



United States
Department of
Agriculture

In cooperation with
the Montana Agricultural
Experiment Station

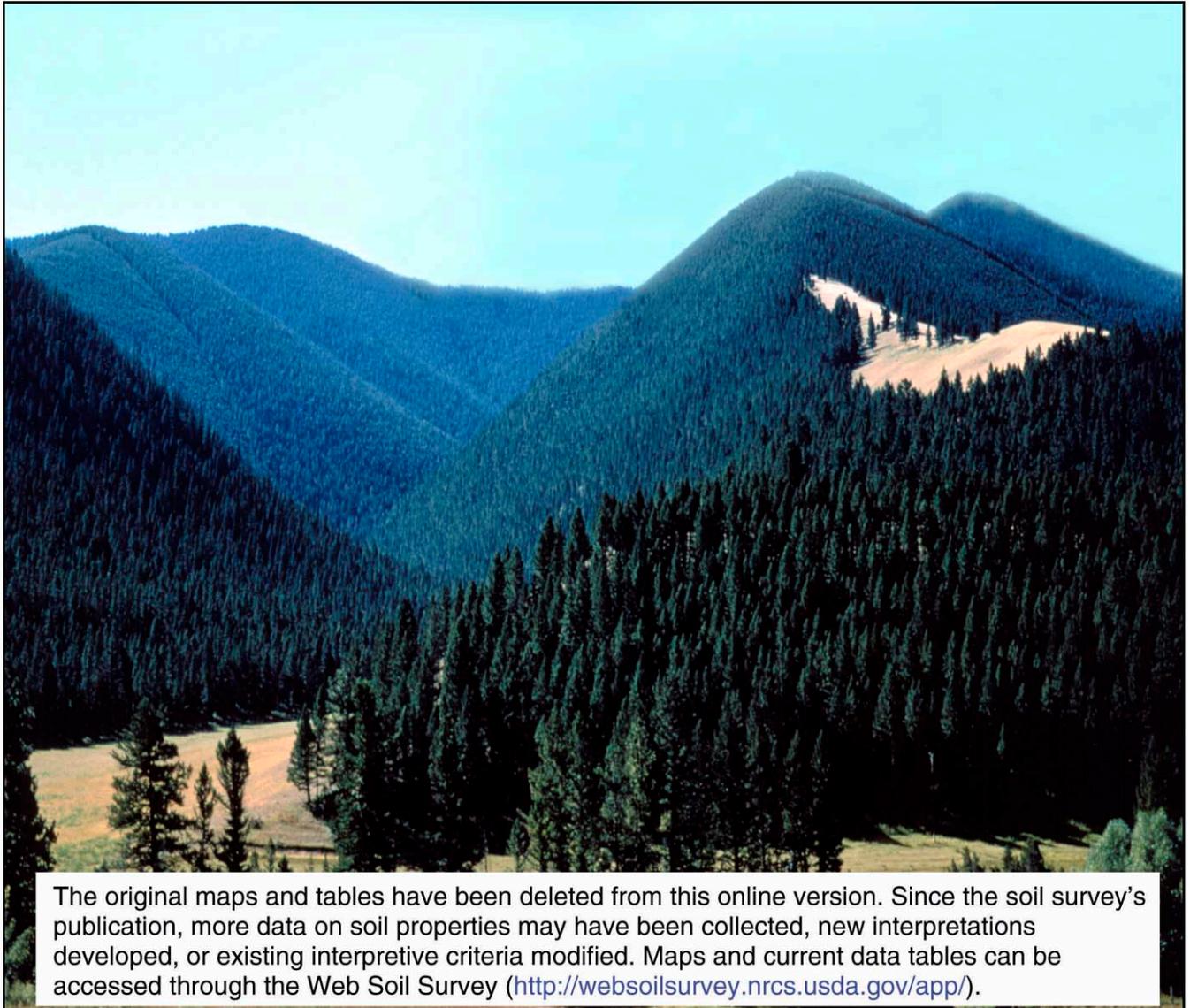
MT631—Soil Survey of Helena National Forest Area, Montana



Forest Service
and



Natural
Resources
Conservation
Service



The original maps and tables have been deleted from this online version. Since the soil survey's publication, more data on soil properties may have been collected, new interpretations developed, or existing interpretive criteria modified. Maps and current data tables can be accessed through the Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/>).

How to Use This Soil Survey

General Soil Map

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

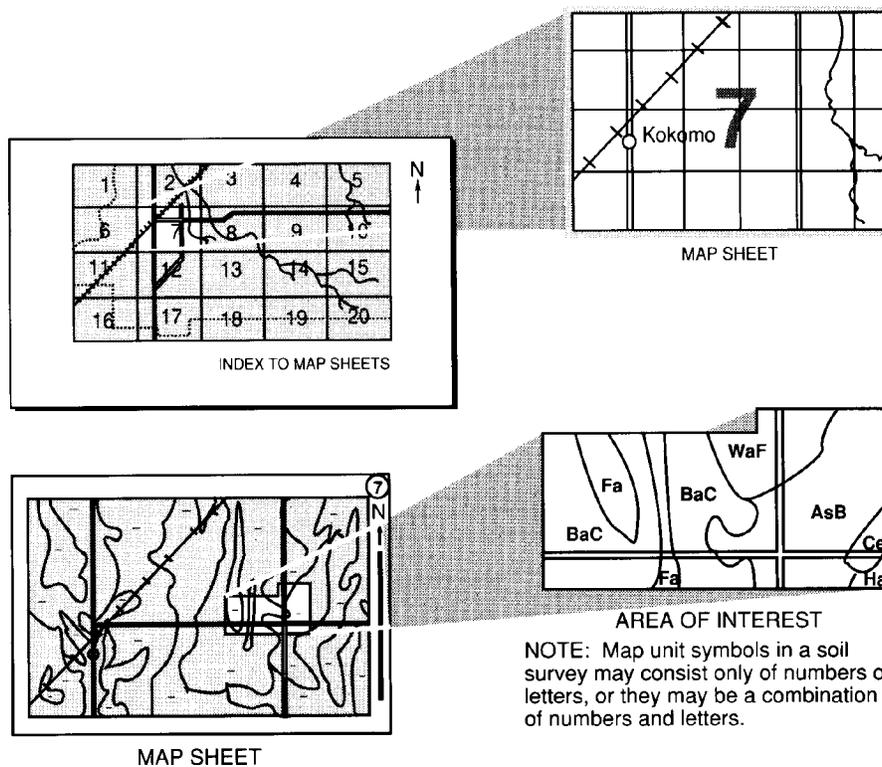
To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

