west and 1,800 feet north of the southeast  
corner of sec. 24, T. 29 N., R. 6 E.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) clay loam,  
very dark grayish brown (2.5Y 4/2) moist;  
moderate medium angular blocky structure parting  
to weak thin platy; hard, friable, sticky and slightly  
plastic; mildly effervescent; slightly alkaline; clear  
smooth boundary.

C1—5 to 12 inches; grayish brown (2.5Y 5/2) loam,  
dark grayish brown (2.5Y 4/2) moist; massive;  
hard, friable, slightly sticky and slightly plastic;  
strongly effervescent; mildly alkaline; clear wavy  
boundary.

C2—12 to 30 inches; light brownish gray (2.5Y 6/2)  
loam with stratified lenses of silt loam and fine  
sandy loam, grayish brown (2.5Y 5/2) moist;  
massive; slightly hard, very friable, slightly sticky  
and slightly plastic; slightly effervescent; mildly  
alkaline; clear wavy boundary.

C3—30 to 60 inches; light brownish gray (2.5Y 6/2)  
loam with stratified lenses of silt loam and fine  
sandy loam throughout, grayish brown (2.5Y 5/2)  
moist; massive; slightly hard, very friable, slightly  
sticky and slightly plastic; mildly alkaline.

#### **Range in Characteristics**

##### *Ap horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 15 to 40 percent

Effervescence: None to strong

Reaction: pH 6.1 to 8.4

##### *C1 horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam, silt loam, or clay loam which  
consist of strata of silt loam, fine sandy loam,  
silty clay loam, and clay loam

Clay content: 18 to 35 percent

Effervescence: Slight or strong

Reaction: pH 7.4 to 9.0

##### *C2 and C3 horizons*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam, silt loam, or clay loam which  
consist of strata of silt loam, fine sandy loam,  
silty clay loam, and clay loam

Clay content: 18 to 35 percent

Effervescence: Slight or strong

Reaction: pH 7.4 to 9.0

### **60A—Havre clay loam, 0 to 1 percent slope**

#### **Setting**

*Landform:* Flood plains

*Slope:* 0 to 1 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Havre and similar soils: 90 percent

#### **Minor Components**

Soils that have slopes more than 1 percent:  
0 to 3 percent

Bigsandy and similar soils: 0 to 3 percent

Harlake and similar soils: 0 to 2 percent

Havre, occasionally flooded: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* Rare

*Available water capacity:* 9.6 inches

### **601A—Havre-Glendive complex, 0 to 2 percent slopes**

#### **Setting**

*Landform:*

- Havre—Flood plains
- Glendive—Flood plains

*Slope:*

- Havre—0 to 2 percent
- Glendive—0 to 2 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Havre and similar soils: 50 percent

Glendive and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 2 percent:  
0 to 2 percent

Thibadeau and similar soils: 0 to 4 percent

Havre, gravelly substratum: 0 to 2 percent

Havre clay loam: 0 to 2 percent

#### **Major Component Description**

##### **Havre**

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* Occasional

*Available water capacity:* 9.7 inches

##### **Glendive**

*Surface layer texture:* Fine sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* Occasional

*Available water capacity:* 8.3 inches

#### **Hedstrom Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour) to  
22 inches; rapid below this depth (6.0 to 20.0  
inches/hour)

*Landform:* Relict stream terraces

*Parent material:* Alluvium

*Slope range:* 0 to 4 percent

*Annual precipitation:* 15 to 19 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine loamy over sandy or sandy  
skeletal, mixed Typic Argiborolls

#### **Typical Pedon**

Hedstrom fine sandy loam, 0 to 4 percent slopes, in cropland; 1,600 feet east and 300 feet north of the southwest corner of sec. 6, T. 35 N., R. 4 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium and fine granular structure; soft, very friable, nonsticky and nonplastic; neutral; clear smooth boundary.

Bt—6 to 16 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many distinct clay films on faces of peds; mildly alkaline; abrupt smooth boundary.

Bk—16 to 22 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky and nonplastic; disseminated lime; violently

effervescent; moderately alkaline; gradual smooth boundary.

2C1—22 to 36 inches; light brownish gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; weak coarse and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C2—36 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grain; loose, nonsticky and nonplastic; disseminated lime; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 10 to 16 inches

*Depth to Bk horizon:* 15 to 30 inches

*Depth to 2C horizon:* 20 to 40 inches

#### Ap horizon

Value: 4 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 15 to 20 percent

Reaction: pH 6.6 to 7.3

#### Bt horizon

Hue: 10YR or 2.5Y

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2, 3, or 4

Texture: Sandy clay loam or clay loam

Clay content: 20 to 35 percent

Content of rock fragments: 0 to 10 percent pebbles

Reaction: pH 6.6 to 7.8

#### Bk horizon

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Sandy clay loam or loam

Clay content: 20 to 30 percent

Content of rock fragments: 0 to 10 percent pebbles

Calcium carbonate equivalent: 8 to 15 percent

Reaction: pH 7.9 to 9.0

#### 2C horizons

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Sand, fine sand, or loamy fine sand

Clay content: 0 to 5 percent

Content of rock fragments: 0 to 15 percent pebbles

Reaction: pH 7.4 to 8.4

## 190B—Hedstrom fine sandy loam, 0 to 4 percent slopes

### Setting

*Landform:* Relict stream terraces

*Slope:* 0 to 4 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Hedstrom and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
0 to 4 percent

Perma and similar soils: 0 to 3 percent

Turner and similar soils: 0 to 3 percent

### Major Component Description

*Surface layer texture:* Fine sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.8 inches

### Hillon Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Till plains or hills

*Parent material:* Glacial till

*Slope range:* 0 to 60 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed (calcareous), frigid Aridic Ustorthents

#### Typical Pedon

Hillon loam, in an area of Joplin-Hillon loams, 2 to 8 percent slopes, in cropland; 1,200 feet east and 1,800 feet south of the northwest corner of sec. 29, T. 28 N., R. 4 E.

Ap—0 to 6 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, friable,

slightly sticky and slightly plastic; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk1—6 to 12 inches; olive gray (5Y 5/2) loam, olive gray (5Y 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many medium soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—12 to 27 inches; olive gray (5Y 5/2) loam, olive gray (5Y 4/2) moist; common, medium, distinct yellowish brown (10YR 5/6) redox concentrations; massive; hard, friable, slightly sticky and slightly plastic; many medium soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bky—27 to 60 inches; olive (5Y 5/3) loam, olive (5Y 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common, medium, soft masses of lime; many medium and large nests of gypsum; strongly effervescent; moderately alkaline.

#### Range in Characteristics

##### *A horizon*

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Texture: Loam or clay loam  
 Clay content: 20 to 35 percent  
 Content of rock fragments: 0 to 25 percent—  
 0 to 10 percent cobbles and stones, 0 to 15 percent pebbles  
 Calcium carbonate equivalent: 0 to 10 percent  
 Effervescence: None to violent  
 Reaction: pH 7.4 to 8.4

##### *Bk horizons*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Loam or clay loam  
 Clay content: 20 to 35 percent with 25 to 35 percent fine and coarser sand  
 Content of rock fragments: 0 to 15 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Effervescence: Strong or violent  
 Bulk density: 1.55 to 1.75 g/ccm  
 Reaction: pH 7.9 to 9.0

##### *Bky horizon*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4  
 Texture: loam or clay loam  
 Clay content: 20 to 35 percent with 25 to 35 percent fine and coarser sand  
 Content of rock fragments: 0 to 15 percent pebbles  
 Bulk density: 1.55 to 1.75 g/ccm  
 Calcium carbonate equivalent: 2 to 12 percent  
 Effervescence: Strong to violent  
 Reaction: pH 7.9 to 9.0

### 22F—Hillon loam, 25 to 60 percent slopes

#### *Setting*

*Landform:* Hills  
*Slope:* 25 to 60 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### *Composition*

##### **Major Components**

Hillon and similar soils: 95 percent

##### **Minor Components**

Soils that have slopes more than 60 percent:  
 0 to 1 percent  
 Areas of Rock outcrop: 0 to 1 percent  
 Hillon gravelly loam: 0 to 1 percent  
 Soils that have slopes less than 25 percent:  
 0 to 2 percent

#### *Major Component Description*

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 10.1 inches

### 225F—Hillon-Cabbart-Yawdim complex, 25 to 70 percent slopes

#### *Setting*

##### *Landform:*

- Hillon—Hills
- Cabbart—Hills
- Yawdim—Hills

*Position on landform:*

- Hillon—Back slopes and shoulders
- Cabbart—Back slopes
- Yawdim—Back slopes

*Slope:*

- Hillon—25 to 45 percent
- Cabbart—25 to 70 percent
- Yawdim—25 to 70 percent

*Elevation:* 2,750 to 3,460 feet*Mean annual precipitation:* 10 to 14 inches*Frost-free period:* 105 to 120 days**Composition****Major Components**

Hillon and similar soils: 40 percent  
 Cabbart and similar soils: 30 percent  
 Yawdim and similar soils: 20 percent

**Minor Components**

Areas of Rock outcrop: 0 to 4 percent  
 Soils that have slopes less than 25 percent:  
 0 to 3 percent  
 Yawdim clay loam: 0 to 3 percent

**Major Component Description****Hillon***Surface layer texture:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Native plant cover type:* Rangeland*Flooding:* None*Available water capacity:* 10.1 inches**Cabbart***Surface layer texture:* Loam*Depth class:* Shallow (10 to 20 inches)*Drainage class:* Well drained*Dominant parent material:* Interbedded sandstone  
and shale residuum*Native plant cover type:* Rangeland*Flooding:* None*Available water capacity:* 2.1 inches**Yawdim***Surface layer texture:* Silty clay*Depth class:* Shallow (10 to 20 inches)*Drainage class:* Well drained*Dominant parent material:* Semiconsolidated shale  
residuum*Native plant cover type:* Rangeland*Flooding:* None*Available water capacity:* 2.0 inches**224B—Hillon-Joplin complex, 0 to 4 percent slopes****Setting***Landform:*

- Hillon—Till plains
- Joplin—Till plains

*Position on landform:*

- Hillon—Back slopes and shoulders
- Joplin—Foot slopes and toe slopes

*Slope:*

- Hillon—0 to 4 percent
- Joplin—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet*Mean annual precipitation:* 10 to 14 inches*Frost-free period:* 105 to 120 days**Composition****Major Components**

Hillon and similar soils: 55 percent  
 Joplin and similar soils: 40 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 Hillon gravelly loam: 0 to 2 percent

**Major Component Description****Hillon***Surface layer texture:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Native plant cover type:* Rangeland*Flooding:* None*Available water capacity:* 10.1 inches**Joplin***Surface layer texture:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Native plant cover type:* Rangeland*Flooding:* None*Available water capacity:* 9.1 inches

## 224E—Hillon-Joplin loams, 8 to 25 percent slopes

### Setting

#### Landform:

- Hillon—Hills
- Joplin—Hills

#### Position on landform:

- Hillon—Shoulders and summits
- Joplin—Back slopes and foot slopes

#### Slope:

- Hillon—8 to 25 percent
- Joplin—8 to 15 percent

Elevation: 2,750 to 3,460 feet

Mean annual precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

### Composition

#### Major Components

Hillon and similar soils: 65 percent  
Joplin and similar soils: 30 percent

#### Minor Components

Soils that have slopes more than 25 percent:  
0 to 1 percent  
Areas of Rock outcrop: 0 to 2 percent  
Hillon gravelly loam: 0 to 2 percent

### Major Component Description

#### Hillon

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Native plant cover type: Rangeland

Flooding: None

Available water capacity: 10.1 inches

#### Joplin

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Native plant cover type: Rangeland

Flooding: None

Available water capacity: 9.1 inches

## 221E—Hillon-Kevin clay loams, 8 to 25 percent slopes

### Setting

#### Landform:

- Hillon—Hills
- Kevin—Hills

#### Position on landform:

- Hillon—Shoulders and summits
- Kevin—Back slopes

#### Slope:

- Hillon—8 to 25 percent
- Kevin—8 to 15 percent

Elevation: 2,750 to 3,460 feet

Mean annual precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

### Composition

#### Major Components

Hillon and similar soils: 55 percent  
Kevin and similar soils: 40 percent

#### Minor Components

Soils that have slopes more than 25 percent:  
0 to 1 percent  
Areas of Rock outcrop: 0 to 1 percent  
Soils that have slopes less than 8 percent:  
0 to 1 percent  
Joplin and similar soils: 0 to 1 percent  
Hillon gravelly clay loam: 0 to 1 percent

### Major Component Description

#### Hillon

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Native plant cover type: Rangeland

Flooding: None

Available water capacity: 9.9 inches

#### Kevin

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Native plant cover type: Rangeland

Flooding: None

Available water capacity: 9.8 inches

**Joplin Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Till plains or hills

*Parent material:* Glacial till

*Slope range:* 0 to 15 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic  
Argiborolls

**Typical Pedon**

Joplin loam, in an area of Telstad-Joplin loams, 0 to 4 percent slopes, in rangeland; 2,100 feet north and 1,000 feet east of the southwest corner of sec. 17, T. 33 N., R. 5 E.

A—0 to 4 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

Bt—4 to 9 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, friable, sticky and plastic; many distinct clay films on faces of peds and lining pores; neutral; clear smooth boundary.

Bk—9 to 20 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine soft masses and seams of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bky—20 to 31 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine soft masses and seams of lime; few fine soft masses and seams of gypsum; strongly effervescent; moderately alkaline; clear wavy boundary.

C—31 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 7 to 9 inches and may include all of the Bt horizon

*Depth to the Bk horizon:* Less than 10 inches

**A horizon**

Hue: 10YR or 2.5Y

Chroma: 2 or 3

Clay content: 10 to 27 percent

Content of rock fragments: 0 to 60 percent—  
0 to 40 percent cobbles, 5 to 20 percent pebbles

Effervescence: None to violent

Calcium carbonate equivalent: 0 to 10 percent

Reaction: pH 6.6 to 8.4

**Bt horizon**

Hue: 10YR or 2.5Y

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 25 to 35 percent

Content of rock fragments: 0 to 15 percent  
pebbles

Reaction: pH 6.6 to 8.4

**Bk horizon**

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 18 to 32 percent

Content of rock fragments: 0 to 35 percent  
pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

**Bky horizon**

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 18 to 32 percent

Content of rock fragments: 0 to 35 percent  
pebbles

Gypsum: 1 to 2 percent

Calcium carbonate equivalent: 5 to 10 percent

Reaction: pH 7.4 to 8.4

**C horizon**

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam or clay loam  
 Clay content: 18 to 32 percent  
 Content of rock fragments: 0 to 35 percent  
 pebbles  
 Bulk density: 1.6 to 1.8 gr/cm  
 Reaction: pH 7.4 to 8.4

## 421C—Joplin-Hillon loams, 2 to 8 percent slopes

### Setting

#### Landform:

- Joplin—Till plains
- Hillon—Till plains

#### Position on landform:

- Joplin—Back slopes and foot slopes
- Hillon—Shoulders

#### Slope:

- Joplin—2 to 8 percent
- Hillon—2 to 8 percent

Elevation: 2,750 to 3,460 feet

Mean annual precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

### Composition

#### Major Components

Joplin and similar soils: 55 percent  
 Hillon and similar soils: 40 percent

#### Minor Components

Hillon gravelly loam: 0 to 1 percent  
 Nishon and similar soils: 0 to 2 percent  
 Soils that have slopes more than 8 percent:  
 0 to 1 percent  
 Soils that have slopes less than 2 percent:  
 0 to 1 percent

### Major Component Description

#### Joplin

Surface layer texture: Loam  
 Depth class: Very deep (more than 60 inches)  
 Drainage class: Well drained  
 Dominant parent material: Till  
 Native plant cover type: Rangeland  
 Flooding: None  
 Available water capacity: 9.1 inches

#### Hillon

Surface layer texture: Loam  
 Depth class: Very deep (more than 60 inches)  
 Drainage class: Well drained

Dominant parent material: Till  
 Native plant cover type: Rangeland  
 Flooding: None  
 Available water capacity: 10.1 inches

### Kenilworth Series

Depth class: Very deep (greater than 60 inches)

Drainage class: Well drained

Permeability: Slow (0.06 to 0.2 inch/hour)

Landform: Till plains

Parent material: Eolian over till or lacustrine material

Slope range: 0 to 4 percent

Annual precipitation: 10 to 14 inches

Annual air temperature: 43 to 45 degrees F

Frost-free period: 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic  
 Argiborolls

### Typical Pedon

Kenilworth fine sandy loam, in an area of Kenilworth-Fortbenton fine sandy loams, 0 to 4 percent slopes, in cropland; 2,600 feet north and 1,000 feet east of the southwest corner of sec. 34, T. 30 N., R. 4 E.

Ap—0 to 5 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to weak very fine and fine granular; soft, very friable, nonsticky and nonplastic; neutral; abrupt smooth boundary.

Bt1—5 to 10 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

Bt2—10 to 21 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic, common distinct clay films on faces of peds; moderately alkaline; clear wavy boundary.

2Bk—21 to 31 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, sticky and slightly plastic; common fine soft masses and soft seams of lime; violently effervescent; moderately alkaline; clear wavy boundary.

2Bky—31 to 40 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common fine soft masses and soft seams of lime; common fine soft seams and nests of gypsum; violently effervescent; moderately alkaline; clear wavy boundary.

2By—40 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; common fine soft seams and nests of gypsum; slightly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches

*Depth to the 2Bk horizon:* 12 to 26 inches

#### *Ap horizon*

Value: 4 or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 5 to 18 percent

Reaction: pH 6.6 to 7.8

#### *Bt1 horizon*

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Fine sandy loam or sandy clay loam

Clay content: 15 to 25 percent and more than 45 percent fine and coarser sand

Reaction: pH 6.6 to 7.8

#### *Bt2 horizon*

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2, 3, or 4

Texture: Sandy clay loam, fine sandy loam, or loam

Clay content: 18 to 30 percent and more than 45 percent fine and coarser sand

Reaction: pH 6.6 to 7.8

Bulk density: 1.40 to 1.60

#### *2Bk horizon*

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay loam or silty clay loam

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 5 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Bulk density: Greater than 1.6

Reaction: pH 7.4 to 8.4

#### *2Bky and 2By horizons*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay loam or silty clay loam

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 5 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.9 to 9.0

### 351B—Kenilworth-Fortbenton fine sandy loams, 0 to 4 percent slopes

#### Setting

##### *Landform:*

- Kenilworth—Till plains
- Fortbenton—Till plains

##### *Position on landform:*

- Kenilworth—Foot slopes
- Fortbenton—Back slopes

##### *Slope:*

- Kenilworth—0 to 4 percent
- Fortbenton—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Kenilworth and similar soils: 60 percent

Fortbenton and similar soils: 35 percent

##### Minor Components

Soils that have slopes more than 4 percent: 0 to 1 percent

Joplin, calcareous surface: 0 to 1 percent

Telstad and similar soils: 0 to 1 percent

Chinook and similar soils: 0 to 1 percent

Assinniboine and similar soils: 0 to 1 percent

#### Major Component Description

##### Kenilworth

*Surface layer texture:* Fine sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Eolian over till or lacustrine material

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 10.5 inches

**Fortbenton**

*Surface layer texture:* Fine sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Eolian over till or lacustrine material  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**Kevin Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Till plains or hills  
*Parent material:* Glacial till  
*Slope range:* 0 to 15 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic Argiborolls

**Typical Pedon**

Kevin clay loam, in an area of Scobey-Kevin clay loams, 0 to 4 percent slopes, in cropland; 800 feet north and 600 feet west of the southeast corner of sec. 33, T. 33 N., R. 4 E.

Ap—0 to 3 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bt—3 to 8 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to strong medium subangular blocky; hard, firm, sticky and plastic; many distinct clay films on faces of peds; neutral; clear wavy boundary.

Bk1—8 to 19 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—19 to 31 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular structure; slightly

hard, friable, slightly sticky and slightly plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk3—31 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 7 to 12 inches and may include all of the Bt horizon

*Depth to the Bk horizon:* Less than 10 inches

*Ap horizon*

Hue: 10YR, 2.5Y, or 5Y

Chroma: 2 or 3

Clay content: 27 to 32 percent

Content of rock fragments: 0 to 60 percent—  
0 to 50 percent pebbles, 0 to 10 percent cobbles

Reaction: pH 6.6 to 7.8

*Bt horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 35 to 45 percent

Content of rock fragments: 0 to 15 percent

Reaction: pH 6.6 to 8.4

*Bk horizons*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 15 percent pebbles

Bulk density: 1.6 to 1.8 gram/cm

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 9.0

**442C—Kevin-Elloam clay loams, 2 to 8 percent slopes****Setting***Landform:*

- Kevin—Till plains
- Elloam—Till plains

*Position on landform:*

- Kevin—Microhighs
- Elloam—Microlows

*Slope:*

- Kevin—2 to 8 percent
  - Elloam—2 to 8 percent
- Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition**

**Major Components**

- Kevin and similar soils: 55 percent
- Elloam and similar soils: 35 percent

**Minor Components**

- Soils that have slopes more than 8 percent:  
0 to 2 percent
- Nishon and similar soils: 0 to 2 percent
- Kevin gravelly clay loam: 0 to 2 percent
- Joplin and similar soils: 0 to 2 percent
- Soils that have slopes less than 2 percent:  
0 to 2 percent

**Major Component Description**

**Kevin**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

**Elloam**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.4 inches

**441C—Kevin-Hillon clay loams, 2 to 8 percent slopes**

**Setting**

*Landform:*

- Kevin—Till plains
  - Hillon—Till plains
- Position on landform:*
- Kevin—Back slopes and foot slopes
  - Hillon—Shoulders

*Slope:*

- Kevin—2 to 8 percent
  - Hillon—2 to 8 percent
- Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition**

**Major Components**

- Kevin and similar soils: 55 percent
- Hillon and similar soils: 35 percent

**Minor Components**

- Soils that have slopes more than 8 percent:  
0 to 2 percent
- Nishon and similar soils: 0 to 2 percent
- Soils that have slopes less than 2 percent:  
0 to 2 percent
- Hillon gravelly clay loam: 0 to 2 percent
- Joplin and similar soils: 0 to 2 percent

**Major Component Description**

**Kevin**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

**Hillon**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.9 inches

**445E—Kevin-Hillon-Nishon complex, 0 to 25 percent slopes**

**Setting**

*Landform:*

- Kevin—Hills
  - Hillon—Hills
  - Nishon—Closed depressions
- Position on landform:*
- Kevin—Back slopes and foot slopes
  - Hillon—Back slopes and shoulders

*Slope:*

- Kevin—4 to 15 percent
- Hillon—15 to 25 percent
- Nishon—0 to 1 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Kevin and similar soils: 45 percent

Hillon and similar soils: 25 percent

Nishon and similar soils: 20 percent

#### **Minor Components**

Soils that have slopes more than 25 percent:  
0 to 5 percent

Hillon gravelly clay loam: 0 to 5 percent

### **Major Component Description**

#### **Kevin**

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 9.8 inches

#### **Hillon**

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 10.1 inches

#### **Nishon**

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Poorly drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Ponding:* Long

*Available water capacity:* 9.3 inches

### **Kobase Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Alluvial fans or lake plains

*Parent material:* Glaciolacustrine deposits

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic, frigid Aridic  
Ustochrepts

#### **Typical Pedon**

Kobase silty clay loam, 0 to 4 percent slopes, in cropland; 1,100 feet east and 800 feet north of the southwest corner of sec. 19, T. 34 N., R. 5 E.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; slightly effervescent; mildly alkaline; abrupt wavy boundary.