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

To find information about your area of interest, you can locate that area on the **Index to Map Sheets**. Go to the Web Soil Survey for more information (<http://websoilsurvey.nrcs.usda.gov/app/>)

Note the map unit symbols that are in that area. Go to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described. See the Contents for sections of this publication that may address your specific needs.



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 fieldwork and technical quality control for this survey were conducted by the Forest Service. The correlation of the soils was conducted by the Natural Resources Conservation Service in consultation with the Forest Service. The Natural Resources Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Fieldwork for this soil survey was performed in the period 1975-1978. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made by the United States Department of Agriculture Forest Service and Natural Resources Conservation Service, in cooperation with the Montana Agricultural Experiment Station.

The most current official data are available through the NRCS Soil Data Mart website at <http://soildatamart.nrcs.usda.gov>. Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. Maps do not show the small areas of contrasting soils that could have been shown at a larger scale, if enlarged.

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Preface

This soil survey contains information that can be used in land-planning programs in the Helena National Forest Area. The landforms, natural vegetation and bedrock were studied to a greater extent than usual in soil surveys in order to define and interpret map units. Surveys such as this one have been referred to in Forest Service publications as "land system inventories" or "integrated inventories." The map units have been called "landtypes."

This soil survey contains information not usually found in soil surveys. Examples are limitations of lower soil layers for road construction and maintenance and landform properties affecting the hazards of sediment for roads. The survey is designed primarily for use by Forest Service personnel who manage the Helena National Forest. Others who are interested in the management of the Helena National Forest can use this information to more effectively participate in decisions affecting the environment of the Forest.

The survey area includes some privately owned urban and agricultural lands. This survey was not designed to provide information that can be used in planning uses of these lands. Additional information can be obtained from the local office of the Natural Resources Conservation Service.

Soil Survey of Helena National Forest Area, Montana

By Dean Sirucek
Fieldwork by Dean Sirucek and Herbert Holdorf

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

The Helena National Forest Area is located in west central Montana (fig. 1). It includes most of the Helena National Forest outside classified wilderness. It also includes about 133,000 acres of intermingled privately owned lands. The total area is 967,113 acres, consisting mostly of forested mountains with some mountain and foothill grasslands. The survey area straddles the Continental Divide and is in the headwaters of the Blackfoot River of the Columbia River Basin and along the Missouri River.

General Nature of the Survey Area

This section gives general information about the Helena National Forest and the surrounding area. It describes history and development, natural resources, climate, physiography, geology, and vegetation.

History and Development

Native Americans were the first known inhabitants of the Helena National Forest Area. There is archaeological evidence of almost continuous use of the survey area by Native Americans, from 6,500 years ago to their last use as a group in the late 1800s. The archaeological evidence suggests they visited the area to hunt and fish and to pursue religious activities. They also traveled across the area on their way to other destinations.

The Lewis and Clark Expedition crossed the survey area in 1805 on their historic journey to the Pacific Ocean. Fur traders and trappers followed soon after. In 1853, Lieutenant John Mullan located a route across the Continental Divide for a military road from the Missouri River to Fort Walla Walla, Washington. A placer gold strike at Last Chance Gulch in 1864 started a gold rush.

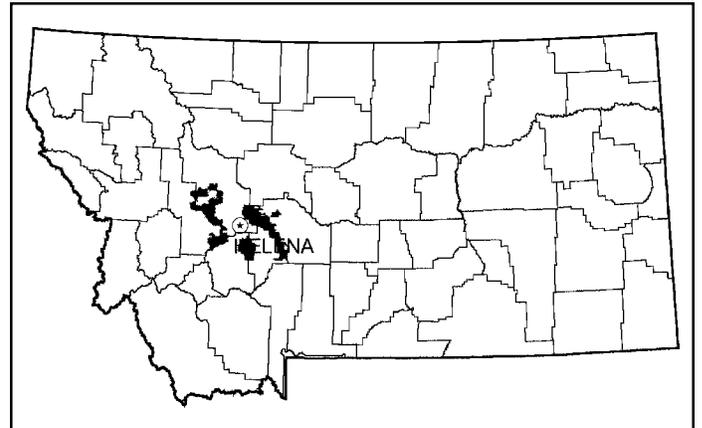


Figure 1.—Location of Helena National Forest Area, Montana

Mining for gold, silver, lead, zinc, and copper was important work for the next 64 years. Livestock ranching developed initially to supply meat to the miners. Railroads were extended into the survey area in 1883 and provided ranchers access to eastern livestock markets.

The Elkhorn and Helena Forest Reserves were set aside from the public domain in the late 1800s. They were combined into the Helena National Forest in 1906. National forests are managed for recreational activities, livestock grazing, timber production, watershed, wildlife, and fish habitat. Most of the survey area is open to mineral exploration and development.

Natural Resources

About 16 million board feet of timber are cut annually within the survey area; most timber is from ponderosa pine, Douglas fir, and lodgepole pine. Mills in the

surrounding communities manufacture dimensional lumber from timber harvested in the survey area.

The survey area provides habitat for at least 267 species of wildlife. Elk, moose, mule deer, white-tailed deer, mountain goat, black bear, and bighorn sheep are important big game species. Large streams and reservoirs in or adjacent to the survey area provide habitat for a cold-water trout fishery.

The Helena National Forest Area straddles the Continental Divide. Watersheds are in the Clark Fork of the Columbia River system and in the Missouri River system. Water is used for irrigation, hydroelectric power generation, domestic water supplies, recreational activities, and fish habitat. Water quality generally is excellent, and quantity is usually adequate for existing uses.

Recreational opportunities include hunting (particularly for elk), fishing, river rafting, hiking, and skiing.

Livestock are grazed on mountain grassland and shrubland and in open-grown timber stands with bunchgrass understories. The survey area ranges are used mainly as summer range for livestock from adjacent farms and ranches. Approximately 13,000 cattle and 11,000 sheep grazed survey area ranges in 1980.

Mineral exploration and development were the first uses of the area and remain important. There are approximately 3,500 patented and unpatented mining claims in the survey area. The potential for mineral development remains high in parts of the survey area.

Climate

The survey area has a continental climate modified by the invasion of Pacific Ocean air masses. The area lies in the strong belt of westerly winds that move out of the Pacific Ocean and deposit much of their precipitation on the mountain ranges in western Montana. The summer months are warm in most valleys and much cooler in the mountains. High-intensity thunderstorms of short duration occur frequently during the summer months. Winter months are relatively cold. Most precipitation falls as snow, and a deep snowpack accumulates on the mountains. East of the Continental Divide, occasional downslope warming winds, or Chinooks, can occur in the winter months. These winds raise air temperatures rapidly.

The percentage of days with possible sunshine is 75 percent in the summer months and 45 percent in the winter months. The prevailing wind is from the west, and the windspeed is highest in the spring months.

Precipitation

Precipitation and temperature data, shown in Table 1, were taken from stations operated by the National

Weather Service (U.S. Dep. Commerce, 1982), the Helena National Forest, and the Natural Resources Conservation Service. The average annual precipitation for these stations has ranged from 11.21 inches at Townsend in an intermountain valley to 50.30 inches at Copper Creek on an alpine mountain ridge.

The valleys are in a rain shadow of the surrounding mountains. Helena and Townsend are valley stations. The valleys generally receive two-thirds to three-fourths of their annual precipitation during the growing season, with definite seasonal peaks in May and June and again in September.

The mountainous areas receive a larger percentage of their precipitation as snow. The average annual snowfall varies from 30 inches at Holter Dam to 108 inches at Lincoln Ranger Station.

Temperature

The normal annual temperature for all stations is in the low 40° F range. Summer temperatures are moderate, with maximum readings occurring in July and August. At all stations, the normal highest temperatures were in the upper 70°s and low 80°s.

Cold waves can occur from November through February, with temperatures occasionally dropping to 0° F or lower. The greatest number of days with 0° F or colder temperatures can be expected during January. The normal minimum temperature for all stations is 7° to 10° F.

The coldest observed temperature for the entire United States, exclusive of Alaska, occurred at Rogers Pass, 40 miles northwest of Helena; the temperature on January 20, 1954, was -70° F.

Physiography

The survey area lies within the Northern Rocky Mountain physiographic province and is characterized by a succession of distinct mountain ranges and intervening valleys (fig. 2). The survey area includes four mountain ranges that are part of the main Northern Rocky Mountains of western Montana. From east to west, these are the Dry Range, Big Belt, Elkhorn, and Boulder Mountains. North of Helena, the general trend of mountain ranges is northwest to southeast. South of Helena, the general trend is northerly, and the mountains are considerably more irregular with somewhat broader basins.

Three major streams drain the survey area: the Missouri, Blackfoot, and Smith Rivers. The Missouri River flows northwest through the Townsend valley between the Big Belt and Elkhorn Mountains. The Blackfoot River flows west through the Lincoln area. The Little Blackfoot, a tributary of the Blackfoot River, originates in the Boulder. On the north, east, and southwest, broad intermontane