Bw—5 to 15 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; slightly effervescent; moderately alkaline; gradual wavy boundary.

Bk1—15 to 25 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure; very hard, firm, sticky and plastic; disseminated lime; strongly effervescent; strongly alkaline; diffuse wavy boundary.

Bk2—25 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; disseminated lime; strongly effervescent; strongly alkaline.

### **Range in Characteristics**

*Depth to the Bk horizon:* 12 to 17 inches

#### *Ap horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 27 to 40 percent

Content of rock fragments: 0 to 5 percent pebbles

Electrical conductivity: 0 to 2 mmhos/cm

Reaction: pH 6.6 to 8.4

#### *Bw horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 1, 2, 3, or 4

Texture: Silty clay loam, silty clay, or clay

Clay content: 35 to 45 percent

Content of rock fragments: 0 to 5 percent pebbles  
Reaction: pH 7.4 to 8.4

**Bk horizons**

Hue: 10YR, 2.5Y, or 5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 1, 2, 3, or 4  
Texture: Silty clay loam, silty clay, or clay  
Clay content: 35 to 45 percent  
Content of rock fragments: 0 to 5 percent pebbles  
Calcium carbonate equivalent: 5 to 15 percent  
Reaction: pH 7.4 to 9.0

**32B—Kobase silty clay loam, 0 to 4 percent slopes****Setting**

*Landform:* Lake plains  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Kobase and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 25 percent:  
0 to 1 percent  
McKenzie and similar soils: 0 to 1 percent  
Kobase, calcareous surface: 0 to 1 percent  
Marias and similar soils: 0 to 1 percent  
Nunemaker and similar soils: 0 to 1 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**32C—Kobase silty clay loam, 4 to 8 percent slopes****Setting**

*Landform:* Lake plains  
*Slope:* 4 to 8 percent  
*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Kobase and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
0 to 1 percent  
McKenzie and similar soils: 0 to 1 percent  
Kobase, calcareous surface: 0 to 1 percent  
Nunemaker and similar soils: 0 to 1 percent  
Soils that have slopes less than 4 percent:  
0 to 1 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**321B—Kobase silty clay loam, calcareous, 0 to 4 percent slopes****Setting**

*Landform:* Lake plains  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Kobase and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
0 to 1 percent  
McKenzie and similar soils: 0 to 1 percent  
Marias and similar soils: 0 to 1 percent  
Nunemaker and similar soils: 0 to 2 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland

*Flooding:* None  
*Available water capacity:* 9.7 inches

### **321C—Kobase silty clay loam, calcareous, 4 to 8 percent slopes**

#### **Setting**

*Landform:* Lake plains  
*Slope:* 4 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### **Composition**

##### **Major Components**

Kobase and similar soils: 95 percent

##### **Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 1 percent  
 McKenzie and similar soils: 0 to 1 percent  
 Nunemaker and similar soils: 0 to 1 percent  
 Soils that have slopes less than 4 percent:  
 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.7 inches

#### **Korchea Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Flood plains  
*Parent material:* Alluvium  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 13 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed (calcareous),  
 frigid Mollic Ustifluvents

#### **Typical Pedon**

Korchea loam, in an area of Enbar-Bigsandy-Korchea loams, 0 to 4 percent slopes, in rangeland;

1,600 feet east and 1,200 feet north of the southwest corner of sec. 17, T. 37 N., R. 5 E.

A—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

C1—6 to 13 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; mildly alkaline; clear smooth boundary.

C2—13 to 40 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—40 to 60 inches; grayish brown (2.5Y 5/2) stratified fine sandy loam and clay loam, dark grayish brown (2.5Y 4/2) moist; few fine faint olive brown (2.5Y 4/4) redox concentrations; massive; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline.

#### **Range in Characteristics**

##### *A horizon*

Hue: 10YR or 2.5Y  
 Value: 3, 4, or 5 dry; 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 18 to 27 percent  
 Reaction: pH 6.6 to 8.4

##### *C horizons*

Hue: 2.5Y or 10YR, but 5Y is in the range  
 Value: 4, 5, 6, 7 dry; 3, 4, 5, 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Loam, silt loam, silty clay loam, clay loam, fine sandy loam, sandy loam, or very fine sandy loam  
 Clay content: 18 to 35 percent  
 Reaction: pH 7.4 to 9.0

#### **Kremlin Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Alluvial fans  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic  
 Haploborolls

### Typical Pedon

Kremlin loam, 2 to 8 percent slopes, in rangeland; 3,100 feet east and 1,800 feet north of the southwest corner of sec. 12, T. 37 N., R. 6 E.

A—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bw—6 to 22 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; slightly effervescent; mildly alkaline; clear wavy boundary.

Bk—22 to 36 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

BC—36 to 60 inches; light brownish gray (2.5Y 6/2) stratified fine sandy loam and loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; strongly effervescent; strongly alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches, in some pedons it includes all or part of the Bw horizon

#### A horizon

Hue: 10YR or 2.5Y  
 Value: 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 18 to 27 percent  
 Content of rock fragments: 0 to 5 percent pebbles  
 Effervescence: None to strong  
 Reaction: pH 6.1 to 7.8

#### Bw horizon

Hue: 10YR or 2.5Y  
 Value: 4, 5, or 6 dry; 4 or 5 moist  
 Chroma: 2 or 3

Texture: Loam, silt loam, clay loam, or sandy clay loam  
 Clay content: 18 to 30 percent  
 Content of rock fragments: 0 to 5 percent pebbles  
 Reaction: pH 6.6 to 7.8

#### Bk horizon

Hue: 10YR or 2.5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Texture: Loam, silt loam, clay loam, or sandy clay loam  
 Clay content: 18 to 30 percent  
 Content of rock fragments: 0 to 5 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Effervescence: Strong or violent  
 Electrical conductivity: 0 to 2 mmhos/cm  
 Reaction: pH 7.4 to 8.4

#### BC horizon

Hue: 10YR, 2.5Y, or 5Y  
 Value: 6, 7, or 8 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Loam, silt loam, or sandy clay loam consisting of thin layers of different textures  
 Clay content: 18 to 25 percent  
 Content of rock fragments: 0 to 5 percent pebbles  
 Calcium carbonate equivalent: 3 to 12 percent  
 Effervescence: Strong or violent  
 Electrical conductivity: 0 to 4 mmhos/cm  
 Reaction: pH 7.4 to 9.0

## 98C—Kremlin loam, 2 to 8 percent slopes

### Setting

*Landform:* Alluvial fans  
*Slope:* 2 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Kremlin and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Benz and similar soils: 0 to 2 percent  
 Yamacall, calcareous surface: 0 to 2 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent  
 Kremlin clay loam: 0 to 1 percent

Kremlin, calcareous soils: 0 to 1 percent

### **Major Component Description**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 10.3 inches

### **Lambeth Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour)  
*Landform:* Hills  
*Parent material:* Glaciolacustrine deposits  
*Slope range:* 8 to 70 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-silty, mixed (calcareous),  
 frigid Aridic Ustorthents

### **Typical Pedon**

Lambeth silt loam, 8 to 25 percent slopes, in rangeland; 2,600 feet east and 500 feet south of the northwest corner of sec. 28, T. 28 N., R. 3 E.

A—0 to 4 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; gradual smooth boundary.

Bk1—4 to 11 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine soft masses of lime; strongly effervescent; mildly alkaline; gradual smooth boundary.

Bk2—11 to 40 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium soft masses of lime; violently effervescent; strongly alkaline; gradual smooth boundary.

Bky—40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine and medium soft masses of lime; common fine and medium nests of gypsum; violently effervescent; moderately alkaline.

### **Range in Characteristics**

#### *A horizon*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Clay content: 20 to 27 percent  
 Effervescence: Slight to violent  
 Reaction: pH 7.4 to 8.4

#### *Bk and Bky horizons*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Silt loam or silty clay loam with thin bands of loam, fine sandy loam, or very fine sandy loam  
 Clay content: 20 to 35 percent  
 Gypsum content: 1 to 6 percent  
 Calcium carbonate equivalent: 10 to 15 percent  
 Effervescence: Strong or violent  
 Reaction: pH 7.9 to 9.0

### **15E—Lambeth silt loam, 8 to 25 percent slopes**

#### **Setting**

*Landform:* Hills  
*Slope:* 8 to 25 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Lambeth and similar soils: 95 percent

#### **Minor Components**

Soils that have slopes more than 25 percent:  
 0 to 2 percent  
 Areas of Rock outcrop: 0 to 1 percent  
 Lambeth silty clay loam: 0 to 1 percent  
 Hillon and similar soils: 0 to 1 percent

### **Major Component Description**

*Surface layer texture:* Silt loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 11.4 inches

**15F—Lambeth silt loam, 25 to 70 percent slopes****Setting**

*Landform:* Hills  
*Slope:* 25 to 70 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Lambeth and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 70 percent:  
 0 to 1 percent  
 Areas of Rock outcrop: 0 to 1 percent  
 Sunburst and similar soils: 0 to 1 percent  
 Hillon and similar soils: 0 to 1 percent  
 Soils that have slopes less than 25 percent:  
 0 to 1 percent

**Major Component Description**

*Surface layer texture:* Silt loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 11.4 inches

**Lawther Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Alluvial fans or stream terraces  
*Parent material:* Alluvium  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic, frigid Udic  
 Haplusterts

**Typical Pedon**

Lawther clay, 0 to 4 percent slopes, in cropland; 2,200 feet west and 1,500 feet south of the northeast corner of sec. 25, T. 35 N., R. 4 E.

Ap—0 to 6 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate very fine and fine granular structure; hard, friable, sticky and plastic; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bw—6 to 19 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate fine and medium subangular blocky; very hard, firm, sticky and very plastic; slightly effervescent; moderately alkaline; gradual wavy boundary.

Bk1—19 to 31 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate medium and coarse angular blocky; very hard, firm, sticky and very plastic; common pressure faces; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—31 to 46 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium and coarse angular blocky; very hard, firm, sticky and very plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bky—46 to 60 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; many fine threads and seams of lime; common fine masses of gypsum; strongly effervescent; moderately alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 7 to more than 20 inches

*Depth to the Bk horizon:* 14 to 20 inches

*Depth to the Bky horizon:* 18 to 50 inches

**Ap horizon:**

Hue: 10YR or 2.5Y  
 Value: 3, 4, or 5 dry; 2 or 3 moist  
 Clay content: 40 to 50 percent  
 Reaction: pH 6.6 to 8.4

**Bw horizon:**

Hue: 10YR or 2.5Y  
 Value: 3, 4, or 5 dry; 2 or 3 moist  
 Texture: Clay or silty clay  
 Clay content: 40 to 60 percent  
 Reaction: pH 7.4 to 8.4  
 Other features: Some pedons lack a Bw horizon

**Bk horizons:**

Hue: 2.5Y or 5Y  
 Value: 4, 5, or 6 dry; 2, 3, 4 or 5 moist

Texture: Clay or silty clay  
 Clay content: 40 to 60 percent  
 Reaction: pH 7.4 to 9.0  
 Other features: Common pressure faces

*Bky horizon:*

Hue: 2.5Y or 5Y  
 Value: 4, 5, or 6 dry; 2, 3, 4 or 5 moist  
 Texture: Clay or silty clay  
 Clay content: 35 to 60 percent  
 Reaction: pH 7.9 to 9.0

### 54B—Lawther clay, 0 to 4 percent slopes

#### **Setting**

*Landform:* Alluvial fans and stream terraces  
*Slope:* 0 to 4 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Frost-free period:* 90 to 110 days

#### **Composition**

##### **Major Components**

Lawther and similar soils: 95 percent

##### **Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 1 percent  
 Poorly drained soils: 0 to 2 percent  
 Sagedale and similar soils: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.5 inches

### 54C—Lawther clay, 4 to 8 percent slopes

#### **Setting**

*Landform:* Alluvial fans and stream terraces  
*Slope:* 4 to 8 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Frost-free period:* 90 to 110 days

#### **Composition**

##### **Major Components**

Lawther and similar soils: 90 percent

##### **Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 3 percent  
 Sagedale and similar soils: 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.5 inches

#### **Linnet Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Lake plains  
*Parent material:* Glaciolacustrine deposits  
*Slope range:* 0 to 2 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Ustertic  
 Argiborolls

#### **Typical Pedon**

Linnet clay, 0 to 2 percent slopes, in cropland; 2,600 feet east and 1,200 feet north of the southwest corner of sec. 21, T. 30 N., R. 7 E.

Ap1—0 to 2 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 3/2) moist; moderate fine and very fine granular structure; hard, friable, sticky and plastic; neutral; abrupt smooth boundary.

Ap2—2 to 6 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 3/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; neutral; clear smooth boundary.

**Bt1**—6 to 9 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 3/2) moist; peds coated dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to strong medium subangular blocky structure; very hard, firm, sticky and plastic; continuous distinct clay films on faces of peds; neutral; clear wavy boundary.

**Bt2**—9 to 18 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; common distinct clay films on faces of peds; few shiny pressure faces; mildly alkaline; gradual wavy boundary.

**Bk**—18 to 46 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; few shiny pressure faces; common fine soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

**Bky**—46 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; common fine soft masses of lime; common fine threads of gypsum; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches

*Depth to the Bk horizon:* 12 to 18 inches

#### *Ap horizons*

Hue: 10YR or 2.5Y

Chroma: 2 or 3

Clay content: 40 to 45 percent

Content of rock fragments: 0 to 10 percent pebbles

Reaction: pH 6.1 to 7.3

#### *Bt horizons*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Clay content: 45 to 60 percent

Texture: Clay loam, silty clay loam, clay, or silty clay

Content of rock fragments: 0 to 10 percent pebbles

Reaction: pH 6.6 to 7.8

#### *Bk horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay, silty clay, or silty clay loam

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 15 percent pebbles

Calcium carbonate equivalent: 5 to 10 percent

Sodium adsorption ratio: 0 to 13

Reaction: pH 7.4 to 8.4

#### *Bky horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay, silty clay, clay loam, or silty clay loam

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 15 percent pebbles

Gypsum content: 1 to 5 percent

Sodium adsorption ratio: 2 to 13

Reaction: pH 7.9 to 9.0

### 34A—Linnet clay, 0 to 2 percent slopes

#### *Setting*

*Landform:* Lake plains

*Slope:* 0 to 2 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### *Composition*

#### **Major Components**

Linnet and similar soils: 95 percent

#### **Minor Components**

Soils that have slopes more than 2 percent: 0 to 1 percent

McKenzie and similar soils: 0 to 2 percent

Kobase and similar soils: 0 to 1 percent

Marias and similar soils: 0 to 1 percent

#### **Major Component Description**

*Surface layer texture:* Clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Glaciolacustrine deposits

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 8.7 inches

### **Lisk Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour)

*Landform:* Alluvial fans

*Parent material:* Alluvium or eolian deposits

*Slope range:* 2 to 25 percent

*Annual precipitation:* 13 to 17 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Coarse-loamy, mixed, frigid Typic Ustochrepts

### **Typical Pedon**

Lisk sandy loam, 8 to 25 percent slopes, in cropland; 2,200 feet east and 2,100 feet south of the northwest corner of sec. 25, T. 37 N., R. 5 E.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium granular structure parting to fine and very fine granular; soft, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw—5 to 14 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; soft, very friable, nonsticky and nonplastic; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—14 to 18 inches; light brownish gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—18 to 36 inches; light gray (2.5Y 7/2) sandy loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; disseminated lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C—36 to 60 inches; light brownish gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grain; loose; slightly effervescent; moderately alkaline.

### **Range in Characteristics**

*Depth to Bk horizon:* 14 to 20 inches

*Depth to 2C horizon:* 35 to 40 inches

#### *A horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 3 or 4 moist

Chroma: 2 or 3

Clay content: 5 to 18 percent

Reaction: pH 7.4 to 8.4

#### *Bw horizon*

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4, 5, or 6 moist

Chroma: 2 to 4

Texture: Sandy loam or fine sandy loam

Clay content: 5 to 18 percent

Reaction: pH 7.9 to 8.4

#### *Bk1 horizon*

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Sandy loam or fine sandy loam

Clay content: 5 to 18 percent

Calcium carbonate equivalent: 5 to 8 percent

Reaction: pH 7.9 to 8.4

#### *Bk2 horizon*

Hue: 10YR or 2.5Y

Value: 6 or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Sandy loam or fine sandy loam

Clay content: 5 to 18 percent

Calcium carbonate equivalent: 5 to 8 percent

Reaction: pH 7.9 to 8.4

#### *2C horizon*

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loamy sand or loamy fine sand

Clay content: 0 to 10 percent

Reaction: pH 7.9 to 8.4

### **39C—Lisk sandy loam, 2 to 8 percent slopes**

#### **Setting**

*Landform:* Alluvial fans

*Slope:* 2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Lisk and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent

Turner and similar soils: 0 to 2 percent

Lisk fine sandy loam: 0 to 2 percent

Soils that have slopes less than 2 percent:  
0 to 2 percent

Tinsley and similar soils: 0 to 2 percent

#### Major Component Description

*Surface layer texture:* Sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium or eolian material

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 6.4 inches

### 39E—Lisk sandy loam, 8 to 25 percent slopes

#### Setting

*Landform:* Alluvial fans

*Slope:* 8 to 25 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

#### Composition

#### Major Components

Lisk and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 25 percent:  
0 to 2 percent

Turner and similar soils: 0 to 2 percent

Lisk fine sandy loam: 0 to 2 percent

Soils that have slopes less than 8 percent:  
0 to 2 percent

Tinsley and similar soils: 0 to 2 percent

#### Major Component Description

*Surface layer texture:* Sandy loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium or eolian material

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 6.4 inches

### Lonna Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Alluvial fans

*Parent material:* Alluvium

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-silty, mixed, frigid Aridic Ustochrepts

#### Typical Pedon

Lonna silty clay loam, 0 to 4 percent slopes, in cropland; 2,100 feet west and 600 feet south of the northeast corner of sec. 27, T. 33 N., R. 5 E.

Ap—0 to 6 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure parting to moderate very fine and fine granular; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; abrupt smooth boundary.

Bw—6 to 12 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; clear smooth boundary.

Bk1—12 to 29 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; disseminated and few fine soft filaments of lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—29 to 36 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; disseminated and few fine soft filaments of lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk3—36 to 48 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; moderate medium and coarse subangular blocky structure parting to weak thin and medium platy;

slightly hard, very friable, slightly sticky and slightly plastic; disseminated and few fine soft filaments of lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

BC—48 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; weak fine and medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline.

#### Range in Characteristics

##### *Ap horizon*

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 3, 4 or 5 moist  
Chroma: 2, 3, or 4  
Clay content: 27 to 35 percent  
Reaction: pH 7.4 to 8.4

##### *Bw horizon*

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 4 or 5 moist  
Chroma: 2, 3, or 4  
Texture: Silt loam or silty clay loam  
Clay content: 18 to 35 percent  
Effervescence: Slight or strong  
Reaction: pH 7.4 to 8.4

##### *Bk horizon*

Hue: 10YR or 2.5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Silt loam or silty clay loam  
Clay content: 18 to 35 percent  
Calcium carbonate equivalent: 5 to 15 percent  
Electrical conductivity: 0 to 8 mmhos/cm  
Sodium adsorption ratio: 0 to 13  
Effervescence: Strong or violent  
Reaction: pH 7.9 to 9.0

##### *BC horizon*

Hue: 10YR or 2.5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 2, 3, or 4  
Texture: Very fine sandy loam, loam, silt loam, or silty clay loam (may be stratified)  
Clay content: 10 to 35 percent  
Electrical conductivity: 2 to 16 mmhos/cm  
Sodium adsorption ratio: 10 to 30  
Effervescence: Strong or violent  
Reaction: pH 7.9 to 9.0

### 58B—Lonna silty clay loam, 0 to 4 percent slopes

#### Setting

*Landform:* Alluvial fans  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Lonna and similar soils: 95 percent

##### Minor Components

Soils that have slopes more than 4 percent:  
0 to 1 percent  
McKenzie and similar soils: 0 to 1 percent  
Lonna silt loam: 0 to 2 percent  
Lonna, calcareous soils: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

### 58C—Lonna silty clay loam, 4 to 8 percent slopes

#### Setting

*Landform:* Alluvial fans  
*Slope:* 4 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Lonna and similar soils: 95 percent

##### Minor Components

Soils that have slopes more than 8 percent:  
0 to 1 percent

Lonna silt loam: 0 to 2 percent  
 Soils that have slopes less than 4 percent:  
 0 to 1 percent  
 Lonna, calcareous soils: 0 to 1 percent

### **Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

### **Marias Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Lake plains  
*Parent material:* Glaciolacustrine deposits  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic, frigid  
 Chromic Udic Haplusterts

### **Typical Pedon**

Marias silty clay, 0 to 4 percent slopes, in cropland; 1,800 feet east and 700 feet south of the northwest corner of sec. 10, T. 28 N., R. 5 E.

- Ap1—0 to 2 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; slightly hard, very friable, sticky and plastic; strongly effervescent; moderately alkaline; clear smooth boundary.
- Ap2—2 to 7 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; strongly effervescent; moderately alkaline; gradual smooth boundary.
- Bss1—7 to 16 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse angular blocky structure parting to moderate fine and medium angular blocky; very hard, very firm, sticky and very plastic; few slickensides intersecting at 45 degree angles from

- horizontal; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bss2—16 to 28 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse angular blocky structure parting to moderate medium angular blocky; very hard, very firm, sticky and very plastic; common slickensides intersecting at 45 degree angles from horizontal; strongly effervescent; strongly alkaline; gradual smooth boundary.
- Bky1—28 to 38 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common pressure faces along vertical cracks; disseminated lime; few medium soft masses and soft seams of gypsum; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bky2—38 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; disseminated lime; common medium soft filaments, soft masses, and soft seams of gypsum; strongly effervescent; moderately alkaline.

### **Range in Characteristics**

*Depth to the Bky horizon:* 20 to 45 inches

#### *Ap horizons*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 4, 5, or 6 dry; 3, 4, or 5 moist  
 Chroma: 1, 2, or 3  
 Clay content: 40 to 60 percent  
 Electrical conductivity: 0 to 4 mmhos/cm  
 Sodium adsorption ratio: 1 to 4  
 Reaction: pH 7.4 to 8.4.

#### *Bss horizons*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Texture: Clay or silty clay  
 Clay content: 40 to 60 percent clay  
 Slickensides: Common or many  
 Electrical conductivity: 2 to 4  
 Sodium adsorption ratio: 1 to 4  
 Reaction: pH 7.9 to 9.0

#### *Bky horizons*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 3, 4, or 5 moist  
 Chroma: 1, 2, or 3  
 Texture: Clay or silty clay  
 Clay content: 40 to 60 percent  
 Gypsum content: 1 to 6 percent  
 Electrical conductivity: 2 to 4 mmhos/cm above a depth of 30 inches and 2 to 8 mmhos/cm below  
 Sodium adsorption ratio: 1 to 4 above 30 inches and 4 to 13 below  
 Reaction: pH 7.9 to 9.0

### 47B—Marias silty clay, 0 to 4 percent slopes

#### **Setting**

*Landform:* Lake plains  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### **Composition**

##### **Major Components**

Marias and similar soils: 95 percent

##### **Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 1 percent  
 McKenzie and similar soils: 0 to 2 percent  
 Linnet clay: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.5 inches

### 471B—Marias-Kobase complex, 0 to 4 percent slopes

#### **Setting**

*Landform:*

- Marias—Lake plains
- Kobase—Lake plains

*Position on landform:*

- Marias—Foot slopes and toe slopes
- Kobase—Foot slopes and toe slopes

#### **Slope:**

- Marias—0 to 4 percent
  - Kobase—0 to 4 percent
- Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### **Composition**

##### **Major Components**

Marias and similar soils: 50 percent  
 Kobase and similar soils: 40 percent

##### **Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 2 percent  
 McKenzie and similar soils: 0 to 3 percent  
 Linnet clay: 0 to 2 percent  
 Nunemaker and similar soils: 0 to 3 percent

#### **Major Component Description**

##### **Marias**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.5 inches

##### **Kobase**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciolacustrine deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.7 inches

#### **Marmarth Series**

*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Sedimentary plains or till plains  
*Parent material:* Residuum weathered from semiconsolidated sandstone or in glacial till deposited over these soft sedimentary beds  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic  
Argiborolls

### Typical Pedon

Marmarth loam, 0 to 4 percent slopes, in cropland; 2,000 feet south and 2,000 feet east of the northwest corner of sec. 4, T. 37 N., R. 7 E.

- Ap—0 to 6 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.
- Bt—6 to 11 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure; hard, friable, sticky and plastic; many distinct clay films on faces of peds; neutral; clear wavy boundary.
- Bk1—11 to 15 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; slightly effervescent; mildly alkaline; clear wavy boundary.
- Bk2—15 to 22 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Cr—22 to 60 inches; gray (5Y 6/1) semiconsolidated sandstone, dark gray (5Y 5/1) moist.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 16 inches and may include all or part of the Bt horizon

*Depth to the Cr horizon:* 20 to 40 inches

#### Ap horizon

Hue: 10YR  
Chroma: 2 or 3  
Clay content: 20 to 27 percent  
Reaction: pH 6.1 to 7.3

#### Bt horizon

Hue: 10YR or 2.5Y  
Value: 3, 4, 5, or 6 moist  
Chroma: 2 to 4  
Texture: Loam, clay loam, or sandy clay loam  
Clay content: 18 to 35 percent  
Reaction: pH 6.1 to 7.8

#### Bk horizons

Hue: 2.5Y or 5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 to 4  
Texture: Loam, fine sandy loam, or clay loam  
Clay content: 15 to 30 percent  
Reaction: pH 7.4 to 8.4

## 43B—Marmarth loam, 0 to 4 percent slopes

### Setting

*Landform:* Sedimentary plains  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Marmarth and similar soils: 85 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
0 to 3 percent  
Cabbart and similar soils: 0 to 3 percent  
Twilight sandy loam: 0 to 3 percent  
Busby and similar soils: 0 to 3 percent  
Scobey clay loam: 0 to 3 percent

### Major Component Description

*Surface layer texture:* Loam  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Sandstone residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 3.8 inches

### Marvan Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Lake plains, alluvial fans, or till plains  
*Parent material:* Alluvium or glaciolacustrine deposits  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic, frigid  
Sodic Haplusterts

**Typical Pedon**

Marvan silty clay, 0 to 4 percent slopes, in cropland; 600 feet south and 1,200 feet west of the northeast corner of sec. 21, T. 29 N., R. 4 E.

Ap1—0 to 1 inch; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium granular structure; hard, friable, very sticky and very plastic; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Ap2—1 to 4 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium subangular blocky structure; very hard, firm, very sticky and very plastic; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw—4 to 11 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium subangular blocky structure; extremely hard, firm, very sticky and very plastic; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bssky—11 to 25 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium subangular blocky structure; extremely hard, firm, very sticky and very plastic; few slickensides along vertical cracks; common fine and medium soft masses of lime; common fine and medium soft masses of gypsum; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bkyz—25 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, firm, very sticky and very plastic; many fine and medium soft masses of lime; many fine and medium soft masses and nests of gypsum and other salts; strongly effervescent; moderately alkaline.

**Range in Characteristics**

*Depth to the Bssky horizon:* 10 to 24 inches

*Soil phases:* Saline and calcareous

**Ap horizons**

Hue: 2.5Y or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay or silty clay

Clay content: 40 to 60 percent

Electrical conductivity: 0 to 8 mmhos/cm, saline phase is 2 to 8 mmhos/cm

Sodium adsorption ratio: 0 to 18 (Where the SAR is 8 or less, the sodium plus magnesium is greater than calcium plus acidity)

Reaction: pH 7.4 to 9.0

**Bw horizon**

Hue: 2.5Y or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay or silty clay

Clay content: 45 to 60 percent

Electrical conductivity: 2 to 8 mmhos/cm

Sodium adsorption ratio: 4 to 38 (Where the SAR is below 8, the sodium plus magnesium is greater than calcium plus acidity)

Reaction: pH 7.9 to 9.0

**Bssky horizon**

Hue: 2.5Y or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay or silty clay

Clay content: 45 to 60 percent

Gypsum content: 1 to 5 percent

Electrical conductivity: 2 to 16 mmhos/cm

Sodium adsorption ratio: 8 to 18 above a depth of 24 inches and 13 to 38 below that depth (Where the SAR is below 8, the sodium plus magnesium is greater than calcium plus acidity)

Reaction: pH 7.9 to 9.0

**Bkyz horizon**

Hue: 2.5 or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay or silty clay that includes thin layers of silty clay loam and silt loam material

Clay content: 45 to 60 percent

Gypsum content: 1 to 5 percent

Electrical conductivity: 8 to 16 mmhos/cm

Sodium adsorption ratio: 13 to 38

Reaction: pH 7.9 to 9.0

**302B—Marvan clay, 0 to 4 percent slopes****Setting**

*Landform:* Lake plains

*Slope:* 0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Marvan and similar soils: 95 percent

#### **Minor Components**

Soils that have slopes more than 4 percent:  
0 to 1 percent

McKenzie and similar soils: 0 to 1 percent

Marvan silty clay loam: 0 to 1 percent

Marias and similar soils: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Glaciolacustrine deposits

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 6.7 inches

### **30B—Marvan silty clay, 0 to 4 percent slopes**

#### **Setting**

*Landform:* Lake plains

*Slope:* 0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Marvan and similar soils: 95 percent

#### **Minor Components**

Soils that have slopes more than 4 percent:  
0 to 1 percent

McKenzie and similar soils: 0 to 1 percent

Marvan clay: 0 to 1 percent

Marias and similar soils: 0 to 2 percent

#### **Major Component Description**

*Surface layer texture:* Silty clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Glaciolacustrine deposits

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 6.7 inches

### **30C—Marvan silty clay, 4 to 8 percent slopes**

#### **Setting**

*Landform:* Lake plains

*Slope:* 4 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Marvan and similar soils: 95 percent

#### **Minor Components**

Soils that have slopes more than 8 percent:  
0 to 2 percent

McKenzie and similar soils: 0 to 1 percent

Marias and similar soils: 0 to 1 percent

Soils that have slopes less than 4 percent:  
0 to 1 percent

#### **Major Component Description**

*Surface layer texture:* Silty clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Glaciolacustrine deposits

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 6.7 inches

### **304B—Marvan-Joplin complex, 0 to 4 percent slopes**

#### **Setting**

*Landform:*

- Marvan—Till plains
- Joplin—Till plains

*Position on landform:*

- Marvan—Microlows
- Joplin—Microhighs

*Slope:*

- Marvan—0 to 4 percent
- Joplin—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet*Mean annual precipitation:* 10 to 14 inches*Frost-free period:* 105 to 120 days**Composition****Major Components**

Marvan and similar soils: 50 percent  
 Joplin and similar soils: 40 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 Wiengart and similar soils: 0 to 3 percent  
 Absher and similar soils: 0 to 2 percent  
 Elloam and similar soils: 0 to 2 percent

**Major Component Description****Marvan**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.3 inches

**Joplin**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.1 inches

**301C—Marvan-Vanda complex, 2 to 8 percent slopes****Setting***Landform:*

- Marvan—Alluvial fans
- Vanda—Alluvial fans

*Position on landform:*

- Marvan—Foot slopes
- Vanda—Foot slopes

*Slope:*

- Marvan—2 to 8 percent
- Vanda—2 to 8 percent

*Elevation:* 2,750 to 3,460 feet*Mean annual precipitation:* 10 to 14 inches*Frost-free period:* 105 to 120 days**Composition****Major Components**

Marvan and similar soils: 65 percent  
 Vanda and similar soils: 30 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 McKenzie and similar soils: 0 to 1 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent

**Major Component Description****Marvan**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.7 inches

**Vanda**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.0 inches

**306D—Marvan-Yawdim-Cabbart complex, 4 to 15 percent slopes****Setting***Landform:*

- Marvan—Alluvial fans
- Yawdim—Hills

- Cabbart—Hills
- Position on landform:*
- Marvan—Foot slopes
  - Yawdim—Back slopes and shoulders
  - Cabbart—Back slopes and shoulders
- Slope:*
- Marvan—4 to 8 percent
  - Yawdim—4 to 15 percent
  - Cabbart—4 to 15 percent
- Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Marvan and similar soils: 45 percent  
 Yawdim and similar soils: 25 percent  
 Cabbart and similar soils: 20 percent

#### **Minor Components**

Soils that have slopes more than 15 percent:  
 0 to 2 percent  
 Benz and similar soils: 0 to 2 percent  
 Areas of Rock outcrop: 0 to 2 percent  
 Soils that have slopes less than 4 percent:  
 0 to 2 percent  
 Lambeth silt loam: 0 to 2 percent

### **Major Component Description**

#### **Marvan**

*Surface layer texture:* Clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Salt affected:* Saline within 30 inches  
*Sodium affected:* Sodic within 30 inches  
*Available water capacity:* 6.3 inches

#### **Yawdim**

*Surface layer texture:* Silty clay  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.0 inches

#### **Cabbart**

*Surface layer texture:* Loam  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained

*Dominant parent material:* Sandstone residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.1 inches

### **McKenzie Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Poorly drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Closed depressions  
*Parent material:* Glaciolacustrine deposits  
*Slope range:* 0 to 1 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic, frigid  
 Chromic Endoaquerts

#### **Typical Pedon**

McKenzie clay, 0 to 1 percent slope, in cropland;  
 250 feet due east of the southwest corner of sec. 12,  
 T. 29 N., R. 7 E.

Ap1—0 to 1 inch; light gray (5Y 6/1) clay, gray (5Y 5/1)  
 moist; strong fine and medium granular structure;  
 hard, firm, very sticky and very plastic; strongly  
 effervescent with disseminated lime; mildly  
 alkaline; clear smooth boundary.

Ap2—1 to 6 inches; light gray (5Y 6/1) clay, gray  
 (5Y 5/1) moist; strong coarse subangular blocky  
 structure parting to moderate fine and medium  
 angular blocky; very hard, firm, very sticky and  
 very plastic; strongly effervescent with  
 disseminated lime; mildly alkaline; clear wavy  
 boundary.

Bw1—6 to 11 inches; gray (5Y 5/1) clay, dark gray  
 (5Y 4/1) moist; common fine faint light olive gray  
 (5Y 6/2) redox depletions; moderate medium  
 prismatic structure parting to strong fine and  
 medium subangular blocky; extremely hard, very  
 firm, very sticky and very plastic; disseminated  
 lime; strongly effervescent; moderately alkaline;  
 gradual wavy boundary.

Bw2—11 to 27 inches; gray (5Y 5/1) clay, dark gray  
 (5Y 4/1) moist common fine faint light olive gray  
 (5Y 6/2) redox depletions; moderate medium  
 prismatic structure parting to moderate fine and  
 medium subangular blocky; extremely hard, very  
 firm, very sticky and very plastic; few pressure  
 faces; disseminated lime; strongly effervescent;  
 moderately alkaline; gradual wavy boundary.

Bk1—27 to 40 inches; light gray (5Y 6/1) clay, gray  
 (5Y 5/1) moist common fine faint light olive gray

(5Y 6/2) redox depletions; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, very sticky and very plastic; few pressure faces; few fine soft masses of lime; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bk2—40 to 60 inches; light gray (5Y 6/1) clay, gray (5Y 5/1) moist; common fine faint light olive gray (5Y 6/2) redox depletions; massive; extremely hard, very firm, very sticky and very plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Depth to seasonal high water table:* 6 to 12 inches

#### Ap horizons

Hue: 5Y, 2.5Y, or 10YR

Value: 4, 5 moist; 4, 5, 6 dry

Chroma: 1 or 2

Clay content: 40 to 60 percent

Electrical conductivity: 2 to 8 mmhos/cm

Reaction: pH 6.6 to 7.4

Other features: The upper 1/16- to 1-inch is commonly a light gray vesicular crust

#### Bw horizons

Hue: 2.5Y or 5Y

Value: 4 or 5 moist; 5 or 6 dry

Chroma: 1 or 2

Texture: Clay or silty clay

Clay content: 40 to 60 percent

Electrical conductivity: 2 to 8 mmhos/cm

Reaction: pH 7.9 to 9.0

#### Bk horizons

Hue: 2.5Y or 5Y

Value: 4, 5, 6 moist; 5, 6, 7 dry

Chroma: 1, 2, or 3

Texture: Clay or silty clay

Clay content: 40 to 60 percent

Electrical conductivity: 2 to 16 mmhos/cm

Gypsum: 1 to 5 percent

Reaction: pH 7.9 to 9.0

### 5A—McKenzie clay, 0 to 1 percent slope

#### Setting

*Landform:* Closed depressions

*Slope:* 0 to 1 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

McKenzie and similar soils: 95 percent

##### Minor Components

Soils that have slopes more than 1 percent:  
0 to 2 percent

Nishon and similar soils: 0 to 2 percent

McKenzie, saline soils: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Clay

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Poorly drained

*Dominant parent material:* Glaciolacustrine deposits

*Native plant cover type:* Rangeland

*Flooding:* None

*Ponding:* Long

*Salt affected:* Saline within 30 inches

*Available water capacity:* 9.0 inches

### M-W—Miscellaneous Water

#### Composition

##### Major Components

Miscellaneous water: 100 percent

#### Major Component Description

*Definition:* Areas of open water in sewage lagoons, industrial waste pits, fish hatcheries, etc.

### Nesda Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour) to 11 inches; rapid below this depth (6.0 to 20.0 inches/hour)

*Landform:* Stream channels or flood plains

*Parent material:* Alluvium

*Slope range:* 0 to 4 percent

*Annual precipitation:* 13 to 19 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Sandy-skeletal, mixed Fluventic Haploborolls

**Typical Pedon**

Nesda loam, in an area of Enbar-Nesda loams, 0 to 4 percent slopes, in rangeland; 1,000 feet west and 2,300 feet north of the southeast corner of sec. 12, T. 35 N., R. 4 E.

- A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, nonsticky and nonplastic; neutral; clear wavy boundary.
- A2—5 to 11 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; 15 percent pebbles; mildly alkaline; clear wavy boundary.
- 2C1—11 to 22 inches; grayish brown (10YR 5/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose; 45 percent pebbles, 5 percent cobbles; mildly alkaline; gradual wavy boundary.
- 2C2—22 to 60 inches; grayish brown (10YR 5/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose; 45 percent pebbles, 10 percent cobbles; mildly alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 10 to 16 inches

*Depth to the 2C horizon:* 10 to 20 inches

**A1 and A2 horizons**

Hue: 10YR, 2.5Y, or 5Y

Value: 3, 4, or 5 dry; 2 or 3 moist

Chroma: 1, 2, or 3

Texture: Loam or sandy loam

Clay content: 10 to 20 percent

Content of rock fragments: 0 to 65 percent—  
0 to 15 percent stones and cobbles, 0 to 50 percent pebbles

Reaction: pH 6.6 to 7.8

**2C1 and 2C2 horizons**

Hue: 10YR, 2.5Y, or 5Y

Value: 4, 5, 6, or 7 dry; 3, 4, or 5 moist

Chroma: 1, 2, 3, or 4

Texture: Sand or loamy sand

Clay content: 0 to 10 percent

Content of rock fragments: 35 to 80 percent—  
0 to 15 percent stones and cobbles, 35 to 65 percent pebbles

Reaction: pH 7.4 to 8.4

**Nishon Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Poorly drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Closed depressions

*Parent material:* Alluvium derived from adjacent glacial till

*Slope range:* 0 to 1 percent

*Annual precipitation:* 10 to 19 inches

*Annual air temperature:* 41 to 45 degrees F

*Frost-free period:* 90 to 120 days

**Taxonomic class:** Fine, montmorillonitic, frigid Typic Albaqualfs

**Typical Pedon**

Nishon clay loam, 0 to 1 percent slope, in cropland; 2,000 feet east and 1,000 feet south of the northwest corner of sec. 25, T. 28 N., R. 3 E.

- Ap—0 to 4 inches; gray (2.5Y 5/1) clay loam, dark gray (2.5Y 4/1) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.
- Bt1—4 to 10 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; moderate fine and medium prismatic structure parting to moderate fine subangular blocky; very hard, very firm, very sticky and very plastic; common distinct clay films on faces of peds; neutral; clear smooth boundary.
- Bt2—10 to 16 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and very plastic; common distinct clay films on faces of peds; mildly alkaline; gradual smooth boundary.
- C1—16 to 38 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; massive; very hard, firm, very sticky and very plastic; slightly effervescent; mildly alkaline; gradual smooth boundary.
- C2—38 to 60 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; massive; very hard, firm, very sticky and very plastic; slightly effervescent; moderately alkaline.

**Range in Characteristics**

*Depth to seasonal water table:* Ponded to 36 inches

**Ap horizon**

Hue: 2.5Y or 10YR

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 1 or 2

Redoximorphic features: Few to common (10YR 5/3, 4/3)  
Clay content: 27 to 35 percent  
Reaction: pH 6.1 to 7.8

#### *Bt horizons*

Hue: 10YR, 2.5Y, or 5Y  
Value: 4, 5, or 6 dry; 3 or 4 moist  
Chroma: 0, 1, or 2  
Redoximorphic features: Few to common (10YR 5/3, 4/3, or 2.5Y 5/2, 5/3)  
Texture: Clay or silty clay  
Clay content: 40 to 60 percent  
Reaction: pH 6.6 to 9.0  
Other features: the B3cs horizon is clay loam, clay, or silty clay

#### *C horizons*

Hue: 2.5Y or 5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 0, 1, 2, or 3  
Redoximorphic features: Few to common (10YR 4/4, 6/4 moist)  
Texture: Clay loam, clay, or silty clay  
Clay content: 35 to 55 percent  
Calcium carbonate equivalent: 1 to 15 percent  
Reaction: 7.4 to 9.0

## **28A—Nishon clay loam, 0 to 1 percent slope**

### ***Setting***

*Landform:* Closed depressions  
*Slope:* 0 to 1 percent  
*Elevation:* 2,750 to 5,200 feet  
*Mean annual precipitation:* 10 to 19 inches  
*Frost-free period:* 90 to 120 days

### ***Composition***

#### **Major Components**

Nishon and similar soils: 90 percent

#### **Minor Components**

Soils that have slopes more than 1 percent:  
0 to 3 percent  
Absher and similar soils: 0 to 4 percent  
McKenzie and similar soils: 0 to 3 percent

### ***Major Component Description***

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Poorly drained  
*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland  
*Flooding:* None  
*Ponding:* Long  
*Available water capacity:* 9.3 inches

## ***Nunemaker Series***

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Till plains  
*Parent material:* Glaciofluvial deposits  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic, frigid  
Aridic Ustochrepts

### **Typical Pedon**

Nunemaker silty clay loam, 0 to 4 percent slopes, in cropland; 1,800 feet east and 1,700 feet south of the northwest corner of sec. 2, T. 28 N., R. 5 E.

Ap1—0 to 2 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate very fine granular structure; slightly hard, friable, sticky and plastic; strongly effervescent; mildly alkaline; clear smooth boundary.

Ap2—2 to 6 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure parting to moderate fine and very fine granular; hard, firm, sticky and plastic; strongly effervescent; mildly alkaline; clear smooth boundary.

Bw—6 to 12 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—12 to 19 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few fine soft masses of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—19 to 29 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; hard, firm, sticky and plastic; common fine soft masses of lime; strongly

effervescent; moderately alkaline; gradual wavy boundary.

**Bky**—29 to 40 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; common fine and medium soft masses of lime; few fine and medium soft masses and threads of gypsum; strongly effervescent; moderately alkaline; gradual wavy boundary.