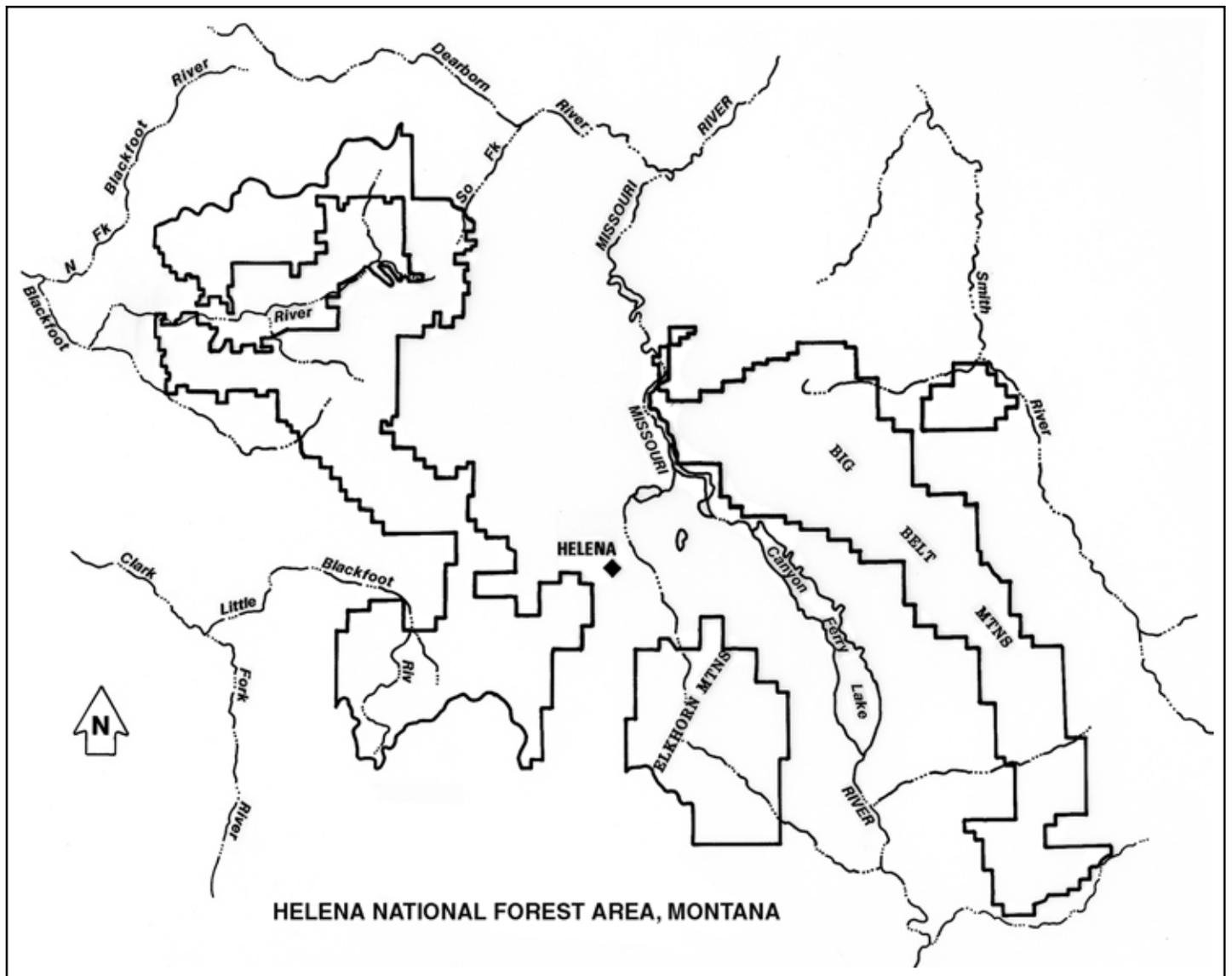


Figure 2.—Physiographic features of the Helena National Forest Area

Mountains. It flows northeast and then north to Elliston, where it changes direction and flows westerly. The Smith River flows north along the eastern edge of the Dry Range.

Big Belt Mountains

The Big Belt Mountains are formed by steeply dipping and, in part, complexly folded and faulted beds of metasedimentary rocks and limestone. Their structure is that of a broad, northwest-to-southeast trending, uplifted arch. The Big Belt Mountains form the eastern boundary of the Missouri River valley. The crest of the Big Belt Mountains, at the heads of Avalanche and Magpie Creeks, rises between 3,000 and 4,000 feet above the

valley floor of the Missouri River. A gravel-covered foreland, ranging in width from 1 to 6 miles, slopes gently toward the Missouri River from the southwest face of the Big Belt Mountains.

The principal streams in the Big Belt Mountains, from north to south, are Beaver and Deep Creeks on the west side of the Continental Divide and Atlanta and Big Camas on the east side of the Continental Divide.

Elkhorn Mountains

The Elkhorn Mountains are northward-trending alternating ridges and valleys underlain principally by a thick sequence of metasedimentary and volcanic rocks that have been folded, faulted, and cut by rhyolitic rocks.

valleys border the mountains. Because the ranges merge to the northwest, the boundary between the Elkhorn and Boulder Mountains is arbitrarily placed along the valleys of the Beavertown and Prickly Pear Creeks. Southward, the Elkhorn Mountains merge into unnamed hills north of the Jefferson River.

The Elkhorn Mountains rise gradually from elevations of 3,800 to 4,100 feet, in the Townsend valley, to 4,500 to 5,000 feet, in the Boulder valley, to 7,500 feet to more than 9,000 feet at crestlines. The highest point in the range is Crow Peak at an elevation of 9,414. Six perennial streams discharge from the area: Crow and Beaver Creeks to the east; Elkhorn, Muskrat, and Prickly Pear Creeks to the west; and McClellan Creek to the north.

Dry Range

Dry Range is a low, yet prominent, range of hills that lie in the northern part of Meagher County and are within the Smith River drainage. Dry Range is formed by intensely folded and faulted limestone. This area represents the southeastern extension of Montana's disturbed belt. The area is characterized by steep canyons and dip slopes formed by massive Madison limestone beds. All drainage is toward the Smith River, is intermittent, and has a radial pattern.

Lincoln Area

The Lincoln area is underlain by metasedimentary rocks and intruded granitic rocks. The Continental Divide is the most prominent feature in the Lincoln area, trending northeast to southwest at elevations ranging from 6,300 to 7,581 feet. The local relief is between 1,000 and 2,000 feet. The area is mountainous except for the Lincoln valley, which is a relatively flat, gravel-covered surface at an elevation of 4,600 feet.

The principal streams in the Lincoln area include the Landers Fork of the Blackfoot; Copper Creek, north of the Blackfoot River; and Little Prickly Pear and Nevada Creeks, south of the river.

Boulder Mountains

The Boulder Mountains are underlain principally by volcanic and granitic rocks. Metasedimentary rocks are found west of the Little Blackfoot River. The part of the Boulder Mountains that is included in the survey area is mostly low and rounded with mountaintops at elevations ranging from 7,000 to 7,600 feet. The relief between the mountaintops and the adjacent valley bottoms rarely

exceeds 1,500 feet and commonly is less than 1,000 feet. The Continental Divide extends in a general northeast-to-southwest direction from Electric Peak to Jericho Mountain.

The drainageway in the western part of the Boulder Mountains is into the Clark Fork River through its tributary, the Little Blackfoot River. Tenmile Creek and its tributaries drain the eastern part of the Boulder Mountains directly into the Missouri River, northeast of Helena. The valleys of the major streams and many of their tributaries trend either northeast or northwest, and the drainage patterns are strikingly rectilinear.

Landforms

The landforms in the survey area have been formed by erosion and by deposition of both water and ice. Glaciers have affected parts of the area, giving a unique character to the landforms. U-shaped valleys, cirques, steep-sided mountain peaks, and rolling glacial moraines are common. In other areas, stream erosion has produced V-shaped mountain valleys, terraces, and flood plains.

The shapes of some landforms are influenced by the structure of the bedrock. The bedding and hardness of the bedrock and the orientation of the beds affect the location of stream channels and the gradient and shape of slopes. Landslides are found in areas where some of the layers of bedrock are soft. They can produce large areas of landslide deposits that are irregular in shape.

Stream bottoms are along major perennial streams (fig. 3). They include flood plains, low terraces, and alluvial fans. They are gently sloping. Soils on stream bottoms can have a water table and are usually subject to flooding.

Terraces are relatively flat surfaces bordering a valley floor (fig. 3). They represent the former position of an alluvial plain or lake bottom and can include steep risers between terrace surfaces and valley floors. They are formed by alluvial, glacial outwash, and lacustrine deposits.

Alluvial fans are formed by stream deposition in areas where channel gradients rapidly decrease. They are in areas where a stream emerges from a narrow mountain valley onto a broader valley bottom or plain (fig. 3). They are smooth, convex, fan-shaped deposits. Their apex is at the mouth of the stream. Alluvial fans are dissected by poorly defined, intermittent streams 1,000 to 5,000 feet apart. The drainage system has braided channels with moderate gradients. Alluvial fans have no major changes in slope aspect.

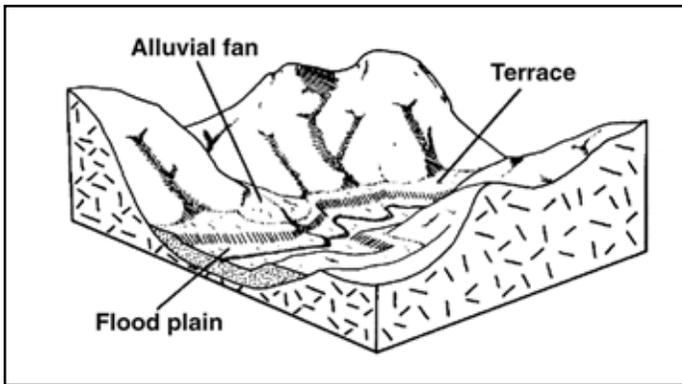


Figure 3.—Stream bottoms are flood plains, terraces, and alluvial fans in narrow mountain valleys. Large terraces and alluvial fans are mapped as separate landforms.

Landslide deposits result from rotational slumps, earthflows, and block glides (fig. 4). They have a hummocky surface with cracks, slump escarpments, and undrained depressions. Some have randomly oriented large blocks of rock. Slopes are very complex with benches and escarpments. The drainage pattern is deranged. There are many seeps, springs, and bogs.

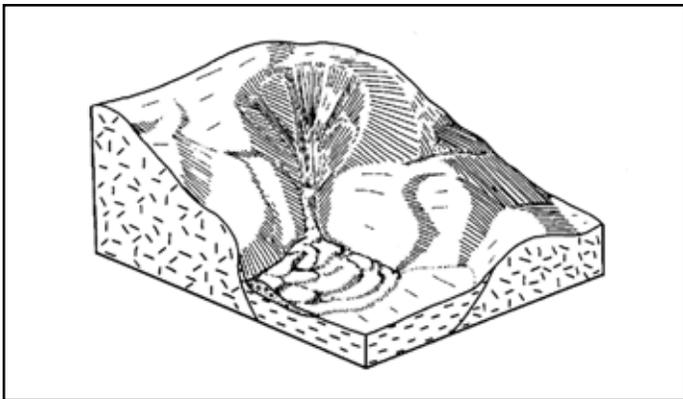


Figure 4.—A landslide deposit resulting from an earthflow

Moraines are glacial drift deposits that have a topography characterized by randomly oriented mounds and depressions (fig. 5). Surface drainage is poor, and many depressions do not have an outlet.

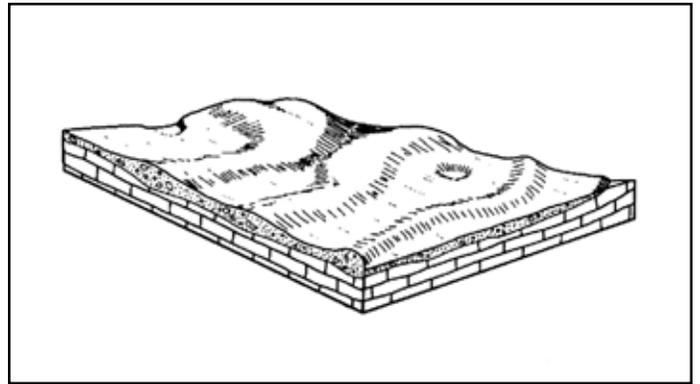


Figure 5.—A hummocky and hilly moraine

Kames and kettles are distinctive morainic landscapes composed of mound-like hills of glacial drift, or kames, in a complex pattern with bowl-shaped depressions, or kettles (fig. 6). Kettles may have been formed by the melting of large blocks of ice buried in the drift. Most kettles have no drainage outlet. Soils on kames and in kettles have a fluctuating water table.