**By**—40 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; few fine soft masses and threads of gypsum; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Depth to the Bk horizon:* 10 to 16 inches

*Soil phases:* Calcareous

#### *Ap horizons*

Hue: 10YR or 2.5Y

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3

Clay content: 35 to 40 percent

Content of rock fragments: 0 to 5 percent pebbles

Reaction: pH 6.6 to 8.4

#### *Bw horizon*

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Silty clay loam, clay, or silty clay

Clay content: 35 to 55 percent

Content of rock fragments: 0 to 5 percent pebbles

Reaction: pH 6.6 to 8.4

#### *Bk horizons*

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay loam, silty clay loam, clay, or silty clay

Clay content: 35 to 55 percent

Content of rock fragments: 0 to 10 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Electrical conductivity: 2 to 4 mmhos/cm

Reaction: pH 7.4 to 8.4

#### *Bky and By horizons*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay or clay loam (below 40 inches textures include sandy clay loam and loam)

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 20 percent pebbles

Calcium carbonate equivalent: 5 to 10 percent

Electrical conductivity: 2 to 4 mmhos/cm

Reaction: pH 7.4 to 8.4

### 63B—Nunemaker silty clay loam, 0 to 4 percent slopes

#### Setting

*Landform:* Till plains

*Slope:* 0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Nunemaker and similar soils: 95 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
0 to 1 percent

McKenzie and similar soils: 0 to 1 percent

Nunemaker, calcareous surface: 0 to 1 percent

Kobase clay loam: 0 to 1 percent

Marias silty clay: 0 to 1 percent

#### Major Component Description

*Surface layer texture:* Silty clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Glaciofluvial deposits

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 8.3 inches

### 63C—Nunemaker silty clay loam, 4 to 8 percent slopes

#### Setting

*Landform:* Till plains

*Slope:* 4 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Nunemaker and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 8 percent: 0 to 1 percent  
 McKenzie and similar soils: 0 to 1 percent  
 Nunemaker, calcareous surface: 0 to 1 percent  
 Soils that have slopes less than 4 percent: 0 to 1 percent  
 Marias and similar soils: 0 to 1 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciofluvial deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.3 inches

**631B—Nunemaker silty clay loam, calcareous, 0 to 4 percent slopes****Setting**

*Landform:* Till plains  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Nunemaker and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 4 percent: 0 to 1 percent  
 McKenzie and similar soils: 0 to 1 percent  
 Kobase clay loam: 0 to 1 percent  
 Marias silty clay: 0 to 2 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciofluvial deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.2 inches

**631C—Nunemaker silty clay loam, calcareous, 4 to 8 percent slopes****Setting**

*Landform:* Till plains  
*Slope:* 4 to 8 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

**Composition****Major Components**

Nunemaker and similar soils: 95 percent

**Minor Components**

Soils that have slopes more than 8 percent: 0 to 1 percent  
 McKenzie and similar soils: 0 to 1 percent  
 Marias silty clay: 0 to 1 percent  
 Kobase clay loam: 0 to 1 percent  
 Soils that have slopes less than 4 percent: 0 to 1 percent

**Major Component Description**

*Surface layer texture:* Silty clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Glaciofluvial deposits  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.2 inches

**Perma Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Somewhat excessively drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour) to 37 inches; moderately rapid below this depth (2.0 to 6.0 inches/hour)  
*Landform:* Mountains  
*Parent material:* Colluvium or slope alluvium  
*Slope range:* 2 to 70 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Loamy-skeletal, mixed Typic Haploborolls

**Typical Pedon**

Perma gravelly loam, in an area of Perma-Whitlash gravelly loams, 25 to 70 percent slopes, in rangeland; 2,300 feet east and 2,700 feet south of the northwest corner of sec. 13, T. 36 N., R. 4 E.

- A1—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and very fine granular structure; soft, very friable, slightly sticky and slightly plastic; 20 percent pebbles; neutral; clear smooth boundary.
- A2—6 to 11 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure, parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; 25 percent pebbles, 5 percent cobbles; neutral; gradual wavy boundary.
- Bw1—11 to 26 inches; brown (10YR 5/3) very gravelly loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 30 percent pebbles, 10 percent cobbles; neutral; gradual wavy boundary.
- Bw2—26 to 37 inches; brown (10YR 5/3) very gravelly loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 30 percent pebbles, 20 percent cobbles; neutral; gradual wavy boundary.
- BC—37 to 60 inches; pale brown (10YR 6/3) extremely gravelly sandy loam, brown (10YR 5/3) moist; single grain; loose, nonsticky and nonplastic; 50 percent pebbles, 15 percent cobbles; neutral.

**Range in Characteristics**

*Mollic epipedon thickness:* 10 to 15 inches

**A horizons**

Value: 4 or 5 dry, 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 7 to 20 percent  
 Content of rock fragments: 15 to 60 percent—  
 0 to 30 percent cobbles, stones, and boulders;  
 10 to 50 percent pebbles  
 Reaction: pH 6.6 to 7.3

**Bw horizons**

Hue: 10YR or 7.5YR  
 Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loam or sandy loam

Clay content: 7 to 20 percent

Content of rock fragments: 35 to 85 percent—  
 0 to 50 percent cobbles and stones, 25 to 65  
 percent pebbles

Reaction: pH 6.6 to 7.8

**BC horizon**

Hue: 10YR or 7.5YR

Value: 6 or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loam, loamy sand, or sandy loam

Clay content: 0 to 15 percent

Content of rock fragments: 60 to 85 percent—  
 10 to 50 percent cobbles and stones, 50 to 65  
 percent pebbles

Reaction: pH 6.6 to 7.8

**88C—Perma gravelly loam, 2 to 8 percent slopes****Setting**

*Landform:* Mountains

*Slope:* 2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Perma and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 8 percent:

0 to 2 percent

Roy gravelly clay loam: 0 to 2 percent

Soils that have slopes less than 2 percent:

0 to 2 percent

Farnuf and similar soils: 0 to 2 percent

Whitlash cobbly loam: 0 to 2 percent

**Major Component Description**

*Surface layer texture:* Gravelly loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Somewhat excessively drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.4 inches

## 88E—Perma gravelly loam, 8 to 25 percent slopes

### Setting

*Landform:* Mountains

*Slope:* 8 to 25 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Perma and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 25 percent:  
0 to 2 percent

Roy gravelly clay loam: 0 to 2 percent

Soils that have slopes less than 8 percent:  
0 to 2 percent

Farnuf and similar soils: 0 to 2 percent

Whitlash cobbly loam: 0 to 2 percent

### Major Component Description

*Surface layer texture:* Gravelly loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Somewhat excessively drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.4 inches

## 882F—Perma-Whitlash gravelly loams, 25 to 70 percent slopes

### Setting

*Landform:*

- Perma—Mountains
- Whitlash—Mountains

*Position on landform:*

- Perma—Back slopes and foot slopes
- Whitlash—Shoulders and summits

*Slope:*

- Perma—25 to 70 percent
- Whitlash—25 to 70 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

## Composition

### Major Components

Perma and similar soils: 60 percent

Whitlash and similar soils: 30 percent

### Minor Components

Soils that have slopes less than 25 percent:  
0 to 2 percent

Soils that have slopes more than 70 percent:  
0 to 2 percent

Moderately deep soils: 0 to 2 percent

Whitlash cobbly loam: 0 to 2 percent

Areas of Rock outcrop: 0 to 2 percent

### Major Component Description

#### Perma

*Surface layer texture:* Gravelly loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Somewhat excessively drained

*Dominant parent material:* Colluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.4 inches

#### Whitlash

*Surface layer texture:* Gravelly loam

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Colluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 1.7 inches

### Phillips Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 0 to 4 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic  
Eutroboralfs

### Typical Pedon

Phillips loam, in an area of Phillips-Elloam complex, 0 to 4 percent slopes, in rangeland; 1,000 feet north

and 10 feet west of the southeast corner of sec. 21,  
T. 28 N., R. 6 E.

A—0 to 2 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

E—2 to 7 inches: light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak thin platy; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt wavy boundary.

Bt—7 to 10 inches: brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong fine and medium prismatic structure parting to strong medium subangular blocky; very hard, friable, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear smooth boundary.

Btk—10 to 16 inches: light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky and plastic; common distinct clay films on faces of peds; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—16 to 30 inches: light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; common fine threads of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—30 to 50 inches: light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, slightly sticky and slightly plastic; common fine soft masses and threads of lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bky—50 to 60 inches: light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, slightly sticky and slightly plastic; with few fine threads of lime; common fine soft masses and threads of gypsum; strongly effervescent; mildly alkaline.

#### Range in Characteristics

Depth to the Bk horizon: 12 to 20 inches

#### A horizon

Hue: 10YR or 2.5Y

Value: 5 dry; 3 or 4 moist

Chroma: 2 or 3

Clay content: 15 to 27 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Reaction: pH 6.1 to 7.3

#### E horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Loam or sandy loam

Clay content: 10 to 27 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Reaction: pH 6.1 to 7.3

Other features: Some pedons have an E/B horizon

#### Bt horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 35 to 45 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Electrical conductivity: 0 to 2 mmhos/cm

Reaction: pH 6.6 to 8.4

#### Btk and Bk horizons

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loam or clay loam

Clay content: 25 to 40 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Electrical conductivity: 2 to 4 mmhos/cm

Calcium carbonate equivalent: 5 to 15 percent

Sodium adsorption ratio: 0 to 13

Reaction: pH 7.4 to 9.0

#### Bky horizon

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loam or clay loam

Clay content: 20 to 40 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Electrical conductivity: 4 to 8 mmhos/cm

Gypsum: 1 to 3 percent

Calcium carbonate equivalent: 5 to 10 percent

Sodium adsorption ratio: 0 to 13

Reaction: pH 7.4 to 9.0

### 331B—Phillips-Elloam complex, 0 to 4 percent slopes

#### Setting

##### Landform:

- Phillips—Till plains
- Elloam—Till plains

##### Position on landform:

- Phillips—Microhighs
- Elloam—Microlows

##### Slope:

- Phillips—0 to 4 percent
- Elloam—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Phillips and similar soils: 60 percent  
Elloam and similar soils: 30 percent

##### Minor Components

Soils that have slopes more than 4 percent:  
0 to 1 percent  
Nishon and similar soils: 0 to 2 percent  
Joplin, calcareous surface: 0 to 1 percent  
Hillon gravelly loam: 0 to 1 percent

#### Major Component Description

##### Phillips

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 9.6 inches

##### Elloam

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 6.4 inches

### Reeder Series

*Depth class:* Moderately deep (20 to 40 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Sedimentary plains

*Parent material:* Residuum weathered from semiconsolidated interbedded sandstone and shale

*Slope range:* 2 to 8 percent

*Annual precipitation:* 13 to 17 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed Typic Argiborolls

#### Typical Pedon

Reeder loam, 2 to 8 percent, in rangeland; 1,600 feet east and 2,300 feet north of the southwest corner of sec. 1, T. 37 N., R. 6 E.

A—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bt—6 to 12 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common distinct clay films on ped faces; neutral; clear wavy boundary.

Bk—12 to 23 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Cr—23 to 60 inches; light gray (10YR 7/1) semiconsolidated interbedded sandstone and shale, gray (10YR 6/1) moist; strongly effervescent.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 16 inches (may include all or part of the Bt horizon)

*Depth to the Bk horizon:* 10 to 26 inches

*Depth to the Cr horizon:* 20 to 40 inches

#### A horizon

Hue: 10YR or 2.5Y

Value: 3, 4, or 5 dry; 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 20 to 27 percent  
 Reaction: pH 6.1 to 7.3

**Bt horizon**

Hue: 7.5YR, 10YR, or 2.5Y  
 Value: 4, 5, or 6 dry; 3, 4, or 5 moist  
 Chroma: 2 to 4  
 Texture: Loam, sandy clay loam, or clay loam  
 Clay content: Between 20 and 30 percent clay, but ranges from 18 to 35 percent and from 20 to 45 percent fine sand and coarser  
 Reaction: pH 6.6 to 7.8

**Bk horizon**

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Clay content: 15 to 30 percent  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

**41C—Reeder loam, 2 to 8 percent slopes****Setting**

*Landform:* Sedimentary plains  
*Slope:* 2 to 8 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 13 to 17 inches  
*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Reeder and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Cabba and similar soils: 0 to 2 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent  
 Roy clay loam: 0 to 2 percent  
 Farnuf and similar soils: 0 to 2 percent

**Major Component Description**

*Surface layer texture:* Loam  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained

*Dominant parent material:* Interbedded sandstone and shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 3.8 inches

**Roy Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour)  
*Landform:* Alluvial fans or hills  
*Parent material:* Colluvium  
*Slope range:* 8 to 60 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Clayey-skeletal, mixed Typic Argiborolls

**Typical Pedon**

Roy gravelly clay loam, 15 to 45 percent slopes, in rangeland; 1,400 feet north and 700 feet east of the southwest corner of sec. 17, T. 35 N., R. 5 E.

- A—0 to 7 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; 15 percent pebbles; neutral; gradual smooth boundary.
- Bt1—7 to 14 inches; brown (7.5YR 5/3) very gravelly clay loam, dark brown (7.5YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common distinct clay films on faces of peds; 35 percent pebbles, 5 percent cobbles; neutral; gradual wavy boundary.
- Bt2—14 to 32 inches; yellowish brown (10YR 5/4) very gravelly clay, dark yellowish brown (10YR 4/4) moist; strong medium angular blocky structure; very hard, very firm, sticky and plastic; many distinct clay films on faces of peds; 30 percent pebbles, 10 percent cobbles; neutral; gradual wavy boundary.
- C—32 to 60 inches; pale brown (10YR 6/3) extremely gravelly sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 45 percent pebbles, 20 percent cobbles; mild alkaline.

**Range in Characteristics**

*Mollic epipedon thickness:* 10 to 16 inches

*A horizon*

Hue: 7.5YR or 10YR  
 Value: 4 or 5 dry, 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 27 to 40 percent  
 Content of rock fragments: 5 to 55 percent—  
 5 to 30 percent stones and cobbles, 0 to 25  
 percent pebbles  
 Reaction: pH 6.1 to 7.8

*Bt horizons*

Hue: 7.5YR or 10YR  
 Value: 4 or 5 dry; 3 or 4 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay loam or clay  
 Clay content: 35 to 50 percent  
 Content of rock fragments: 35 to 80 percent—  
 20 to 50 percent stones and cobbles, 15 to 30  
 percent pebbles  
 Reaction: pH 6.6 to 7.8

*C horizon*

Hue: 7.5YR through 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 3, 4, or 5  
 Texture: Clay loam or sandy clay loam  
 Clay content: 27 to 40 percent  
 Content of rock fragments: 35 to 80 percent—  
 20 to 50 percent stones and cobbles, 15 to 30  
 percent pebbles  
 Reaction: pH 7.4 to 8.4

**71D—Roy complex, 8 to 15 percent slopes*****Setting****Landform:*

- Roy—Alluvial fans
- Roy—Alluvial fans

*Position on landform:*

- Roy—Back slopes and foot slopes
- Roy—Back slopes and foot slopes

*Slope:*

- Roy—8 to 15 percent
- Roy—8 to 15 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

***Composition*****Major Components**

Roy and similar soils: 60 percent  
 Roy and similar soils: 30 percent

**Minor Components**

Soils that have slopes more than 15 percent:  
 0 to 2 percent  
 Roy stony clay loam: 0 to 2 percent  
 Perma and similar soils: 0 to 2 percent  
 Soils that have slopes less than 8 percent:  
 0 to 2 percent  
 Farnuf loam: 0 to 2 percent

***Major Component Description*****Roy**

*Surface layer texture:* Gravelly clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Colluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.6 inches

**Roy**

*Surface layer texture:* Very cobbly clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Colluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.4 inches

**71F—Roy gravelly clay loam, 15 to 45 percent slopes*****Setting***

*Landform:* Alluvial fans

*Slope:* 15 to 45 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

***Composition*****Major Components**

Roy and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 45 percent:  
0 to 2 percent  
Soils that have slopes less than 15 percent:  
0 to 2 percent  
Roy very cobbly clay loam: 0 to 2 percent  
Perma and similar soils: 0 to 2 percent  
Farnuf loam: 0 to 2 percent

**Major Component Description**

*Surface layer texture:* Gravelly clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Colluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.6 inches

**712E—Roy-Barkof complex, 8 to 25 percent slopes****Setting***Landform:*

- Roy—Hills
- Barkof—Hills

*Position on landform:*

- Roy—Back slopes
- Barkof—Back slopes

*Slope:*

- Roy—8 to 25 percent
- Barkof—8 to 25 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Roy and similar soils: 50 percent  
Barkof and similar soils: 40 percent

**Minor Components**

Soils that have slopes less than 8 percent:  
0 to 2 percent  
Soils that have slopes more than 25 percent:  
0 to 2 percent  
Areas of Rock outcrop: 0 to 2 percent  
Wayden and similar soils: 0 to 2 percent  
Roy very cobbly clay loam: 0 to 1 percent  
Farnuf loam: 0 to 1 percent

**Major Component Description****Roy**

*Surface layer texture:* Gravelly clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Colluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.6 inches

**Barkof**

*Surface layer texture:* Clay  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.0 inches

**712F—Roy-Barkof-Rock outcrop complex, 25 to 60 percent slopes****Setting***Landform:*

- Roy—Hills
- Barkof—Hills

*Position on landform:*

- Roy—Back slopes
- Barkof—Back slopes

*Slope:*

- Roy—25 to 60 percent
- Barkof—25 to 45 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Roy and similar soils: 45 percent  
Barkof and similar soils: 35 percent  
Rock outcrop: 15 percent

**Minor Components**

Soils that have slopes less than 25 percent:  
0 to 1 percent  
Soils that have slopes more than 60 percent:  
0 to 1 percent  
Wayden and similar soils: 0 to 1 percent

Roy very cobbly clay loam: 0 to 1 percent  
Farnuf loam: 0 to 1 percent

### **Major Component Description**

#### **Roy**

*Surface layer texture:* Gravelly clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Colluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.6 inches

#### **Barkof**

*Surface layer texture:* Clay  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.0 inches

#### **Rock outcrop**

*Definition:* Exposures of synite bedrock

### **100F—Rubble land**

#### **Composition**

##### **Major Components**

Rubble land: 95 percent

##### **Minor Components**

Areas supporting vegetation: 0 to 5 percent

#### **Major Component Description**

*Definition:* Areas with more than 90 percent of the surface covered by stones and boulders, supporting little or no vegetation

### **Sagedale Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Alluvial fans  
*Parent material:* Alluvium  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 13 to 17 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic, frigid Typic Ustochrepts

#### **Typical Pedon**

Sagedale silty clay, 0 to 4 percent slopes, in cropland; 2,000 feet east and 800 feet north of the southwest corner of sec. 10, T. 37 N., R. 5 E.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; hard, friable, sticky and plastic; slightly effervescent; mildly alkaline; abrupt smooth boundary.

Bw—5 to 12 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; slightly effervescent; moderately alkaline; gradual wavy boundary.

Bk—12 to 25 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium angular blocky; very hard, very firm, sticky and plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bky—25 to 45 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, sticky and plastic; few fine soft masses of lime; common fine soft masses of gypsum; strongly effervescent; moderately alkaline; clear wavy boundary.

BC—45 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, sticky and plastic; strongly effervescent; moderately alkaline.

#### **Range in Characteristics**

*Depth to the Bk horizon:* 10 to 15 inches

*Depth to the Bky horizon:* 17 to 36 inches

##### *A horizon*

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 4 moist  
Chroma: 2, 3, or 4  
Clay content: 40 to 45 percent  
Reaction: pH 7.4 to 8.4

##### *Bw horizon*

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 4 moist  
Chroma: 2, 3, or 4  
Texture: Silty clay loam, silty clay, or clay loam  
Clay content: 35 to 45 percent  
Reaction: pH 7.4 to 8.4

*Bk horizon*

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Silty clay loam or silty clay  
 Clay content: 35 to 45 percent  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

*Bky and BC horizons*

Hue: 10YR, 2.5Y, 5Y, or N  
 Value: 4, 5, or 6 dry; 3, 4, or 5 moist  
 Chroma: 0, 2, 3, or 4  
 Texture: Silty clay loam, clay, silty clay, or clay loam  
 Clay content: 35 to 45 percent  
 Calcium carbonate equivalent: 5 to 10 percent  
 Electrical conductivity: Less than 4 mmhos/cm  
 Gypsum content: 1 to 7 percent  
 Reaction: pH 7.9 to 9.0

**323B—Sagedale silty clay, 0 to 4 percent slopes****Setting**

*Landform:* Alluvial fans  
*Slope:* 0 to 4 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 13 to 17 inches  
*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Sagedale and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 Barkof and similar soils: 0 to 3 percent  
 Lawther silty clay loam: 0 to 4 percent

**Major Component Description**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.3 inches

**323C—Sagedale silty clay, 4 to 8 percent slopes****Setting**

*Landform:* Alluvial fans  
*Slope:* 4 to 8 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 13 to 17 inches  
*Frost-free period:* 90 to 110 days

**Composition****Major Components**

Sagedale and similar soils: 90 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Barkof and similar soils: 0 to 3 percent  
 Lawther silty clay loam: 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent

**Major Component Description**

*Surface layer texture:* Silty clay  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.3 inches

**Savage Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Alluvial fans, stream terraces, or small drainageways  
*Parent material:* Alluvium  
*Slope range:* 0 to 4 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic Typic Argiborolls

**Typical Pedon**

Savage silty clay loam, 0 to 4 percent slopes, in rangeland; 1,100 feet east and 2,100 feet south of the northwest corner of sec. 3, T. 35 N., R. 5 E.

- A—0 to 3 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable, sticky and plastic; neutral; clear wavy boundary.
- Bt1—3 to 8 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to strong fine and medium subangular blocky; hard, firm, very sticky and very plastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.
- Bt2—8 to 16 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky; hard, firm, very sticky and very plastic; continuous distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.
- Bk1—16 to 34 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bk2—34 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 8 to 16 inches and may include all or part of the Bt horizon

*Depth to the Bk horizon:* 12 to 22 inches

#### A horizon

Hue: 7.5YR, 10YR, or 2.5Y

Value: 3, 4, or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 5 percent pebbles

Reaction: pH 6.1 to 7.8

#### Bt1 and Bt2 horizons

Hue: 7.5YR, 10YR, or 2.5Y

Value: 3, 4, or 5 dry; 2, 3, or 4 moist

Chroma: 2, 3, or 4

Texture: Silty clay loam, silty clay, or clay

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 5 percent pebbles

Electrical conductivity: 0 to 4

Reaction: pH 6.1 to 8.4

Other features: A Btk horizon 4 to 18 inches thick is allowed

#### Bk horizons

Hue: 7.5YR through 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Clay content: 30 to 45 percent

Content of rock fragments: 0 to 10 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Electrical conductivity: 0 to 4 mmhos/cm

Reaction: pH 7.4 to 8.4

Other features: Some pedons have C and By horizons below a depth of 36 inches

## 82B—Savage silty clay loam, 0 to 4 percent slopes

### Setting

*Landform:* Alluvial fans, stream terraces, and drainageways

*Slope:* 0 to 4 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Savage and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
0 to 3 percent

Nishon and similar soils: 0 to 3 percent

Sagedale silty clay: 0 to 2 percent

Work clay loam: 0 to 2 percent

### Major Component Description

*Surface layer texture:* Silty clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 9.0 inches

### Scobey Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Aridic  
Argiborolls

### Typical Pedon

Scobey clay loam, in an area of Scobey-Kevin clay loams, 0 to 4 percent slopes, in cropland; 1,600 feet east and 100 feet south of the northwest corner of sec. 30, T. 37 N., R. 7 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to fine and medium granular; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bt—6 to 12 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong fine and medium subangular blocky; hard, firm, sticky and plastic; common distinct clay films on faces of peds; slightly alkaline; clear wavy boundary.

Bk—12 to 25 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine soft masses of lime; slightly effervescent; slightly alkaline; clear wavy boundary.