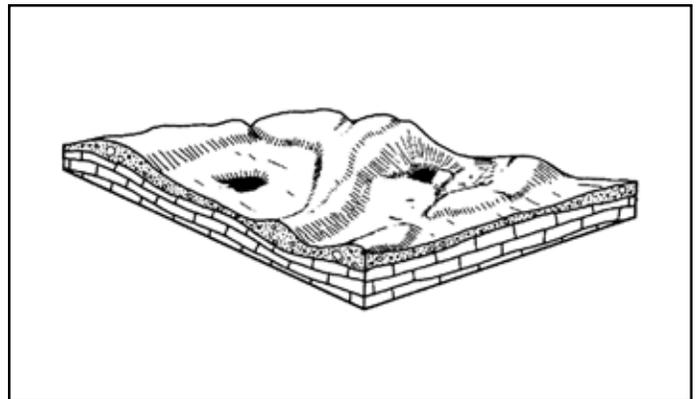


Figure 6.—An area of kames and kettles

Glacial trough walls are straight or concave slopes in U-shaped glacial valleys (fig. 7). The slopes are very steep, and there are avalanche chutes. Glacial scouring has resulted in areas of rock outcrop and in areas on the upper slopes where the soils are shallow. Deposits of glacial drift are common on the lower slopes.

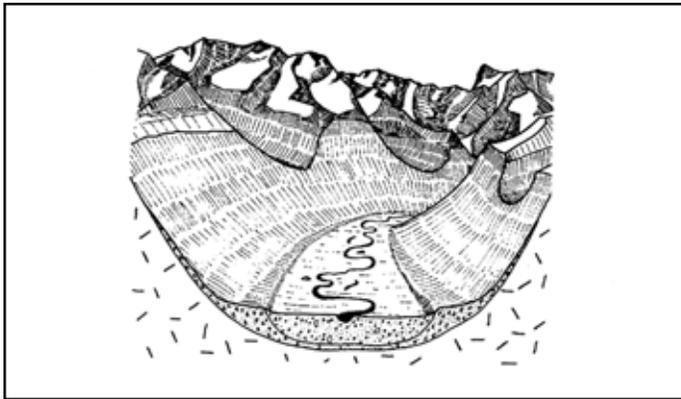


Figure 7.—Glacial trough walls in a U-shaped valley

Cirque headwalls and alpine ridges are very steep rock cliffs surrounding glacial cirque basins and the very narrow ridges at the higher elevations above the cirques (fig. 8). The cirques tend to be on northerly aspects and the alpine ridges on southerly aspects.

Cirque basins are characterized by low relief and were formed by glacial overriding with a combination of scouring and deposition of drift (fig. 8). These basins are found at the head of glacial valleys. They are semicircular and contain scoured, striated outcrops of bedrock and thin, discontinuous deposits of glacial drift. They are dissected by widely spaced, poorly defined perennial and intermittent streams. Some cirque basins have small lakes.

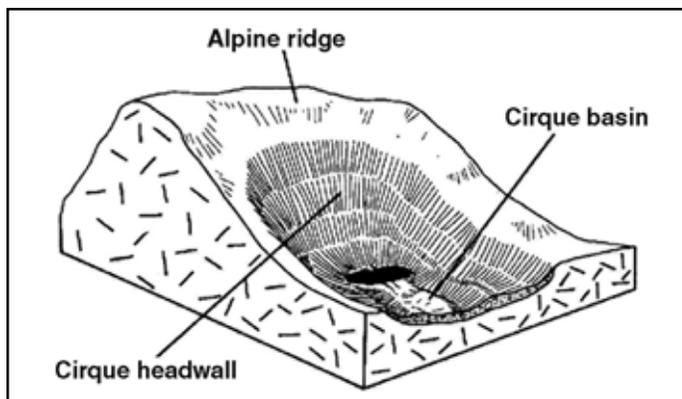


Figure 8.—Glacial cirques have very steep headwalls and a basin that often contains a small lake. Alpine ridges are very narrow.

Glacial mountain slopes are mantled by till (fig. 9). The drainage pattern is usually dendritic, and the drainageways are widely spaced. Slopes are weakly to moderately dissected by low-order streams.

Glaciated mountain ridges are rounded mountain ridges that have been overridden by glaciers (fig. 9). Glacial scouring has resulted in areas of rock outcrop and in areas on the ridge crest where the soils are shallow. Thick deposits of glacial till are on the lower slopes.

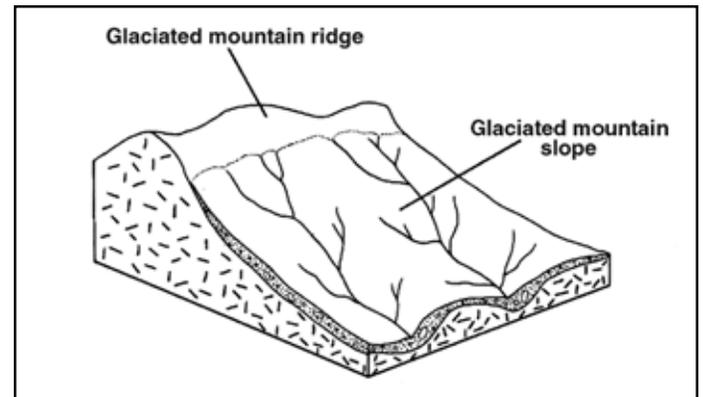


Figure 9.—Glaciated mountain slopes are mantled by glacial till. Rock outcrop and thin deposits of till are in areas of glaciated mountain ridges.