Bky—25 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; common fine and medium soft masses of lime; common fine soft masses of gypsum; strongly effervescent; moderately alkaline; gradual wavy boundary.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches and may include all or part of the Bt horizon

*Depth to the Bk horizon:* 10 to 20 inches

#### Ap horizon

Hue: 10YR or 2.5Y

Chroma: 2 or 3

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 60 percent—  
0 to 25 percent cobbles and stones, trace to 40 percent pebbles

Reaction: pH 6.1 to 7.8

#### Bt horizon

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 3 or 4 moist

Chroma: 2 or 3

Texture: Clay loam or clay

Clay content: 35 to 45 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles, trace to 10 percent pebbles

Reaction: pH 6.6 to 8.4

#### Bk horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Clay content: 30 to 40 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles, trace to 10 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

Other features: A Btk horizon is allowed

#### Bky horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 30 to 40 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles, trace to 10 percent pebbles

Calcium carbonate equivalent: 5 to 12 percent

Sodium adsorption ratio: 1 to 8

Gypsum content: 1 to 6 percent

Reaction: pH 7.4 to 9.0

## 561B—Scobey-Kevin clay loams, 0 to 4 percent slopes

### Setting

#### Landform:

- Scobey—Till plains
- Kevin—Till plains

#### Position on landform:

- Scobey—Foot slopes and toe slopes
- Kevin—Back slopes and shoulders

#### Slope:

- Scobey—0 to 4 percent
- Kevin—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Scobey and similar soils: 50 percent  
Kevin and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 4 percent:  
0 to 2 percent  
Nishon and similar soils: 0 to 2 percent  
Hillon loam: 0 to 2 percent  
Hillon gravelly loam: 0 to 2 percent  
Joplin, calcareous surface: 0 to 2 percent

### **Major Component Description**

#### **Scobey**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.9 inches

#### **Kevin**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

## **561C—Scobey-Kevin clay loams, 4 to 8 percent slopes**

### **Setting**

#### *Landform:*

- Scobey—Till plains
- Kevin—Till plains

#### *Position on landform:*

- Scobey—Back slopes and foot slopes
- Kevin—Shoulders

#### *Slope:*

- Scobey—4 to 8 percent
- Kevin—4 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Scobey and similar soils: 50 percent  
Kevin and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 8 percent:  
0 to 2 percent  
Nishon and similar soils: 0 to 2 percent  
Joplin, calcareous surface: 0 to 2 percent  
Hillon loam: 0 to 2 percent  
Hillon gravelly loam: 0 to 1 percent  
Soils that have slopes less than 4 percent:  
0 to 1 percent

### **Major Component Description**

#### **Scobey**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.9 inches

#### **Kevin**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

## **Sunburst Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Hills

*Parent material:* Glacial till

*Slope range:* 8 to 45 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic (calcareous), frigid Aridic Ustorthents

#### **Typical Pedon**

Sunburst clay loam, 8 to 15 percent slopes, in

cropland; 4,000 feet east and 100 feet north of the southwest corner of sec. 6, T. 34 N., R. 5 E.

**Ap**—0 to 4 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate very fine and fine granular structure; slightly hard, friable, sticky and plastic; disseminated lime; strongly effervescent; mildly alkaline; abrupt smooth boundary.

**Bk1**—4 to 11 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine soft masses of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

**Bk2**—11 to 23 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

**Bky1**—23 to 35 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate fine angular blocky; very hard, firm, sticky and plastic; common fine soft masses of lime; many nests and seams of gypsum; strongly effervescent; moderately alkaline; clear smooth boundary.

**Bky2**—35 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine angular blocky structure; very hard, firm, sticky and plastic; many fine soft masses and threads of lime; many nests and seams of gypsum; strongly effervescent; moderately alkaline.

#### Range in Characteristics

##### *Ap horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 27 to 40 percent

Content of rock fragments: 2 to 60 percent—  
2 to 50 percent pebbles, 0 to 10 percent cobbles

Calcium carbonate equivalent: 5 to 10 percent

Reaction: pH 7.4 to 8.4

##### *Bk horizons*

Hue: 2.5Y or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Texture: Clay, clay loam, or silty clay loam

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.9 to 8.4

##### *Bky horizons*

Hue: 2.5Y or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Texture: Clay, clay loam, or silty clay

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles, 0 to 10 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Gypsum: 1 to 3 percent

Reaction: pH 7.4 to 9.0

## 92D—Sunburst clay loam, 8 to 15 percent slopes

### Setting

*Landform:* Hills

*Slope:* 8 to 15 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Sunburst and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 15 percent:  
0 to 3 percent

Sunburst clay: 0 to 2 percent

Soils that have slopes less than 8 percent:  
0 to 2 percent

Hillon loam: 0 to 3 percent

### Major Component Description

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 8.2 inches

## 92F—Sunburst clay loam, 15 to 45 percent slopes

### Setting

*Landform:* Hills  
*Slope:* 15 to 45 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Sunburst and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 45 percent:  
 0 to 2 percent  
 Areas of Rock outcrop: 0 to 2 percent  
 Sunburst clay: 0 to 2 percent  
 Soils that have slopes less than 15 percent:  
 0 to 2 percent  
 Hillon loam: 0 to 2 percent

### Major Component Description

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.2 inches

### Tamaneen Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour) to 26 inches; moderately rapid below this depth (2.0 to 6.0 inches/hour)  
*Landform:* Relict stream terraces  
*Parent material:* Calcareous alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic Typic Argiborolls

#### Typical Pedon

Tamaneen clay loam, in an area of Tamaneen complex, 2 to 8 percent slopes, in rangeland; 1,400

feet north and 1,600 feet east of the southwest corner of sec. 3, T. 35 N., R. 4 E.

A—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure parting to moderate very fine and fine granular; slightly hard, friable, sticky and plastic; neutral; clear wavy boundary.

Bt—7 to 14 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to strong fine and medium subangular blocky; hard, firm, sticky and plastic; continuous distinct clay films on faces of peds; neutral; clear wavy boundary.

Btk—14 to 17 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, sticky and plastic; many distinct clay films on faces of peds; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—17 to 26 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many fine and medium soft masses of lime; violently effervescent; moderately alkaline; clear irregular boundary.

2Bk2—26 to 31 inches; light gray (10YR 7/2) very gravelly loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 40 percent pebbles, 5 percent cobbles; many fine and medium soft masses of lime and lime coating coarse fragments; violently effervescent; moderately alkaline; gradual wavy boundary.

2Bk3—31 to 60 inches; light brownish gray (10YR 6/2) extremely gravelly sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; 55 percent pebbles, 10 percent cobbles; common fine and medium soft masses of lime and lime coating coarse fragments; violently effervescent; moderately alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 8 to 15 inches  
*Depth to the calcic horizon:* 11 to 15 inches  
*Soil phases:* Cobbly

#### A horizons

Hue: 10YR or 2.5Y  
 Value: 4 or 5 dry; 2 or 3 moist  
 Chroma: 2 or 3

Clay content: 27 to 35 percent  
 Content of rock fragments: 0 to 10 percent—  
 0 to trace cobbles, 0 to 10 percent pebbles  
 Reaction: pH 6.6 to 7.8

*Bt horizons*

Hue: 10YR or 2.5Y  
 Value: 4 or 5 dry; 3 or 4 moist  
 Chroma: 2 or 3  
 Texture: Silty clay, silty clay loam, or clay loam  
 Clay content: 35 to 50 percent  
 Content of rock fragments: 0 to 10 percent—  
 0 to trace cobbles, 0 to 10 percent pebbles  
 Reaction: pH 6.6 to 7.8

*Btk and Bk horizons*

Hue: 10YR or 2.5Y  
 Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Texture: Clay loam, silty clay, or silty clay loam  
 Clay content: 30 to 45 percent  
 Content of rock fragments: 5 to 20 percent—  
 0 to trace cobbles, 5 to 20 percent pebbles  
 Calcium carbonate equivalent: 20 to 30 percent  
 Reaction: pH 7.4 to 8.4

*2Bk horizons*

Hue: 10YR or 2.5Y  
 Value: 6, 7, or 8 dry; 5, 6, or 7 moist  
 Chroma: 2, 3, or 4  
 Clay content: 8 to 35 percent  
 Content of rock fragments: 30 to 45 percent—  
 0 to 10 percent cobbles, 30 to 35 percent  
 pebbles  
 Calcium carbonate equivalent: 25 to 40 percent  
 Reaction: pH 7.9 to 8.4

## 87C—Tamaneen complex, 2 to 8 percent slopes

### Setting

*Landform:*

- Tamaneen—Relict stream terraces
- Tamaneen—Relict stream terraces

*Position on landform:*

- Tamaneen—Treads
- Tamaneen—Treads

*Slope:*

- Tamaneen—2 to 8 percent
- Tamaneen—2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

## Composition

### Major Components

Tamaneen and similar soils: 60 percent  
 Tamaneen and similar soils: 30 percent

### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Roy gravelly clay loam: 0 to 2 percent  
 Farnuf loam: 0 to 2 percent  
 Soils that have slopes less than 2 percent:  
 0 to 2 percent  
 Turner and similar soils: 0 to 2 percent

### Major Component Description

#### Tamaneen

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 5.8 inches

#### Tamaneen

*Surface layer texture:* Cobbly clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 5.6 inches

### Telstad Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Till plains  
*Parent material:* Glacial till  
*Slope range:* 0 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed Aridic  
 Argiborolls

### Typical Pedon

Telstad loam, in an area of Telstad-Joplin loams, 0 to 4 percent slopes, in cropland; 800 feet east and

2,100 feet south of the northwest corner of sec. 24,  
T. 32 N., R. 6 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam,  
very dark grayish brown (10YR 3/2) moist;  
moderate fine and medium granular structure;  
soft, very friable, slightly sticky and slightly plastic;  
neutral; clear smooth boundary.

Bt—6 to 14 inches; brown (10YR 5/3) clay loam, dark  
brown (10YR 4/3) moist; moderate medium  
prismatic structure parting to moderate medium  
angular blocky; hard, friable, sticky and plastic;  
many distinct clay films on faces of peds; neutral;  
clear wavy boundary.

Bk1—14 to 19 inches; pale brown (10YR 6/3) clay  
loam, brown (10YR 5/3) moist; moderate medium  
prismatic structure parting to moderate medium  
angular blocky; hard, friable, slightly sticky and  
slightly plastic; few fine and medium soft masses  
of lime; strongly effervescent; moderately alkaline;  
gradual wavy boundary.

Bk2—19 to 28 inches; light brownish gray (10YR 6/2)  
clay loam, grayish brown (10YR 5/2) moist; weak  
medium prismatic structure parting to moderate  
medium angular blocky; hard, friable, sticky and  
plastic; many fine and medium soft masses of  
lime; strongly effervescent; moderately alkaline;  
gradual wavy boundary.

Bky—28 to 60 inches; light brownish gray (10YR 6/2)  
clay loam, grayish brown (10YR 5/2) moist;  
massive; hard, friable, sticky and plastic; common  
fine and medium soft masses and seams of lime;  
common medium nests of gypsum; slightly  
effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 12 inches

*Depth to the Bk horizon:* 10 to 16 inches

#### Ap horizon

Hue: 10YR or 2.5Y

Chroma: 2 or 3

Clay content: 18 to 27 percent

Content of rock fragments: 0 to 25 percent—

0 to 5 percent cobbles, 0 to 20 percent pebbles

Reaction: pH 6.6 to 7.8

#### Bt horizon

Hue: 10YR or 2.5Y

Value: 4, 5, or 6 dry; 3, 4, or 5 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 25 to 35 percent

Content of rock fragments: 0 to 10 percent—

0 to 2 percent cobbles, 0 to 8 percent pebbles

Reaction: pH 6.6 to 8.4

#### Bk horizons

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 20 to 32 percent

Content of rock fragments: 0 to 10 percent—

0 to 2 percent cobbles, 0 to 8 percent pebbles

Electrical conductivity: 2 to 4 mmhos/cm

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.9 to 8.4

#### Bky horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam or clay loam

Clay content: 20 to 32 percent

Content of rock fragments: 0 to 10 percent—

0 to 2 percent cobbles, 0 to 8 percent pebbles

Calcium carbonate equivalent: 3 to 12 percent

Gypsum: 0 to 3 percent

Electrical conductivity: 2 to 4 mmhos/cm

Bulk density air dry: 1.7 or more

Reaction: pH 7.9 to 9.0

### 503B—Telstad-Joplin loams, 0 to 4 percent slopes

#### Setting

##### Landform:

- Telstad—Till plains
- Joplin—Till plains

##### Position on landform:

- Telstad—Foot slopes and toe slopes
- Joplin—Back slopes and shoulders

##### Slope:

- Telstad—0 to 4 percent
- Joplin—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Telstad and similar soils: 50 percent

Joplin and similar soils: 40 percent

##### Minor Components

Soils that have slopes more than 4 percent:

0 to 2 percent

Nishon and similar soils: 0 to 2 percent  
 Elloam and similar soils: 0 to 2 percent  
 Joplin, calcareous surface: 0 to 2 percent  
 Scobey clay loam: 0 to 2 percent

### **Major Component Description**

#### **Telstad**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

#### **Joplin**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.1 inches

### **503C—Telstad-Joplin loams, 4 to 8 percent slopes**

#### **Setting**

##### *Landform:*

- Telstad—Till plains
- Joplin—Till plains

##### *Position on landform:*

- Telstad—Back slopes and foot slopes
- Joplin—Shoulders

##### *Slope:*

- Telstad—4 to 8 percent
- Joplin—4 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### **Composition**

#### **Major Components**

Telstad and similar soils: 45 percent  
 Joplin and similar soils: 40 percent

#### **Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 3 percent  
 Elloam and similar soils: 0 to 3 percent

Joplin, calcareous surface: 0 to 1 percent  
 Kevin clay loam: 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 3 percent

### **Major Component Description**

#### **Telstad**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.8 inches

#### **Joplin**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.1 inches

### **Thibadeau Series**

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Somewhat poorly drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Flood plains and drainageways

*Parent material:* Alluvium

*Slope range:* 0 to 2 percent

*Annual precipitation:* 10 to 13 inches

*Annual air temperature:* 42 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed (calcareous), frigid Oxyaquic Ustifluvents

#### **Typical Pedon**

Thibadeau loam, in an area of Thibadeau loam, 0 to 4 percent slopes, occasionally flooded, in rangeland, 1,600 feet north and 600 feet east of the southwest corner of sec. 11, T. 35 N., R. 12 E.

A—0 to 2 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak very fine granular structure; soft, very friable, sticky and plastic; many very fine roots; common very fine pores; strongly alkaline; clear smooth boundary.

C—2 to 14 inches; grayish brown (2.5Y 5/2) clay loam

consisting of thin strata of loam and fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, sticky and plastic; many very fine roots; common very fine pores; strongly effervescent; strongly alkaline; clear wavy boundary.

Cyz—14 to 60 inches; light olive brown (2.5Y 5/4) clay loam consisting of thin strata of loam and fine sandy loam, olive brown (2.5Y 4/4) moist; many fine distinct yellowish brown (10YR 5/6) redox concentrations; massive; hard, friable, sticky and plastic; few very fine roots; common very fine pores; common fine masses and seams of gypsum and other salts; strongly effervescent; very strongly alkaline.

#### Range in Characteristics

*Soil temperature:* 42 to 47 degrees F.

*Moisture control section:* Between 4 and 12 inches; depth to water table is 24 to 42 inches

#### A horizon

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Clay content: 15 to 27 percent

Electrical conductivity: 8 to 16 mmhos/cm

Sodium adsorption ratio: 8 to 20

Reaction: pH 7.4 to 9.6

#### C horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Clay loam, loam, or silty clay loam with or without thin strata of loam, clay loam, silty clay loam, fine sandy loam, or silt loam

Clay content: 18 to 35 percent

Electrical conductivity: 8 to 16 mmhos/cm

Sodium adsorption ratio: 13 to 20

Reaction: pH 7.4 to 9.6

#### Cyz horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 3 or 4

Texture: Clay loam, loam, or silty clay loam with or without thin strata of fine sandy loam, loam, clay loam, silty clay loam, or silt loam

Clay content: 18 to 35 percent

Electrical conductivity: 8 to 16 mmhos/cm

Sodium adsorption ratio: 13 to 30

Gypsum: 2 to 5 percent

Reaction: pH 7.4 to 9.6

## 603B—Thibadeau loam, 0 to 4 percent slopes

### Setting

*Landform:* Flood plains

*Slope:* 0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Thibadeau and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 4 percent:

0 to 3 percent

Big sandy and similar soils: 0 to 3 percent

Thibadeau silty clay loam: 0 to 4 percent

#### Major Component Description

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Moderately well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* Occasional

*Water table:* Apparent

*Salt affected:* Saline within 30 inches

*Available water capacity:* 9.6 inches

### Thoeny Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Very slow (less than 0.06 inch/hour)

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 0 to 4 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic Natriborafs

#### Typical Pedon

Thoeny loam, in an area of Thoeny-Elloam complex, 0 to 4 percent slopes, in cropland; 1,200 feet west and 600 feet south of the northeast corner of sec. 19, T. 31 N., R. 5 E.

**Ap**—0 to 6 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure parting to very fine and fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

**Btn**—6 to 15 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong fine and medium columnar structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common distinct clay films on faces of peds; mildly alkaline; clear wavy boundary.

**Btkn**—15 to 18 inches; pale brown (10YR 6/3) clay, dark brown (10YR 4/3) moist; moderate fine and medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few distinct clay films on faces of peds; common fine soft masses and seams of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

**Bkn**—18 to 28 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine soft masses of lime; violently effervescent; moderately alkaline; clear smooth boundary.

**Bkny1**—28 to 41 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; strong fine and medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common fine soft masses of lime; common fine soft masses of gypsum; strongly effervescent; strongly alkaline; gradual wavy boundary.

**Bkny2**—41 to 60 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine soft masses of lime; common fine soft masses of gypsum; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Depth to the Bk horizon:* 12 to 22 inches

*Depth to the Bky horizon:* 24 to 36 inches

#### *Ap horizon*

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Clay content: 15 to 27 percent

Content of rock fragments: 0 to 15 percent—

0 to 5 percent cobbles and stones, 0 to 10 percent pebbles

Electrical conductivity: 0 to 4 mmhos/cm

Reaction: pH 5.6 to 7.8

#### *Btn horizon*

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay or clay loam

Clay content: 35 to 50 percent

Sodium adsorption ratio: 5 to 20

Electrical conductivity: 4 to 8 mmhos/cm

Skeletons: Unstained sand and silt grains range from very few to common faint on vertical faces of peds

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles and stones, 0 to 10 percent pebbles

Structure: Strong to medium columnar, prismatic, or blocky

Reaction: pH 7.4 to 9.0

#### *Btkn and Bkn horizons*

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Texture: Clay or clay loam

Clay content: 35 to 50 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles and stones, 0 to 10 percent pebbles

Electrical conductivity: 4 to 8 mmhos/cm

Sodium adsorption ratio: 13 to 25 or more  
exchangeable magnesium plus sodium than calcium plus exchange acidity

Reaction: pH 7.4 to 9.0

#### *Bkny horizonss*

Hue: 2.5Y or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2 or 3

Texture: Clay or clay loam

Clay content: 35 to 50 percent

Bulk density, air dry: 1.55 gr/ccm and greater

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles and stones, 0 to 10 percent pebbles

Electrical conductivity: 4 to 16 mmhos/cm

Calcium carbonate equivalent: 5 to 15 percent

Sodium adsorption ratio: 13 to 25 or more  
exchangeable magnesium plus sodium than calcium plus exchange acidity

Gypsum content: 1 to 3 percent

Reaction: pH 7.9 to 9.6

## 115B—Thoeny-Elloam complex, 0 to 4 percent slopes

### Setting

#### Landform:

- Thoeny—Till plains
- Elloam—Till plains

#### Position on landform:

- Thoeny—Microhighs
- Elloam—Microlows

#### Slope:

- Thoeny—0 to 4 percent
- Elloam—0 to 4 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

### Composition

#### Major Components

Thoeny and similar soils: 65 percent

Elloam and similar soils: 30 percent

#### Minor Components

Soils that have slopes more than 4 percent:  
0 to 1 percent

Nishon and similar soils: 0 to 1 percent

Absher and similar soils: 0 to 2 percent

Gerdrum and similar soils: 0 to 1 percent

### Major Component Description

#### Thoeny

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 7.6 inches

#### Elloam

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Salt affected:* Saline within 30 inches

*Sodium affected:* Sodic within 30 inches

*Available water capacity:* 6.4 inches

## Tinsley Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Excessively drained

*Permeability:* Rapid (6.0 to 20.0 inches/hour)

*Landform:* Kames, eskers, or stream terraces

*Parent material:* Alluvium, glacial outwash, or outwash plains

*Slope range:* 2 to 70 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Sandy-skeletal, mixed, frigid  
Typic Ustorthents

### Typical Pedon

Tinsley gravelly sandy loam, in an area of Beaverell-Tinsley complex, 4 to 15 percent slopes, in cropland; 2,500 feet north and 2,600 feet west of the southeast corner of sec. 27, T. 34 N., R. 4 E.

Ap—0 to 4 inches; grayish brown (10YR 5/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; disseminated lime; 30 percent pebbles, 5 percent cobbles; strongly effervescent; mildly alkaline; clear wavy boundary.

C—4 to 60 inches; pale brown (10YR 6/3) very gravelly sand, brown (10YR 5/3) moist; single grain; loose; 50 percent pebbles, 15 percent cobbles; thin to moderately thick lime coatings on the underside of pebbles and cobbles; strongly effervescent; moderately alkaline.

### Range in Characteristics

#### Ap horizon

Hue: 10YR or 2.5Y

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2, 3, or 4

Clay content: 5 to 10 percent

Content of rock fragments: 15 to 60 percent—

0 to 10 percent stones and cobbles, 15 to 50 percent pebbles

Reaction: pH 6.6 to 7.8

#### C horizon

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Sand or loamy sand

Clay content: 0 to 10 percent

Content of rock fragments: 35 to 70 percent—  
5 to 25 percent stones and cobbles, 30 to 45  
percent pebbles  
Reaction: pH 6.6 to 8.4

### 77D—Tinsley gravelly sandy loam, 4 to 15 percent slopes

#### Setting

*Landform:* Kames and eskers  
*Slope:* 4 to 15 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Tinsley and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 15 percent:  
0 to 4 percent  
Soils that have slopes less than 4 percent:  
0 to 3 percent  
Beaverell sandy loam: 0 to 3 percent

#### Major Component Description

*Surface layer texture:* Gravelly sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Excessively drained  
*Dominant parent material:* Glacial outwash  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 1.2 inches

### 77F—Tinsley gravelly sandy loam, 15 to 70 percent slopes

#### Setting

*Landform:* Stream terraces  
*Position on landform:* Risers  
*Slope:* 15 to 70 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Tinsley and similar soils: 90 percent

#### Minor Components

Soils that have slopes less than 15 percent:  
0 to 5 percent  
Beaverell sandy loam: 0 to 5 percent

#### Major Component Description

*Surface layer texture:* Gravelly sandy loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Excessively drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 1.2 inches

#### Turner Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour) to  
23 inches; rapid below this depth (6.0 to 20.0  
inches/hour)  
*Landform:* Relict stream terraces  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine loamy over sandy or sandy  
skeletal, mixed Typic Argiborolls

#### Typical Pedon

Turner loam, in an area of Turner-Beaverton  
complex, 2 to 8 percent slopes, in rangeland; 2,200  
feet west and 1,000 feet south of the northeast corner  
of sec. 18, T. 37 N., R. 5 E.

- A—0 to 8 inches; dark grayish brown (10YR 4/2)  
loam, very dark grayish brown (10YR 3/2) moist;  
moderate medium subangular blocky structure  
parting to moderate fine granular; slightly hard,  
very friable, slightly sticky and nonplastic; neutral;  
abrupt wavy boundary.
- Bt—8 to 17 inches; dark grayish brown (10YR 4/2)  
clay loam, very dark grayish brown (10YR 3/2)  
moist; moderate medium prismatic structure  
parting to moderate medium subangular blocky;  
slightly hard, very friable, slightly sticky and  
slightly plastic; many distinct clay films on faces of  
peds; mildly alkaline; clear wavy boundary.
- Bk—17 to 23 inches; light brownish gray (10YR 6/2)  
loam, grayish brown (10YR 5/2) moist; weak fine  
and medium subangular blocky structure; hard,

very friable, slightly sticky and slightly plastic; many fine and medium soft masses of lime; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Ck—23 to 60 inches; light brownish gray (2.5Y 6/2) very gravelly loamy sand, grayish brown (2.5Y 5/2) moist; single grain; loose; 15 percent cobbles, 35 percent pebbles; lime coatings on the underside of cobbles and pebbles; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches and may include all or part of the Bt horizon

*Depth to the Bk horizon:* 11 to 20 inches

*Depth to the 2C horizon:* 20 to 40 inches

#### A horizon

Hue: 10YR or 7.5YR

Value: 2 or 3 moist

Chroma: 2 or 3

Clay content: 18 to 25 percent

Content of rock fragments: 0 to 50 percent—  
0 to 3 percent stones, 0 to 5 percent cobbles,  
0 to 15 percent pebbles

Reaction: pH 6.1 to 7.8

#### Bt horizon

Hue: 7.5YR, 10YR, or 2.5Y

Value: 4, 5, or 6 dry; 3, 4, or 5 moist

Chroma: 2 or 3

Texture: Clay loam, sandy clay loam, or loam

Clay content: 25 to 35 percent

Content of rock fragments: 0 to 30 percent—  
0 to 5 percent cobbles, 0 to 25 percent pebbles

Reaction: pH 6.6 to 8.4

#### Bk horizon

Hue: 7.5YR, 10YR, or 2.5Y

Value: 5, 6, 7, or 8 dry; 4, 5, 6, or 7 moist

Chroma: 2 or 3

Texture: Loam or clay loam

Clay content: 25 to 35 percent

Content of rock fragments: 0 to 30 percent—  
0 to 5 percent cobbles, 0 to 25 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

#### 2Ck horizon

Hue: 2.5Y or 10YR

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loamy sand or sand

Clay content: 0 to 5 percent

Content of rock fragments: 35 to 80 percent—  
5 to 20 percent cobbles, 30 to 60 percent  
pebbles

Calcium carbonate equivalent: 2 to 12 percent

Reaction: pH 7.4 to 8.4

## 531C—Turner-Beaverton complex, 2 to 8 percent slopes

### Setting

#### Landform:

- Turner—Relict stream terraces
- Beaverton—Relict stream terraces

#### Position on landform:

- Turner—Treads
- Beaverton—Treads

#### Slope:

- Turner—2 to 8 percent
- Beaverton—2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Turner and similar soils: 50 percent

Beaverton and similar soils: 40 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent

Turner cobbly loam: 0 to 3 percent

Roy gravelly clay loam: 0 to 3 percent

Soils that have slopes less than 2 percent:  
0 to 2 percent

### Major Component Description

#### Turner

*Surface layer texture:* Loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 4.9 inches

#### Beaverton

*Surface layer texture:* Gravelly loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 3.2 inches

### Twilight Series

*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately rapid (2.0 to 6.0 inches/hour)  
*Landform:* Sedimentary plains  
*Parent material:* Residuum weathered from sandstone  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Coarse-loamy, mixed, frigid Aridic Ustochrepts

### Typical Pedon

Twilight fine sandy loam, in an area of Twilight-Blacksheep fine sandy loams, 2 to 8 percent slopes, in cropland; 3,200 feet east and 2,600 feet north of the southwest corner of sec. 12, T. 37 N., R. 7 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; slightly effervescent; mildly alkaline; clear smooth boundary.

Bw—6 to 13 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak coarse prismatic structure; slightly hard, very friable, nonsticky and nonplastic; strongly effervescent; slightly alkaline; clear wavy boundary.

Bk1—13 to 18 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure; slightly hard, very friable, nonsticky and nonplastic; disseminated lime; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—18 to 35 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; disseminated lime; violently effervescent; moderately alkaline; gradual wavy boundary.

Cr—35 to 60 inches; light gray (10YR 6/1) semiconsolidated sandstone, gray (10YR 5/1) moist; slightly effervescent; moderately alkaline.

### Range in Characteristics

*Depth to the Cr horizon:* 20 to 40 inches

#### Ap horizon

Hue: 10YR or 2.5Y  
 Value: 4 or 5 dry; 3 or 4 moist  
 Chroma: 2 or 3  
 Clay content: 5 to 18 percent  
 Reaction: pH 6.6 to 7.8

#### Bw horizon

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Fine sandy loam or sandy loam  
 Clay content: 5 to 18 percent  
 Reaction: pH 6.6 to 7.8

#### Bk horizons

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Sandy loam or fine sandy loam  
 Clay content: 5 to 18 percent  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

### 661C—Twilight-Blacksheep fine sandy loams, 2 to 8 percent slopes

#### Setting

##### Landform:

- Twilight—Sedimentary plains
- Blacksheep—Sedimentary plains

##### Position on landform:

- Twilight—Foot slopes
- Blacksheep—Foot slopes

##### Slope:

- Twilight—2 to 8 percent
- Blacksheep—2 to 8 percent

*Elevation:* 2,750 to 3,460 feet

*Mean annual precipitation:* 10 to 14 inches

*Frost-free period:* 105 to 120 days

#### Composition

#### Major Components

Twilight and similar soils: 55 percent  
 Blacksheep and similar soils: 30 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 3 percent

Benz and similar soils: 0 to 3 percent  
 Soils that have slopes less than 2 percent:  
 0 to 3 percent  
 Twilight sandy loam: 0 to 3 percent  
 Busby sandy loam: 0 to 3 percent

### **Major Component Description**

#### **Twilight**

*Surface layer texture:* Fine sandy loam  
*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Sandstone residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 4.9 inches

#### **Blacksheep**

*Surface layer texture:* Fine sandy loam  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Sandstone residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.6 inches

#### **Vanda Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Alluvial fans  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic (calcareous), frigid Aridic Ustorthents

#### **Typical Pedon**

Vanda silty clay, in an area of Marvan-Vanda complex, 2 to 8 percent slopes, in rangeland; 2,900 feet east and 2,200 feet south of the northwest corner of sec. 12, T. 31 N., R. 7 E.

A—0 to 4 inches; light olive brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; weak very fine granular structure; hard, friable, very sticky and very plastic; disseminated lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw—4 to 12 inches; light olive brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; massive; very

hard, firm, very sticky and very plastic; disseminated lime; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bnyz1—12 to 25 inches; light olive brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; massive; very hard, firm, very sticky and very plastic; disseminated lime; common fine masses of gypsum and other salts; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bnyz2—25 to 36 inches; light olive brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) moist; massive; very hard, firm, very sticky and very plastic; disseminated lime; few fine masses of gypsum and other salts; strongly effervescent; strongly alkaline; gradual wavy boundary.

Bnyz3—36 to 60 inches; light olive brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) moist; massive; hard, friable, sticky and plastic; disseminated lime; common fine masses of gypsum and other salts; strongly effervescent; strongly alkaline.

### **Range in Characteristics**

*Depth to the Bnyz horizon:* 7 to 24 inches

#### *A and Bw horizons*

Hue: 2.5Y or 5Y  
 Value: 5, 6, or 7 dry; 4 or 5 moist  
 Chroma: 1, 2, or 3  
 Clay content: 40 to 60 percent  
 Electrical conductivity: 2 to 8 mmhos/cm  
 Sodium adsorption ratio: 20 to 30  
 Reaction: pH 7.9 to 9.6

#### *Bnyz horizons*

Hue: 2.5Y or 5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2 or 3  
 Texture: Clay, silty clay, or silty clay loam  
 Clay content: 35 to 60 percent  
 Gypsum content: 1 to 5 percent with total gypsum less than 150  
 Electrical conductivity: 8 to 16 mmhos/cm  
 Sodium adsorption ratio: 13 to 30  
 Gypsum content: 1 to 5 percent  
 Reaction: pH 7.9 to 9.6

#### **Vida Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Till plains or hills  
*Parent material:* Glacial till  
*Slope range:* 0 to 15 percent

*Annual precipitation:* 13 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine loamy, mixed Typic Argiborolls

### Typical Pedon

Vida clay loam, in an area of Vida-Bearpaw clay loams, 4 to 15 percent slopes, in cropland; 2,500 feet south and 1,900 feet east of the northwest corner of sec. 7, T. 37 N., R. 4 E.

- Ap—0 to 5 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; abrupt smooth boundary.
- Bt—5 to 7 inches; dark brown (10YR 4/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; many clay films on faces of peds; mildly alkaline; clear smooth boundary.
- Btk—7 to 9 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common clay films on faces of peds; common fine soft masses of lime; strongly effervescent; mildly alkaline; clear smooth boundary.
- Bk—9 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure; hard, firm, sticky and plastic; many fine and medium soft masses of lime; strongly effervescent; moderately alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 10 inches (may include Bt horizon)

*Depth to the Bk horizon:* 6 to 10 inches

#### Ap horizon

Value: 3 or 4 dry; 2 or 3 moist  
 Chroma: 2 or 3  
 Clay content: 27 to 30 percent  
 Content of rock fragments: 0 to 50 percent—  
 0 to 40 percent cobbles and stones, 0 to 10 percent pebbles  
 Reaction: pH 6.6 to 7.8

#### Bt horizon

Hue: 10YR  
 Value: 4 or 5 dry; 3 or 4 moist  
 Chroma: 2 or 3

Texture: Loam or clay loam  
 Clay content: 25 to 35 percent  
 Content of rock fragments: 0 to 15 percent—  
 0 to 5 percent cobbles, 0 to 10 percent pebbles  
 Reaction: pH 6.6 to 7.8

#### Btk horizon

Hue: 10YR or 2.5Y  
 Value: 6 or 7 dry; 5 or 6 moist  
 Chroma: 2 or 3  
 Texture: Loam or clay loam  
 Clay content: 25 to 35 percent  
 Content of rock fragments: 0 to 15 percent—  
 0 to 5 percent cobbles, 0 to 10 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

#### Bk horizon

Hue: 10YR or 2.5Y  
 Value: 6 or 7 dry; 4, 5, or 6 moist  
 Chroma: 2, 3, or 4  
 Texture: Loam or clay loam  
 Clay content: 25 to 35 percent  
 Content of rock fragments: 0 to 15 percent—  
 0 to 5 percent cobbles, 0 to 10 percent pebbles  
 Calcium carbonate equivalent: 5 to 15 percent  
 Gypsum content: 0 to 5 percent  
 Reaction: pH 7.9 to 9.0

## 69C—Vida clay loam, 2 to 8 percent slopes

### Setting

*Landform:* Till plains (fig. 4)  
*Slope:* 2 to 8 percent  
*Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 13 to 19 inches  
*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Vida and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 3 percent  
 Vida gravelly clay loam: 0 to 2 percent  
 Vida, calcareous surface: 0 to 3 percent

### Major Component Description

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)



Figure 4. - Typical area of Vida clay loam, 2 to 8 percent slopes, with Mount Brown in the Sweetgrass Hills in the background.

*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

### 692D—Vida-Bearpaw clay loams, 4 to 15 percent slopes

#### **Setting**

*Landform:*

- Vida—Hills
- Bearpaw—Hills

*Position on landform:* (fig. 5)

- Vida—Back slopes and shoulders
- Bearpaw—Foot slopes

*Slope:*

- Vida—4 to 15 percent

- Bearpaw—4 to 8 percent
- Elevation:* 3,460 to 5,200 feet  
*Mean annual precipitation:* 15 to 19 inches  
*Frost-free period:* 90 to 110 days

#### **Composition**

##### **Major Components**

Vida and similar soils: 50 percent  
 Bearpaw and similar soils: 40 percent

##### **Minor Components**

Soils that have slopes more than 15 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 2 percent  
 Zahill loam: 0 to 2 percent  
 Soils that have slopes less than 4 percent:  
 0 to 2 percent  
 Vida gravelly clay loam: 0 to 2 percent



Figure 5. - Typical area of Vida-Bearpaw loams, 4 to 15 percent slopes in the foreground with the Sweetgrass Hills in the background.

**Major Component Description**

**Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**Bearpaw**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.7 inches

**693D—Vida-Bearpaw-Nishon clay loams, 0 to 15 percent slopes**

**Setting**

*Landform:*

- Vida—Hills
- Bearpaw—Hills
- Nishon—Closed depressions

*Position on landform:*

- Vida—Shoulders and summits
- Bearpaw—Back slopes and foot slopes

*Slope:*

- Vida—4 to 15 percent
- Bearpaw—0 to 8 percent
- Nishon—0 to 1 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### **Composition**

#### **Major Components**

Vida and similar soils: 35 percent  
 Bearpaw and similar soils: 30 percent  
 Nishon and similar soils: 25 percent

#### **Minor Components**

Soils that have slopes more than 15 percent:  
 0 to 3 percent  
 Daglum and similar soils: 0 to 2 percent  
 Zahill loam: 0 to 3 percent  
 Vida gravelly clay loam: 0 to 2 percent

#### **Major Component Description**

##### **Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

##### **Bearpaw**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 8.7 inches

##### **Nishon**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Poorly drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Water table:* Perched  
*Ponding:* Long  
*Available water capacity:* 9.3 inches

### **691D—Vida-Williams complex, 4 to 15 percent slopes**

#### **Setting**

##### *Landform:*

- Vida—Hills
- Williams—Till plains

##### *Position on landform:*

- Vida—Back slopes and shoulders
- Williams—Foot slopes

##### *Slope:*

- Vida—4 to 15 percent
- Williams—4 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

### **Composition**

#### **Major Components**

Vida and similar soils: 55 percent  
 Williams and similar soils: 35 percent

#### **Minor Components**

Soils that have slopes more than 15 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 2 percent  
 Zahill loam: 0 to 2 percent  
 Vida gravelly clay loam: 0 to 2 percent  
 Soils that have slopes less than 4 percent:  
 0 to 2 percent

#### **Major Component Description**

##### **Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

##### **Williams**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 10.5 inches

### **695C—Vida-Zahill clay loams, 2 to 8 percent slopes**

#### **Setting**

##### *Landform:*

- Vida—Till plains
- Zahill—Till plains

*Position on landform:*

- Vida—Back slopes and foot slopes
- Zahill—Shoulders

*Slope:*

- Vida—2 to 8 percent
- Zahill—2 to 8 percent

*Elevation:* 3,460 to 5,200 feet*Mean annual precipitation:* 13 to 19 inches*Frost-free period:* 90 to 110 days**Composition****Major Components**

Vida and similar soils: 65 percent  
Zahill and similar soils: 30 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
0 to 1 percent  
Nishon and similar soils: 0 to 1 percent  
Williams loam: 0 to 1 percent  
Vida gravelly clay loam: 0 to 1 percent  
Soils that have slopes less than 2 percent:  
0 to 1 percent

**Major Component Description****Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**Zahill**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**695E—Vida-Zahill clay loams, 8 to 25 percent slopes****Setting***Landform:*

- Vida—Hills
- Zahill—Hills

*Position on landform:*

- Vida—Back slopes and foot slopes
- Zahill—Shoulders and summits

*Slope:*

- Vida—8 to 15 percent
- Zahill—8 to 25 percent

*Elevation:* 3,460 to 5,200 feet*Mean annual precipitation:* 13 to 19 inches*Frost-free period:* 90 to 110 days**Composition****Major Components**

Vida and similar soils: 65 percent  
Zahill and similar soils: 30 percent

**Minor Components**

Soils that have slopes more than 25 percent:  
0 to 1 percent  
Vida loam: 0 to 1 percent  
Soils that have slopes less than 8 percent:  
0 to 2 percent  
Vida gravelly clay loam: 0 to 1 percent

**Major Component Description****Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**Zahill**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

**W—Water****Composition****Major Components**

Water: 100 percent

**Major Component Description**

*Definition:* Areas of open water

## Wayden Series

*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Hills  
*Parent material:* Semiconsolidated shale residuum  
*Slope range:* 4 to 60 percent  
*Annual precipitation:* 13 to 17 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Clayey, montmorillonitic  
 (calcareous) frigid, shallow Typic Ustorthents

### Typical Pedon

Wayden silty clay, in an area of Cabba-Wayden-Rock outcrop complex, 15 to 60 percent slopes, in rangeland; 1,000 feet east and 1,800 feet south of the northwest corner of sec. 17, T. 37 N., R. 5 E.

A—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; slightly effervescent; mildly alkaline; clear wavy boundary.

BC—5 to 12 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few soft shale chips; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cr—12 to 60 inches; light brownish gray (2.5Y 6/2) semiconsolidated shale, grayish brown (2.5Y 5/2) moist; brownish yellow (10YR 6/6) stains on some plates; slightly effervescent; moderately alkaline.

### Range in Characteristics

*Depth to the Cr horizon:* 10 to 20 inches

#### A horizon

Hue: 2.5Y or 5Y  
 Value: 5, 6 or 7 dry; 3, 4 or 5 moist  
 Chroma: 2 or 3  
 Clay content: 40 to 50 percent  
 Reaction: pH 7.4 to 8.4

#### BC horizon

Hue: 2.5Y or 5Y  
 Value: 5, 6, 7 or 8 dry; 4, 5 or 6 moist  
 Chroma: 1, 2, 3, or 4  
 Texture: Silty clay loam, clay loam, or silty clay  
 Clay content: 35 to 50 percent  
 Reaction: pH 7.4 to 8.4

## Weingart Series

*Depth class:* Moderately deep (20 to 40 inches)  
*Drainage class:* Well drained  
*Permeability:* Very slow (less than 0.06 inch/hour)  
*Landform:* Alluviol fans or stream terraces  
*Parent material:* Residuum weathered from semiconsolidated shale  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine, montmorillonitic Typic Natriboralfs

### Typical Pedon

Weingart clay loam, in an area of Creed-Weingart complex, 2 to 8 percent slopes, in rangeland; 1,800 feet south and 700 feet east of the northwest corner of sec. 9, T. 37 N., R. 7 E.

E—0 to 2 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak very thin platy structure; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt wavy boundary.

Btn1—2 to 5 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong medium columnar structure parting to moderate medium prismatic; very hard, firm, sticky and plastic; many distinct clay films on faces of peds; strongly alkaline; clear wavy boundary.

Btn2—5 to 10 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; very hard, firm, sticky and plastic; many distinct clay films on faces of peds; strongly alkaline; clear wavy boundary.

Bknyz—10 to 25 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate medium and fine subangular blocky structure; very hard, firm, sticky and plastic; common fine soft masses of lime; common fine and medium soft masses of gypsum; strongly effervescent; strongly alkaline; gradual wavy boundary.

Cr—25 to 60 inches; pale olive (5Y 6/3) and light gray (5Y 7/2) semiconsolidated shale, olive (5Y 5/3) and light olive gray (5Y 6/2) moist; few fine prominent strong brown (7.5YR 5/6) redox concentrations; strongly alkaline.

### Range in Characteristics

*Depth to the Cr horizon:* 20 to 40 inches

*E horizon*

Hue: 10YR or 2.5Y  
 Value: 5, 6, or 7 dry; 3, 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Clay content: 27 to 40 percent  
 Content of rock fragments: 0 to 10 percent—  
 0 to 10 percent stones and cobbles, 0 to 5  
 percent hard shale, 0 to 5 percent soft shale  
 Reaction: pH 5.6 to 7.8

*Btn horizons*

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 2, 3, or 4  
 Texture: Clay, silty clay, or sandy clay  
 Clay content: 35 to 60 percent  
 Content of rock fragments: 0 to 10 percent—  
 0 to 5 percent hard shale, 0 to 5 percent soft  
 shale  
 Electrical conductivity: 2 to 8 mmhos/cm  
 Sodium adsorption ratio: 10 to 30  
 Reaction: pH 6.6 to 9.0  
 Other features: When the SAR is less than 13,  
 there is more exchangeable magnesium plus  
 sodium then calcium plus exchange acidity

*Bknyz horizon*

Hue: 2.5Y or 5Y  
 Value: 5 or 6 dry; 4 or 5 moist  
 Chroma: 1, 2, 3, or 4  
 Texture: Clay, silty clay, clay loam, or silty clay  
 loam  
 Clay content: 35 to 55 percent  
 Content of rock fragments: 0 to 10 percent—  
 0 to 5 percent hard shale, 0 to 5 percent soft  
 shale  
 Electrical conductivity: 4 to 16 mmhos/cm  
 Sodium adsorption ratio: 13 to 30  
 Gypsum content: 1 to 5 percent  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.8 to 9.6

**Whitlash Series**

*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderate (0.6 to 2.0 inches/hour)  
*Landform:* Mountains  
*Parent material:* Colluvium and material weathered  
 from igneous rocks  
*Slope range:* 25 to 70 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Loamy-skeletal, mixed Lithic  
 Haploborolls

**Typical Pedon**

Whitlash gravelly loam, in an area of Perma-  
 Whitlash gravelly loams, 25 to 70 percent slopes, in  
 rangeland; 2,400 feet east and 2,800 feet south of the  
 northwest corner of sec. 13, T. 36 N., R. 4 E.

- A1—0 to 4 inches; dark grayish brown (10YR 4/2)  
 gravelly loam, very dark grayish brown (10YR  
 3/2) moist; moderate medium and fine granular  
 structure; soft, very friable, slightly sticky and  
 slightly plastic; 20 percent pebbles; neutral; clear  
 smooth boundary.
- A2—4 to 9 inches; dark grayish brown (10YR 4/2)  
 gravelly loam, very dark grayish brown (10YR  
 3/2) moist; moderate medium subangular blocky  
 structure parting to moderate medium and fine  
 granular; slightly hard, very friable, slightly sticky  
 and slightly plastic; 20 percent pebbles, 5 percent  
 cobbles; neutral; clear smooth boundary.
- Bw—9 to 16 inches; brown (10YR 5/3) very gravelly  
 loam, brown (10YR 4/3) moist; moderate medium  
 subangular blocky structure; slightly hard, very  
 friable, slightly sticky and slightly plastic; 35  
 percent pebbles, 15 percent cobbles; neutral;  
 abrupt smooth boundary.
- R—16 inches; igneous bedrock.