Structural breaklands have very steep slopes of more than 60 percent (fig. 10). A large amount of rock outcrop pattern of breaklands is parallel to dendritic. Sediment delivery efficiency is high because of the steep drainage channels. The slope is a limitation in areas of breakland.

Stream breaklands are very steep, high relief slopes along major streams. Slope gradients are 60 to 90 percent. Stream breaklands form V-shaped valleys along rapidly downcutting streams. Sediment delivery efficiency is very high on stream breaklands.

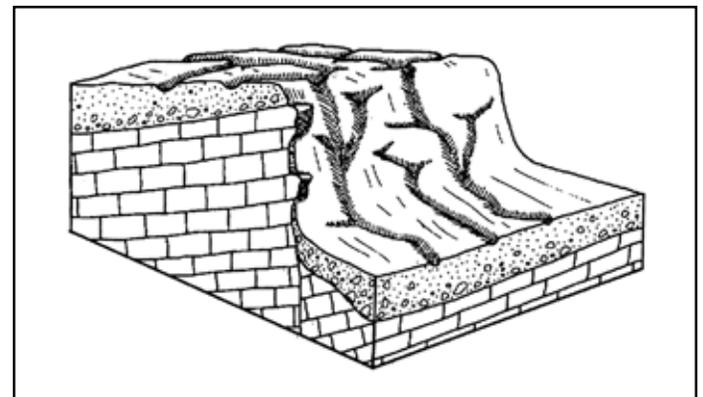


Figure 10.—The dip of underlying rock layers is roughly perpendicular to the slope of structural breaklands.

Geology

The mountain ranges in the survey area were formed by folded and faulted metasedimentary rocks and limestone. There are extensive exposures of Boulder Batholith granitic, basaltic, and rhyolitic rocks in the western part of the survey area. The granitic rocks were intruded into pre-existing limestone and metasedimentary rocks. The basaltic and rhyolitic rocks were extruded and covered granitic or metasedimentary rocks. There are moderately extensive deposits of glacial till, colluvium, and alluvium in the larger valleys. There are minor surface deposits of loess that have been influenced by volcanic ash in the northern part of the survey area. These deposits originated with the eruption of Mt. Mazama in Oregon approximately 6,700 years ago. They are much more extensive to the north and west of the survey area.

Parent Material Groups

There are many relationships between geology and the properties of soils. Relationships between soil properties and geologic origin of parent material were observed and used to map the distribution of soils. Relationships between geologic origin of parent material and the performance of materials on road cutbanks, in roadfills, and as native road surfaces were observed and used to identify limitations to these uses. The following parent material groups were used to assist in mapping and interpreting map units.

Metasedimentary rocks are argillites, quartzites, siltites, and siliceous limestones of the Precambrian Age Belt Supergroup. These types of bedrock are usually moderately to highly fractured and weakly weathered. The hardness of the bedrock does not limit excavation. This bedrock group weathers to produce moderately coarse-textured to moderately fine-textured materials with angular rock fragments. Soil substrata formed in these materials are subject to a slight hazard of erosion. Reaction varies from slightly acid to neutral. Included in this group are small areas of sandstone and shale. Parent material derived from shale has higher clay content than parent materials derived from other rocks.

Basaltic rocks are basalts, tuffs, andesites, and breccias. These types of bedrock are usually weakly to moderately fractured and are weakly weathered. The hardness of the bedrock limits excavation in some areas. This bedrock group weathers to produce medium-textured to moderately fine-textured parent material with angular rock fragments. Soil substrata formed in these materials are subject to a slight or moderate hazard of erosion. Reaction varies from medium acid to neutral.

Granitic rocks are granite, granodiorites, and diorites. These types of bedrock generally are weakly to

moderately jointed and are weakly to moderately weathered. The hardness of the bedrock limits excavation when rocks are weakly weathered. This bedrock group weathers to produce moderately coarse-textured and coarse-textured parent materials with subrounded rock fragments. Soil substrata formed in these parent materials are subject to a severe hazard of erosion. Reaction varies from slightly to medium acid.

Limestone rocks are limestones and calcareous sandstones of the Madison group. These types of bedrock are usually weakly fractured and weakly weathered. The hardness of the bedrock limits excavation. This bedrock group weathers to produce medium-textured calcareous parent material with angular rock fragments. Soil substrata formed in these parent materials are subject to a slight hazard of erosion. The reaction is moderately alkaline.

Rhyolitic rocks are rhyolites and tuffs. These types of bedrock are usually moderately to highly fractured and are moderately to highly weathered. The hardness of the bedrock limits excavation. This bedrock group weathers to produce moderately coarse-textured and coarse-textured parent materials with angular rock fragments. The soil erosion for soil substrata formed in these parent materials is severe. Reaction varies from strongly to slightly acid.

Alluvial deposits are unconsolidated deposits sorted and deposited by flowing streams. These deposits are sandy to clayey with rounded rock fragments. Reaction varies from slightly acid to neutral.

Glacial till and glacial drift deposits are unconsolidated deposits of clay, sand, gravel, and boulders. Rock fragments are rounded. Most glacial till and drift in the survey area are of local origin and the properties of the local bedrock determine its properties. Till and drift derived from granitic and rhyolitic rocks are moderately coarse textured. Till and drift derived from metasedimentary, limestone, or basaltic rocks are medium textured and moderately fine textured. Till deposited in larger valleys is hard and brittle when moist. The bulk density of soil substrata is 1.5 to 1.7 grams per cubic centimeter. Root penetration is restricted to vertical clearages. Soil substrata formed in these materials are subject to a moderate hazard of erosion. Reaction varies from moderately acid to moderately alkaline.