**Range in Characteristics**

*Mollic epipedon thickness:* 7 to 15 inches

*Depth to bedrock:* 10 to 20 inches

*A horizons*

Value: 3 or 4 dry; 2 or 3 moist  
 Chroma: 1, 2, or 3  
 Clay content: 10 to 27 percent and less than 35  
 percent fine and coarser sand  
 Content of rock fragments: 15 to 60 percent—  
 15 to 35 percent pebbles or channers, 0 to 30  
 percent cobbles, flagstones, or stones  
 Rock fragments, surface cover: 0.01 to 3 percent  
 stones  
 Reaction: pH 6.1 to 7.3

*Bw horizon*

Value: 4 or 5 dry; 3 or 4 moist  
 Chroma: 2 or 3  
 Texture: Loam, sandy clay loam, or sandy loam  
 Clay content: 10 to 27 percent and less than 35  
 percent fine and coarser sand  
 Content of rock fragments: 35 to 80 percent—  
 15 to 60 percent pebbles or channers, 5 to 50  
 percent cobbles, flagstones, or stones

Reaction: pH 6.1 to 7.3

Other features: Some pedons have a C horizon

## 892F—Whitlash-Rock outcrop complex, 25 to 70 percent slopes

### Setting

*Landform:* Mountains

*Position on landform:* Back slopes

*Slope:* 25 to 70 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Whitlash and similar soils: 60 percent

Rock outcrop: 30 percent

#### Minor Components

Soils that have slopes less than 25 percent:

0 to 2 percent

Soils that have slopes more than 70 percent:

0 to 2 percent

Perma and similar soils: 0 to 2 percent

Whitlash very cobbly loam: 0 to 2 percent

Areas of rubble land: 0 to 2 percent

### Major Component Description

#### Whitlash

*Surface layer texture:* Gravelly loam

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Material weathered from igneous rocks

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 1.7 inches

#### Rock outcrop

*Definition:* Exposures of igneous and metamorphic bedrock

#### Williams Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Slow (0.06 to 0.2 inch/hour)

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 0 to 8 percent

*Annual precipitation:* 13 to 17 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed Typic Argiborolls

#### Typical Pedon

Williams loam, in an area of Williams-Vida complex, 4 to 8 percent slopes, in cropland; 300 feet east and 700 feet south of the northwest corner of sec. 16, T. 37 N., R. 5 E.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate very fine and fine granular; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bt1—5 to 10 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, sticky and plastic; common distinct clay films on faces of peds; neutral; clear smooth boundary.

Bt2—10 to 17 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, sticky and plastic; common distinct clay films on faces of peds; neutral; gradual smooth boundary.

Bk1—17 to 30 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; many fine soft masses of lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—30 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; many fine soft masses of lime; strongly effervescent; moderately alkaline.

### Range in Characteristics

*Mollic epipedon thickness:* 7 to 15 inches and may include all or part of the Bt horizons

*Depth to the Bk horizon:* 10 to 25 inches

#### Ap horizon

Hue: 10YR

Value: 3, 4, or 5 dry; 2 or 3 moist

Chroma: 2 (some pedons in native grassland have

a moist chroma of less than 1.5 in the upper 1 to 3 inches)  
 Clay content: 15 to 27 percent  
 Reaction: pH 6.6 to 7.3

**Bt horizons**

Hue: 10YR or 2.5Y  
 Value: 4, 5, or 6 dry; 2, 3, 4, or 5 moist  
 Chroma: 2 to 4  
 Texture: Loam or clay loam  
 Clay content: 22 to 35 percent clay  
 Structure: Strong or moderate, medium or coarse prismatic that parts to strong or moderate, medium or fine angular, or subangular blocky  
 Reaction: pH 6.6 to 7.8

**Bk horizons**

Hue: 10YR, 2.5Y, or 5Y  
 Value: 4, 5, 6, 7, or 8 dry; 3, 4, 5, or 6 moist  
 Chroma: 2 to 4  
 Texture: Loam or clay loam  
 Calcium carbonate equivalent: 5 to 15 percent  
 Reaction: pH 7.4 to 8.4

**801B—Williams-Vida complex, 0 to 4 percent slopes****Setting****Landform:**

- Williams—Till plains
- Vida—Till plains

**Position on landform:**

- Williams—Foot slopes and toe slopes
- Vida—Back slopes and shoulders

**Slope:**

- Williams—0 to 4 percent
- Vida—0 to 4 percent

**Elevation:** 3,460 to 5,200 feet

**Mean annual precipitation:** 13 to 17 inches

**Frost-free period:** 90 to 110 days

**Composition****Major Components**

Williams and similar soils: 55 percent  
 Vida and similar soils: 35 percent

**Minor Components**

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 Nishon and similar soils: 0 to 2 percent  
 Reeder and similar soils: 0 to 2 percent

Vida gravelly clay loam: 0 to 3 percent

**Major Component Description****Williams**

**Surface layer texture:** Loam  
**Depth class:** Very deep (more than 60 inches)  
**Drainage class:** Well drained  
**Dominant parent material:** Till  
**Native plant cover type:** Rangeland  
**Flooding:** None  
**Available water capacity:** 10.5 inches

**Vida**

**Surface layer texture:** Clay loam  
**Depth class:** Very deep (more than 60 inches)  
**Drainage class:** Well drained  
**Dominant parent material:** Till  
**Native plant cover type:** Rangeland  
**Flooding:** None  
**Available water capacity:** 9.6 inches

**801C—Williams-Vida complex, 4 to 8 percent slopes****Setting****Landform:**

- Williams—Till plains
- Vida—Till plains

**Position on landform:**

- Williams—Back slopes and foot slopes
- Vida—Shoulders

**Slope:**

- Williams—4 to 8 percent
- Vida—4 to 8 percent

**Elevation:** 3,460 to 5,200 feet

**Mean annual precipitation:** 13 to 17 inches

**Frost-free period:** 90 to 110 days

**Composition****Major Components**

Williams and similar soils: 55 percent  
 Vida and similar soils: 35 percent

**Minor Components**

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Nishon and similar soils: 0 to 2 percent  
 Reeder and similar soils: 0 to 2 percent  
 Vida gravelly clay loam: 0 to 2 percent

Soils that have slopes less than 4 percent:  
0 to 2 percent

### **Major Component Description**

#### **Williams**

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 10.5 inches

#### **Vida**

*Surface layer texture:* Clay loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Till  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.6 inches

### **Winspect Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour)  
*Landform:* Mountains  
*Parent material:* Limestone colluvium  
*Slope range:* 25 to 60 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Loamy-skeletal, mixed Typic  
Calciborolls

#### **Typical Pedon**

Winspect cobbly loam, in an area of Winspect-Winspect, cool-Rock outcrop complex, 25 to 60 percent slopes, in rangeland; 2,700 feet east and 1,600 feet north of the southwest corner of sec. 9, T. 36 N., R. 5 E.

A—0 to 3 inches; dark grayish brown (10YR 4/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; 10 percent cobbles, 10 percent pebbles; mildly alkaline; clear smooth boundary.

Bk1—3 to 8 inches; brown (10YR 5/3) cobbly loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable,

slightly sticky and slightly plastic; 15 percent cobbles, 10 percent pebbles; disseminated lime with lime coatings on underside of coarse fragments; strongly effervescent; mildly alkaline; clear wavy boundary.

Bk2—8 to 18 inches; light brownish gray (10YR 6/2) very cobbly loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; 20 percent cobbles, 20 percent pebbles; disseminated with lime coating underside of coarse fragments; violently effervescent; moderately alkaline; gradual wavy boundary.

C—18 to 60 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; 25 percent cobbles, 25 percent pebbles; violently effervescent; moderately alkaline.

### **Range in Characteristics**

*Mollic epipedon thickness:* 7 to 14 inches

#### *A horizon*

Value: 4 or 5 dry; 2 or 3 moist  
Chroma: 1 or 2  
Clay content: 20 to 25 percent  
Content of rock fragments: 15 to 30 percent—  
0 to 5 percent stones, 5 to 15 percent cobbles,  
10 to 15 percent pebbles  
Reaction: pH 7.4 to 8.4

#### *Bk1 horizon*

Hue: 10YR or 2.5Y  
Value: 5 or 6 dry; 4 or 5 moist  
Chroma: 2 or 3  
Clay content: 20 to 30 percent  
Content of rock fragments: 35 to 60 percent—  
0 to 5 percent stones, 5 to 25 percent cobbles,  
20 to 35 percent pebbles  
Calcium carbonate equivalent: 10 to 40 percent  
Reaction: pH 7.9 to 8.4

#### *Bk2 horizon*

Hue: 10YR or 2.5Y  
Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
Chroma: 2 or 3  
Texture: Loam, clay loam, or sandy clay loam  
Clay content: 20 to 30 percent  
Content of rock fragments: 35 to 60 percent—  
10 to 25 percent cobbles, 25 to 35 percent  
pebbles  
Calcium carbonate equivalent: 15 to 40 percent  
Reaction: pH 7.4 to 8.4

*C horizon*

Hue: 10YR or 2.5Y  
 Value: 5, 6, or 7 dry; 4, 5, or 6 moist  
 Chroma: 2 or 3  
 Texture: Loam, clay loam, or sandy clay loam  
 Clay content: 20 to 35 percent  
 Content of rock fragments: 35 to 60 percent—  
 10 to 25 percent cobbles, 25 to 35 percent  
 pebbles  
 Reaction: pH 7.4 to 8.4

### 702F—Winspect-Winspect,cool-Rock outcrop complex, 25 to 60 percent slopes

#### Setting

*Landform:*

- Winspect—Mountains
- Winspect—Mountains

*Position on landform:*

- Winspect—Back slopes
- Winspect—Back slopes

*Slope:*

- Winspect—25 to 60 percent, southeast aspect
- Winspect—25 to 60 percent, north aspect

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

#### Composition

#### Major Components

Winspect and similar soils: 40 percent  
 Winspect and similar soils: 30 percent  
 Rock outcrop: 20 percent

#### Minor Components

Soils that have slopes less than 25 percent:  
 0 to 3 percent  
 Soils that have slopes more than 60 percent:  
 0 to 3 percent  
 Perma gravelly loam: 0 to 2 percent  
 Whitlash and similar soils: 0 to 2 percent

#### Major Component Description

#### Winspect

*Surface layer texture:* Cobbly loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Limestone colluvium  
*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 6.0 inches

#### Winspect

*Surface layer texture:* Cobbly loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Limestone colluvium  
*Native plant cover type:* Forest land  
*Flooding:* None  
*Available water capacity:* 6.0 inches

#### Rock outcrop

*Definition:* Exposures of limestone bedrock

- “Forest Land” section

#### Work Series

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Moderately slow (0.2 to 0.6 inch/hour)  
*Landform:* Alluvial fans or stream terraces  
*Parent material:* Alluvium  
*Slope range:* 2 to 8 percent  
*Annual precipitation:* 15 to 19 inches  
*Annual air temperature:* 41 to 44 degrees F  
*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine, montmorillonitic Typic  
 Argiborolls

#### Typical Pedon

Work clay loam, 2 to 8 percent slopes, in  
 rangeland; 2,500 feet east and 2,000 feet south of  
 the northwest corner of sec. 15, T. 35 N., R. 4 E.

A—0 to 4 inches; dark grayish brown (10YR 4/2) clay  
 loam, very dark grayish brown (10YR 3/2) moist;  
 moderate fine and medium granular structure;  
 slightly hard, very friable, slightly sticky and  
 slightly plastic; neutral; clear wavy boundary.  
 Bt—4 to 12 inches; brown (10YR 4/3) clay, dark brown  
 (10YR 3/3) moist; moderate medium prismatic  
 structure parting to strong medium subangular  
 blocky; hard, firm, sticky and plastic; continuous  
 distinct clay films on faces of peds; neutral; clear  
 wavy boundary.  
 Btk—12 to 15 inches; brown (10YR 5/3) clay loam,  
 dark brown (10YR 4/3) moist; moderate medium  
 prismatic structure parting to strong medium  
 subangular blocky; hard, friable, sticky and plastic;  
 common distinct clay films on faces of peds;  
 disseminated lime; slightly effervescent; mildly  
 alkaline; clear wavy boundary.

- Bk1**—15 to 22 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium soft masses of lime; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bk2**—22 to 33 inches; grayish brown (2.5Y 5/2) gravelly clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 15 percent pebbles; common fine and medium soft masses of lime and lime coating pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bk3**—33 to 60 inches; grayish brown (2.5Y 5/2) gravelly clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 25 percent pebbles, 5 percent cobbles; common fine and medium soft masses of lime and lime coating pebbles; strongly effervescent; moderately alkaline.

#### Range in Characteristics

*Mollic epipedon thickness:* 10 to 16 inches (includes all or part of the Bt horizons)

*Depth to the Btk horizon:* 12 to 30 inches

#### A horizon

Value: 4 or 5 dry; 2 or 3 moist

Chroma: 2 or 3

Clay content: 27 to 40 percent

Content of rock fragments: 0 to 60 percent—  
0 to 30 percent stones or cobbles, 0 to 30 percent pebbles

Reaction: pH 6.1 to 7.8

#### Bt horizon

Value: 4 or 5 dry; 2, 3, or 4 moist

Chroma: 2 or 3

Texture: Clay loam, clay, or silty clay

Clay content: 35 to 50 percent and more than 15 percent fine sand and coarser

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles or stones, 0 to 10 percent pebbles

Reaction: pH 6.6 to 7.8

#### Btk horizon

Hue: 10YR or 2.5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2 or 3

Texture: Clay or clay loam

Clay content: 20 to 40 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles or stones, 0 to 10 percent pebbles

Reaction: pH 6.6 to 7.8

#### Bk horizons

Hue: 10YR or 2.5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam or clay loam

Clay content: 20 to 40 percent

Content of rock fragments: 0 to 35 percent—  
0 to 5 percent cobbles, 0 to 30 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Reaction: pH 7.4 to 8.4

### 86C—Work clay loam, 2 to 8 percent slopes

#### Setting

*Landform:* Alluvial fans and stream terraces

*Slope:* 2 to 8 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 15 to 19 inches

*Frost-free period:* 90 to 110 days

#### Composition

#### Major Components

Work and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 8 percent:  
0 to 2 percent

Farnuf loam: 0 to 2 percent

Tamaneen cobbly clay loam: 0 to 3 percent

Soils that have slopes less than 2 percent:  
0 to 3 percent

#### Major Component Description

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Alluvium

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 8.4 inches

## Yamacall Series

*Depth class:* Very deep (greater than 60 inches)

*Drainage class:* Well drained

*Permeability:* Moderate (0.6 to 2.0 inches/hour)

*Landform:* Alluvial fans

*Parent material:* Alluvium

*Slope range:* 0 to 8 percent

*Annual precipitation:* 10 to 14 inches

*Annual air temperature:* 43 to 45 degrees F

*Frost-free period:* 105 to 120 days

**Taxonomic class:** Fine-loamy, mixed, frigid Aridic  
Ustochrepts

### Typical Pedon

Yamacall loam, 0 to 4 percent slopes, in cropland; 100 feet west and 900 feet north of the southeast corner of sec. 13, T. 35 N., R. 7 E.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak fine and medium subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

Bw—5 to 12 inches; light yellowish brown (2.5Y 6/4) loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; clear smooth boundary.

Bk—12 to 27 inches; light yellowish brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine soft masses of lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bky1—27 to 40 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine soft masses and threads of lime; common fine nests of gypsum; strongly effervescent; moderately alkaline; clear smooth boundary.

Bky2—40 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist;

massive; hard, friable, sticky and slightly plastic; many fine soft masses and threads of lime; many fine nests of gypsum; strongly effervescent; strongly alkaline.

### Range in Characteristics

*Depth to the Bk horizon:* 10 to 20 inches

*Soil phases:* Calcareous

#### Ap horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Clay content: 18 to 27 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles, 0 to 10 percent pebbles

Effervescence: None to strong

Reaction: pH 6.6 to 8.4

Other features: This horizon when mixed to 7 inches will not meet the requirements for a mollic epipedon

#### Bw horizon

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam, clay loam, or silt loam

Clay content: 18 to 30 percent with 15 to 35 percent fine sand and coarser

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles, 0 to 10 percent pebbles

Effervescence: None to strong

Reaction: pH 6.6 to 8.4

#### Bk and Bky horizons

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, 7, or 8 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam, clay loam, or silt loam

Clay content: 18 to 30 percent with 15 to 35 percent fine sand and coarser

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent cobbles, 0 to 10 percent pebbles

Electrical conductivity: 0 to 4 mmhos/cm

Gypsum: 0 to 1 percent

Calcium carbonate equivalent: 5 to 15 percent

Effervescence: Strong or violent

Reaction: pH 7.9 to 9.0

### 79B—Yamacall loam, 0 to 4 percent slopes

#### Setting

*Landform:* Alluvial fans  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Yamacall and similar soils: 90 percent

##### Minor Components

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 Benz and similar soils: 0 to 2 percent  
 Yamacall, calcareous surface: 0 to 3 percent  
 Yamacall clay loam: 0 to 2 percent

#### Major Component Description

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.7 inches

### 791B—Yamacall loam, calcareous, 0 to 4 percent slopes

#### Setting

*Landform:* Alluvial fans  
*Slope:* 0 to 4 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Yamacall and similar soils: 90 percent

##### Minor Components

Soils that have slopes more than 4 percent:  
 0 to 3 percent  
 Lambeth silt loam: 0 to 3 percent  
 Yamacall, calcareous surface: 0 to 4 percent

#### Major Component Description

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.7 inches

### 605C—Yamacall-Havre loams, 0 to 8 percent slopes

#### Setting

*Landform:*

- Yamacall—Alluvial fans
- Havre—Flood plains

*Slope:*

- Yamacall—0 to 8 percent
- Havre—0 to 2 percent

*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

#### Composition

##### Major Components

Yamacall and similar soils: 50 percent  
 Havre and similar soils: 40 percent

##### Minor Components

Soils that have slopes more than 8 percent:  
 0 to 2 percent  
 Bigsandy and similar soils: 0 to 2 percent  
 Benz and similar soils: 0 to 2 percent  
 Beaverell loam: 0 to 2 percent  
 Glendive sandy loam: 0 to 2 percent

#### Major Component Description

##### Yamacall

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 9.7 inches

##### Havre

*Surface layer texture:* Loam  
*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained  
*Dominant parent material:* Alluvium  
*Native plant cover type:* Rangeland  
*Flooding:* Occasional  
*Available water capacity:* 9.7 inches

### **Yawdim Series**

*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Hills  
*Parent material:* Residuum weathered from shale  
*Slope range:* 4 to 70 percent  
*Annual precipitation:* 10 to 14 inches  
*Annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 105 to 120 days

**Taxonomic class:** Clayey, montmorillonitic  
 (calcareous), frigid, shallow Aridic Ustorthents

### **Typical Pedon**

Yawdim silty clay, in an area of Hillon-Cabbart-Yawdim complex, 25 to 70 percent slopes, in rangeland; 2,300 feet east and 2,600 feet north of the southwest corner of sec. 25, T. 29 N., R. 5 E.

A—0 to 3 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak fine platy structure parting to moderate fine granular; slightly hard, firm, sticky and plastic; disseminated lime; strongly effervescent; mildly alkaline; clear smooth boundary.

C—3 to 12 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, very firm, sticky and plastic; disseminated lime; slightly effervescent; moderately alkaline; clear wavy boundary.

Cr—12 to 60 inches; light brownish gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/4) semiconsolidated shale; slightly effervescent.

### **Range in Characteristics**

*Depth to the Cr horizon:* 10 to 20 inches

#### *A horizon*

Hue: 10YR or 2.5Y  
 Value: 5 or 6 dry; 3 or 4 moist  
 Chroma: 1 or 2  
 Clay content: 40 to 50 percent  
 Reaction: pH 6.6 to 7.8

#### *C horizon*

Hue: 10YR, 2.5Y, or 5Y  
 Value: 5, 6, 7 or 8 dry; 4, 5, or 6 moist  
 Chroma: 1, 2, 3, or 4  
 Texture: Silty clay loam, clay loam, or clay  
 Clay content: 35 to 50 percent  
 Reaction: pH 7.4 to 8.4

## **18E—Yawdim silty clay, 8 to 25 percent slopes**

### **Setting**

*Landform:* Hills  
*Slope:* 8 to 25 percent  
*Elevation:* 2,750 to 3,460 feet  
*Mean annual precipitation:* 10 to 14 inches  
*Frost-free period:* 105 to 120 days

### **Composition**

#### **Major Components**

Yawdim and similar soils: 90 percent

#### **Minor Components**

Soils that have slopes more than 25 percent:  
 0 to 2 percent  
 Areas of Rock outcrop: 0 to 2 percent  
 Marvan and similar soils: 0 to 1 percent  
 Soils that have slopes less than 8 percent:  
 0 to 2 percent  
 Delpoint and similar soils: 0 to 2 percent  
 Kobase and similar soils: 0 to 1 percent

### **Major Component Description**

*Surface layer texture:* Silty clay  
*Depth class:* Shallow (10 to 20 inches)  
*Drainage class:* Well drained  
*Dominant parent material:* Shale residuum  
*Native plant cover type:* Rangeland  
*Flooding:* None  
*Available water capacity:* 2.0 inches

## **Zahill Series**

*Depth class:* Very deep (greater than 60 inches)  
*Drainage class:* Well drained  
*Permeability:* Slow (0.06 to 0.2 inch/hour)  
*Landform:* Hills or till plains  
*Parent material:* Glacial till  
*Slope range:* 2 to 60 percent

*Annual precipitation:* 13 to 19 inches

*Annual air temperature:* 41 to 44 degrees F

*Frost-free period:* 90 to 110 days

**Taxonomic class:** Fine-loamy, mixed (calcareous)  
frigid Typic Ustorthents

### Typical Pedon

Zahill clay loam, in an area of Vida-Zahill clay loams, 8 to 25 percent slopes, in cropland; 2,100 feet west and 900 feet south of the northeast corner of sec. 10, T. 37 N., R. 4 E.

Ap—0 to 6 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—6 to 16 inches; olive gray (5Y 5/2) clay loam, olive gray (5Y 4/2) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; common medium soft masses of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

C—16 to 60 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; massive; hard, firm, slightly sticky and slightly plastic; disseminated lime; strongly effervescent; moderately alkaline.

### Range in Characteristics

#### *Ap horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Clay content: 27 to 35 percent

Content of rock fragments: 0 to 35 percent—  
0 to 15 percent cobbles and stones, 0 to 20  
percent pebbles

Reaction: pH 7.4 to 8.4

#### *Bk horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5, 6, or 7 dry; 4, 5, or 6 moist

Chroma: 2, 3, or 4

Texture: Loam or clay loam

Clay content: 25 to 35 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent stones or cobbles, 0 to 10  
percent pebbles

Calcium carbonate equivalent: 8 to 15 percent

Effervescence: Strong or violent

Reaction: pH 7.4 to 8.4

#### *C horizon*

Hue: 10YR, 2.5Y, or 5Y

Value: 5 or 6 dry; 4 or 5 moist

Chroma: 2, 3, or 4

Texture: Loam or clay loam

Clay content: 20 to 35 percent

Content of rock fragments: 0 to 15 percent—  
0 to 5 percent stones or cobbles, 0 to 10  
percent pebbles

Effervescence: Slight or strong

Gypsum content: 1 to 5 percent

Reaction: pH 7.4 to 9.0

## 72F—Zahill clay loam, 25 to 60 percent slopes

### Setting

*Landform:* Hills

*Slope:* 25 to 60 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 19 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Zahill and similar soils: 90 percent

#### Minor Components

Soils that have slopes more than 60 percent:  
0 to 2 percent

Zahill gravelly clay loam: 0 to 2 percent

Soils that have slopes less than 25 percent:  
0 to 2 percent

Vida, calcareous surface: 0 to 2 percent

Areas of Rock outcrop: 0 to 2 percent

### Major Component Description

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 9.6 inches

## 723F—Zahill-Cabba complex, 15 to 45 percent slopes

### Setting

#### Landform:

- Zahill—Hills
- Cabba—Hills

#### Position on landform:

- Zahill—Shoulders and summits
- Cabba—Back slopes

#### Slope:

- Zahill—15 to 45 percent
- Cabba—15 to 45 percent

*Elevation:* 3,460 to 5,200 feet

*Mean annual precipitation:* 13 to 17 inches

*Frost-free period:* 90 to 110 days

### Composition

#### Major Components

Zahill and similar soils: 55 percent  
Cabba and similar soils: 35 percent

#### Minor Components

Soils that have slopes more than 45 percent:  
0 to 3 percent

Areas of Rock outcrop: 0 to 4 percent  
Soils that have slopes less than 15 percent:  
0 to 3 percent

### Major Component Description

#### Zahill

*Surface layer texture:* Clay loam

*Depth class:* Very deep (more than 60 inches)

*Drainage class:* Well drained

*Dominant parent material:* Till

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 9.6 inches

#### Cabba

*Surface layer texture:* Loam

*Depth class:* Shallow (10 to 20 inches)

*Drainage class:* Well drained

*Dominant parent material:* Interbedded sandstone  
and shale residuum

*Native plant cover type:* Rangeland

*Flooding:* None

*Available water capacity:* 2.0 inches



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# Glossary

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**Ablation till.** Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvial fan.** A body of alluvium, with overflow of water and debris flow deposits, whose surface forms a segment of a cone that radiates downslope from the point where the stream emerges from a narrow valley onto a less sloping surface. Source uplands range in relief and areal extent from mountains to gullied terrains on hill slopes.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Animal-unit-month (AUM).** The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Argillite.** Weakly metamorphosed mudstone or shale.

**Association, soil.** A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low ..... 0 to 3.75

Low ..... 3.75 to 5.0

Moderate ..... 5.0 to 7.5

High ..... More than 7.5

**Avalanche chute.** The track or path formed by an avalanche.

**Back slope.** The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes in profile are commonly steep and linear and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

**Badland.** Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

**Basal area.** The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

**Basal till.** Compact glacial till deposited beneath the ice.

**Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

**Bedding planes.** Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bedrock-floored plain.** An extensive nearly level to gently rolling or moderately sloping area that is underlain by hard bedrock and has a slope of 0 to 8 percent.

- Bench terrace.** A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.
- Blowout.** A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.
- Board foot.** A unit of measure of the wood in lumber, logs, or trees. The amount of wood in a board one foot wide, one foot long, and one inch thick before finishing.
- Bottom land.** The normal flood plain of a stream, subject to flooding.
- Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.
- Breaks.** The steep or very steep broken land at the border of an upland summit that is dissected by ravines.
- Breast height.** An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.
- Brush management.** Use of mechanical, chemical, or biological methods to reduce or eliminate competition from woody vegetation and thus to allow understory grasses and forbs to recover or to make conditions favorable for reseeding. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.
- Cable yarding.** A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, a felled tree generally is reeled in while one end is lifted or the entire log is suspended.
- Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.
- Caliche.** A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.
- California bearing ratio (CBR).** The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.
- Canopy.** The leafy crown of trees or shrubs. (See Crown.)
- Capillary water.** Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.
- Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.
- Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.
- Catsteps.** Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.
- Channeled.** Refers to a drainage area in which natural meandering or repeated branching and convergence of a streambed have created deeply incised cuts, either active or abandoned, in alluvial material.
- Channery soil.** A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.
- Chemical treatment.** Control of unwanted vegetation by use of chemicals.
- Chiseling.** Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.
- Cirque.** A semicircular, concave, bowl-like area that has steep faces primarily resulting from erosive activity of a mountain glacier.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Clayey soil.** Silty clay, sandy clay, or clay.
- Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.
- Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Clearcut.** A method of forest harvesting that removes the entire stand of trees in one cutting.

Reproduction is achieved artificially or by natural seeding from adjacent stands.

**Climax plant community.** The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.

**Closed depression.** A low area completely surrounded by higher ground and having no natural outlet.

**Coarse textured soil.** Sand or loamy sand.

**Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

**Cobbly soil material.** Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

**Codominant trees.** Trees whose crowns form the general level of the forest canopy and that receive full light from above but comparatively little from the sides.

**Colluvium.** Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Commercial forest.** Forest land capable of producing 20 cubic feet or more per acre per year at the culmination of mean annual increment.

**Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

**Compressible** (in tables). Excessive decrease in volume of soft soil under load.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conglomerate.** A coarse grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It

commonly has a matrix of sand and finer material. Conglomerate is the consolidated equivalent of gravel.

**Conservation cropping system.** Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

**Conservation tillage.** Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the soil surface after planting in order to reduce the hazard of water erosion; in areas where soil blowing is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or the equivalent during the critical erosion period.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Consolidated sandstone.** Sandstone that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry, are not easily crushed, and cannot be textured by the usual field method.

**Consolidated shale.** Shale that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry and are not easily crushed.

**Contour stripcropping (or contour farming).** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Coprogenous earth (sedimentary peat).** Fecal material deposited in water by aquatic organisms.

**Corrosion.** Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cropping system.** Growing crops according to a planned system of rotation and management practices.

**Crop residue management.** Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

**Cross-slope farming.** Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

**Crown.** The upper part of a tree or shrub, including the living branches and their foliage.

**Culmination of the mean annual increment (CMAI).** The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Decreasers.** The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

**Deep soil.** A soil that is 40 to 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Deferred grazing.** Postponing grazing or arresting grazing for a prescribed period.

**Dense layer** (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Dip slope.** A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rock.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Divided-slope farming.** A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit the use of a full stripcropping pattern.

**Dominant trees.** Trees whose crowns form the general level of the forest canopy and that receive full light from above and from the sides.

**Drainage class (natural).** Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

*Somewhat excessively drained.*—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

*Well drained.*—These soils have an intermediate water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

*Moderately well drained.*—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless

a drainage system is installed. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

*Somewhat poorly drained.*—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless a drainage system is installed. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

*Poorly drained.*—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

*Very poorly drained.*—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except rice) unless a drainage system is installed.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Drainageway.** An area of ground at a lower elevation than the surrounding ground and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may or may not have distinctly incised channels at its upper reaches or throughout its course.

**Drumlin.** A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

**Duff.** A term used to identify a generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

**Dune.** A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Ephemeral stream.** A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion (geologic).* Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion (accelerated).* Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

**Erosion pavement.** A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

**Escarpment.** A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.

**Esker.** A long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that were deposited by a subsurface stream flowing between ice walls or through ice tunnels of a retreating glacier and that were left behind when the ice melted. Eskers range from less than a mile to more than 100 miles in length and from 10 to 100 feet in height.

**Even aged.** Refers to a stand of trees in which only small differences in age occur between the individuals. A range of 20 years is allowed.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**Excess lime** (in tables). Excess carbonates in the soil that restrict the growth of some plants.

**Excess salts** (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

**Excess sodium** (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

- Excess sulfur** (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.
- Extrusive rock.** Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.
- Fallow.** Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.
- Fast intake** (in tables). The rapid movement of water into the soil.
- Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.
- Fibric soil material (peat).** The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.
- Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.
- Fine textured soil.** Sandy clay, silty clay, or clay.
- Firebreak.** An area cleared of flammable material to stop or help control creeping or running fires. A firebreak also serves as a line from which to work and to facilitate the movement of fire fighters and equipment. Designated roads also serve as firebreaks.
- First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.
- Flaggy soil material.** Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.
- Flagstone.** A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.
- Flood plain.** A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the stream.
- Fluvial.** Of or pertaining to rivers; produced by river action, as a fluvial plain.
- Foothills.** A region of relatively low, rounded hills at the base of a mountain range.
- Foot slope.** The geomorphic component that forms the inner, gently inclined surface at the base of a hill slope. The surface profile is dominantly concave. In terms of gradational processes, a foot slope is a transition zone between an upslope site of erosion (back slope) and a downslope site of deposition (toe slope).
- Forb.** Any herbaceous plant not a grass or a sedge.
- Forest cover.** All trees and other woody plants (underbrush) covering the ground in a forest.
- Forest type.** A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.
- Fragile** (in tables). A soil that is easily damaged by use or disturbance.
- Fragipan.** A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.
- Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.
- Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.
- Giant ripple mark.** The undulating surface sculpture produced in noncoherent granular materials by currents of water and by the agitation of water in wave action during the draining of large glacial lakes, such as Glacial Lake Missoula.
- Glacial drift (geology).** Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.
- Glacial outwash (geology).** Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.
- Glacial till (geology).** Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

- Glaciated uplands.** Land areas that were previously covered by continental or alpine glaciers and that are at a higher elevation than the flood plain.
- Glaciofluvial deposits (geology).** Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.
- Glaciolacustrine deposits.** Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.
- Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.
- Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.
- Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.
- Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.
- Green manure crop (agronomy).** A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.
- Ground water (geology).** Water filling all the unblocked pores of the material below the water table.
- Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. A gullied map unit is one that has numerous gullies.
- Gypsum.** A mineral consisting of hydrous calcium sulfate.
- Habitat type.** An aggregation of all land areas potentially capable of producing similar plant communities at climax.
- Hard bedrock.** Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.
- Hardpan.** A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.
- Head out.** To form a flower head.
- Heavy metal.** Inorganic substances that are solid at ordinary temperatures and are not soluble in water. They form oxides and hydroxides that are basic. Examples are copper, iron, cadmium, zinc, manganese, lead, and arsenic.
- Hemic soil material (mucky peat).** Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.
- High-residue crops.** Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.
- Hill.** A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 8 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.
- Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:  
*O horizon.*—An organic layer of fresh and decaying plant residue.  
 A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.  
*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.  
*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.  
*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected

by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

*Cr horizon.*—Sedimentary beds of consolidated sandstone and semiconsolidated and consolidated shale. Generally, roots can penetrate this horizon only along fracture planes.

*R layer.*—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Igneous rock.** Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Increasesers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and are less palatable to livestock.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration capacity.** The maximum rate at which water can infiltrate into a soil under a given set of conditions.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2 .....	Very low
0.2 to 0.4 .....	Low
0.4 to 0.75 .....	Moderately low
0.75 to 1.25 .....	Moderate
1.25 to 1.75 .....	Moderately high
1.75 to 2.5 .....	High
More than 2.5 .....	Very high

**Intermittent stream.** A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

**Invaders.** On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are:  
*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.  
*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Kame.** A moundlike hill of glacial drift, composed chiefly of stratified sand and gravel.

**Kame terrace.** A terracelike ridge consisting of stratified sand and gravel that were deposited by a meltwater stream flowing between a melting glacier and a higher valley wall or lateral moraine and that remained after the disappearance of the ice. It is commonly pitted with kettles and has an irregular ice-contact slope.

**Lacustrine deposit (geology).** Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Lake plain.** A surface marking the floor of an extinct lake, filled in by well sorted, stratified sediments.

**Landslide.** The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Lateral moraine.** A ridgelike moraine carried on and deposited at the side margin of a valley glacier. It is composed chiefly of rock fragments derived from the valley walls by glacial abrasion and plucking or by mass wasting.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loamy soil.** Coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silt, clay loam, sandy clay loam, or silty clay loam.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by the wind.

**Low-residue crops.** Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

**Low strength.** The soil is not strong enough to support loads.

**Marl.** An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

**Mean annual increment (MAI).** The average annual increase in volume of a tree during the entire life of the tree.

**Mechanical treatment.** Use of mechanical equipment for seeding, brush management, and other management practices.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Merchantable trees.** Trees that are of sufficient size to be economically processed into wood products.

**Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

**Microhigh.** An area that is 2 to 12 inches higher than the adjacent microlow.

**Microlow.** An area that is 2 to 12 inches lower than the adjacent microhigh.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.

**Miscellaneous water.** A sewage lagoon, an industrial waste pit, a fish hatchery, or a similar water area.

**Moderately coarse textured soil.** Coarse sandy loam, sandy loam, or fine sandy loam.

**Moderately deep soil.** A soil that is 20 to 40 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.

**Moraine.** An accumulation of glacial drift in a topographic landform of its own, resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—

*few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Mountain.** A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of limited summit area and generally having steep sides (slopes greater than 25 percent) and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are primarily formed by deep-seated earth movements or volcanic action and secondarily by differential erosion.

**Muck.** Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

**Mudstone.** Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Observed rooting depth.** Depth to which roots have been observed to penetrate.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Outwash plain.** An extensive area of glaciofluvial material that was deposited by meltwater streams.

**Overstory.** The trees in a forest that form the upper crown cover.

**Oxbow.** The horseshoe-shaped channel of a former meander, remaining after the stream formed a cutoff across a narrow meander neck.

**Pan.** A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan, and traffic pan.*

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Peat.** Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly** (in tables). The slow movement of water through the soil, adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow .....	Less than 0.06 inch
Slow .....	0.06 to 0.2 inch
Moderately slow .....	0.2 to 0.6 inch
Moderate .....	0.6 inch to 2.0 inches
Moderately rapid .....	2.0 to 6.0 inches
Rapid .....	6.0 to 20 inches
Very rapid .....	More than 20 inches

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Playa.** The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**Ponding.** Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

**Poor filter** (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

**Poorly graded.** Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Poor outlets** (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

**Potential native plant community.** See Climax plant community.

**Potential rooting depth (effective rooting depth).** Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

**Prescribed burning.** The application of fire to land under such conditions of weather, soil moisture, and time of day as presumably will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Proper grazing use.** Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

**Quartzite, metamorphic.** Rock consisting mainly of quartz that formed through recrystallization of quartz-rich sandstone or chert.

**Quartzite, sedimentary.** Very hard but unmetamorphosed sandstone consisting chiefly of quartz grains.

**Range condition.** The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

**Rangeland.** Land on which the potential natural vegetation is predominantly grasses, grasslike

plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

**Range site.** An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid .....	Below 4.5
Very strongly acid .....	4.5 to 5.0
Strongly acid .....	5.1 to 5.5
Medium acid .....	5.6 to 6.0
Slightly acid .....	6.1 to 6.5
Neutral .....	6.6 to 7.3
Mildly alkaline .....	7.4 to 7.8
Moderately alkaline .....	7.9 to 8.4
Strongly alkaline .....	8.5 to 9.0
Very strongly alkaline .....	9.1 and higher

**Recessional moraine.** A moraine formed during a temporary but significant halt in the retreat of a glacier.

**Red beds.** Sedimentary strata mainly red in color and composed largely of sandstone and shale.

**Regeneration.** The new growth of a natural plant community, developing from seed.

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

**Relict stream terrace.** One of a series of platforms in or adjacent to a stream valley that formed prior to the current stream system.

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

**Rill.** A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

**Riser.** The relatively short, steeply sloping area below a terrace tread that grades to a lower terrace tread or base level.

**Riverwash.** Unstable areas of sandy, silty, clayey, or gravelly sediments. These areas are flooded, washed, and reworked by rivers so frequently that they support little or no vegetation.

**Road cut.** A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rock outcrop.** Exposures of bare bedrock other than lava flows and rock-lined pits.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Rubble land.** Areas that have more than 90 percent of the surface covered by stones or boulders. Voids contain no soil material and virtually no vegetation other than lichens. The areas commonly are at the base of mountain slopes, but some are on mountain slopes as deposits of cobbles, stones, and boulders left by Pleistocene glaciation or by periglacial phenomena.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Saline soil.** A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

**Salinity.** The electrical conductivity of a saline soil. It is expressed, in millimhos per centimeter, as follows:

Nonsaline .....	0 to 4
Slightly saline .....	4 to 8
Moderately saline .....	8 to 16
Strongly saline .....	More than 16

**Salty water** (in tables). Water that is too salty for consumption by livestock.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-sized particles.

**Sandy soil.** Sand or loamy sand.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**Sawlogs.** Logs of suitable size and quality for the production of lumber.

**Scarification.** The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

**Scribner's log rule.** A method of estimating the number of board feet that can be cut from a log of a given diameter and length.

**Sedimentary plain.** An extensive nearly level to gently rolling or moderately sloping area that is underlain by sedimentary bedrock and that has a slope of 0 to 8 percent.

**Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

**Sedimentary uplands.** Land areas of bedrock formed from water- or wind-deposited sediments. They are higher on the landscape than the flood plain.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Semiconsolidated sedimentary beds.** Soft geologic sediments that disperse when fragments are placed in water. The fragments are hard or very hard when dry. Determining the texture by the usual field method is difficult.

**Sequum.** A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Shallow soil.** A soil that is 10 to 20 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shelterwood system.** A forest management system requiring the removal of a stand in a series of cuts so that regeneration occurs under a partial canopy. After regeneration, a final cut removes the shelterwood and allows the stand to develop in the open as an even-aged stand. The system is well suited to sites where shelter is needed for regeneration, and it can aid regeneration of the more intolerant tree species in a stand.

**Shoulder slope.** The uppermost inclined surface at the top of a hillside. It is the transition zone from the back slope to the summit of a hill or mountain. The surface is dominantly convex in profile and erosional in origin.

**Shrink-swell** (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silica.** A combination of silicon and oxygen. The mineral form is called quartz.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Siltstone.** Sedimentary rock made up of dominantly silt-sized particles.

**Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

**Sinkhole.** A depression in the landscape where limestone has been dissolved.

**Site class.** A grouping of site indexes into five to seven production capability levels. Each level can be represented by a site curve.

**Site curve (50-year).** A set of related curves on a graph that shows the average height of dominant or dominant and codominant trees for the range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant or dominant and codominant trees that are 50 years old or are 50 years old at breast height.

**Site curve (100-year).** A set of related curves on a graph that shows the average height of dominant or dominant and codominant trees for a range of

ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant or dominant and codominant trees that are 100 years old or are 100 years old at breast height.

**Site index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant or dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

**Skid trails.** Pathways along which logs are dragged to a common site for loading onto a logging truck.

**Slash.** The branches, bark, treetops, reject logs, and broken or uprooted trees left on the ground after logging.

**Slickens.** Accumulations of fine-textured material, such as material separated in placer-mine and ore-mill operations. Slickens from ore mills commonly consist of freshly ground rock that has undergone chemical treatment during the milling process.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slick spot.** A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is loamy or clayey, is slippery when wet, and is low in productivity.

**Slippage** (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

Nearly level .....	0 to 2 percent
Gently sloping .....	2 to 4 percent
Moderately sloping .....	4 to 8 percent
Strongly sloping .....	8 to 15 percent
Moderately steep .....	15 to 25 percent
Steep .....	25 to 45 percent
Very steep .....	More than 45 percent

**Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

**Slow intake** (in tables). The slow movement of water into the soil.

**Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Sodic (alkali) soil.** A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

**Sodicity.** The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of  $\text{Na}^+$  to  $\text{Ca}^{++} + \text{Mg}^{++}$ . The degrees of sodicity and their respective ratios are:

Slight .....	Less than 13:1
Moderate .....	13-30:1
Strong .....	More than 30:1

**Soft bedrock.** Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand .....	2.0 to 1.0
Coarse sand .....	1.0 to 0.5
Medium sand .....	0.5 to 0.25
Fine sand .....	0.25 to 0.10
Very fine sand .....	0.10 to 0.05
Silt .....	0.05 to 0.002
Clay .....	Less than 0.002

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant

and animal activities are largely confined to the solum.

**Species.** A single, distinct kind of plant or animal having certain distinguishing characteristics.

**Stone line.** A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Strath terrace.** A surface cut formed by the erosion of hard or semiconsolidated bedrock and thinly mantled with stream deposits.

**Stream channel.** The hollow bed where a natural stream of surface water flows or may flow; the deepest or central part of the bed, formed by the main current and covered more or less continuously by water.

**Stream terrace.** One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel. It originally formed near the level of the stream and is the dissected remnants of an abandoned flood plain, streambed, or valley floor that were produced during a former stage of erosion or deposition.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Stubble mulch.** Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Subsoiling.** Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that is restrictive to roots.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Technically, the E horizon.

Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

**Summer fallow.** The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

**Summit.** A general term for the top, or highest level, of an upland feature, such as a hill or mountain. It commonly refers to a higher area that has a gentle slope and is flanked by steeper slopes.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Tailwater.** The water directly downstream of a structure.

**Talus.** Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

**Terminal moraine.** A belt of thick glacial drift that generally marks the termination of important glacial advances. It commonly is a massive arcuate ridge or complex of ridges underlain by till and other types of drift.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

**Till plain.** An extensive nearly level to gently rolling or moderately sloping area that is underlain by or consists of till and that has a slope of 0 to 8 percent.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Toe slope.** The outermost inclined surface at the base of a hill. Toe slopes are commonly gentle and linear in profile.

**Too arid** (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Toxicity** (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

**Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

**Trafficability.** The degree to which a soil is capable of supporting vehicular traffic across a wide range in soil moisture conditions.

**Tread.** The relatively flat terrace surface that was cut or built by stream or wave action.

**Tuff.** A compacted deposit that is 50 percent or more volcanic ash and dust.

**Understory.** Any plants in a forest community that grow to a height of less than 5 feet.

**Unstable fill** (in tables). Risk of caving or sloughing on banks of fill material.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Valley.** An elongated depressional area primarily developed by stream action.

**Valley fill.** In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

**Variiegation.** Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

**Varve.** A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

**Very deep soil.** A soil that is more than 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Very shallow soil.** A soil that is less than 10 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Water bars.** Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the

downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

**Waterspreading.** Diverting runoff from natural channels by means of a system of dams, dikes, or ditches and spreading it over relatively flat surfaces.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

**Windthrow.** The action of uprooting and tipping over trees by the wind.