Landslide deposits are unconsolidated deposits deposited by rotational slumps, earthflows, or block glides. These deposits have loamy to clayey texture with angular rock fragments. Soil substrata formed in these parent materials are subject to a slight hazard of erosion. Portions of these deposits can be unstable; slope stability should be evaluated onsite. Reaction varies from moderately acid to moderately alkaline.

Colluvial deposits are unconsolidated deposits thought to be deposited by solifluction. The deposits resemble

glacial till, but rock fragments are angular instead of rounded. The rock fragments are found in landscapes not subject to glaciation. These deposits are medium textured to moderately fine textured. Soil substrata formed in these parent materials are subject to a slight hazard of erosion. Reaction varies from medium to slightly acid.

Vegetation

The survey area consists mainly of coniferous forest, but there are extensive mountain grassland and shrubland scattered throughout. Ponderosa pine, Douglas fir, and lodgepole pine are important tree species. Subalpine fir, whitebark pine, limber pine, and Engelmann spruce are locally important. Rough fescue, Idaho fescue, bluebunch wheatgrass, and big sagebrush are important plants in mountain grassland and shrubland. Grassland and shrubland at the lowest elevations contain plants from adjacent intermountain basins. Blue gramma, sandberg bluegrass, and western wheatgrass are examples of plants from adjacent basins. The patterns of plant communities often reflect the occurrence of periodic wildfires.

Habitat Types

Habitat types are considered to be basic ecological subdivisions of landscapes. Each type is recognized by distinctive combinations of overstory and understory plants at climax (Pfister, 1977). They are named for the dominant or characteristic vegetation of the climax community.

Habitat types are particularly useful in soil surveys of mountainous areas for assessing the combined effects of aspect, slope, elevation, and soil properties on potential plant growth. The distribution of habitat types within map units was an important factor in evaluating potential timber and forage productivity, limitations to forest regeneration, and wildlife habitat potential in this survey.

Habitat Type Groups

Individual habitat types often have similar implications for the interpretive uses made of them in soil surveys. Habitat types with similar interpretive values are grouped in this survey. The groups are named and described below; the group names are used throughout this survey.

Lower, mixed forest contains habitat types on which forest stands are ponderosa pine or mixed Douglas fir and ponderosa pine. The major habitat types are ponderosa pine/Idaho fescue; Douglas fir/snowberry; Douglas fir/Idaho fescue; Douglas fir/rough fescue; and Douglas fir/pinegrass, kinnikinnick phase. Ponderosa pine/bluebunch wheatgrass and ponderosa pine/bitterbrush are less extensive.

This habitat type group is moderately extensive on low elevation mountain slopes, rolling uplands, and southerly aspect breaklands. Elevation ranges from 3,500 to 7,000 feet.

Upper, mixed forest contains habitat types on which forest stands generally are Douglas fir, lodgepole pine, or a mixture of these species. These habitat types generally are above the cold limits of ponderosa pine, but they are not too cold to support Douglas fir. Habitat types are higher-elevation habitat types in the Douglas-fir series and lower-elevation habitat types in the subalpine fir series. Douglas fir/pinegrass, Douglas fir/ninebark, Douglas fir/twinflower, and Douglas fir/elk sedge are the major Douglas-fir series habitat types. Subalpine fir/twinflower; subalpine fir/blue huckleberry; and subalpine fir/beargrass, blue huckleberry phase are the major subalpine-fir series habitat types. Subalpine fir/queencup beadlily, subalpine fir/pinegrass, subalpine fir/dwarf huckleberry, and lower elevation subalpine fir/Menziesia are less extensive.

This habitat type group is extensive at elevations ranging from 4,200 to 7,000 feet. It is also found at elevations as high as 7,500 feet on southerly aspects and as low as 3,800 feet on steep, northerly aspects. It commonly is associated with soils underlain by limestone bedrock at elevations of 6,000 to 7,500 feet.

Lower subalpine forest contains habitat types on which forest stands generally are lodgepole pine. Douglas fir is not common, although it is sometimes present on southerly aspects or at lower elevations. Engelmann spruce and subalpine fir are sometimes dominant in old growth stands. The major habitat types are subalpine fir/beargrass, grouse whortleberry phase; subalpine fir/grouse whortleberry; and subalpine fir/menziesia.

This habitat type group is extensive at elevations of 6,000 to 7,200 feet. It is associated with moderately acid to neutral soils and is not found on neutral to moderately alkaline soils underlain by limestone.

Upper subalpine forest contains habitat types on which forest stands generally are mixed whitebark pine and lodgepole pine. Engelmann spruce and subalpine fir are sometimes dominant in old growth stands, and limber pine is sometimes present on soils underlain by limestone or on windswept ridges. Subalpine fir-whitebark pine/grouse whortleberry, subalpine fir/woodrush, and whitebark pine-subalpine fir are the major habitat types.

This habitat type group is of minor extent on mountain ridges or in glacial valleys. It generally is found at elevations of 7,200 to 9,000 feet but can be found as low as 6,000 feet on windswept ridges or in glacial valleys.

Wet forest contains habitat types that are found on soils with fluctuating water tables. Forest stands are often dominated by Engelmann spruce but can contain

subalpine fir and lodgepole pine. The major habitat types are alpine fir/bluejoint, spruce/sweetscented bedstraw, and spruce/common horsetail.

This habitat type group is of very minor extent on stream flood plains, terraces, and glacial moraines at elevations of 4,000 to 7,000 feet.

Dry grassland contains habitat types having grasses that are more abundant on lower-elevation drier sites. Blue gramma, western wheatgrass, needleandthread, and sandberg bluegrass are most common. This vegetative group occupies a transition zone between mountain grassland and grassland in intermountain basins. The major habitat types are Idaho fescue/western wheatgrass and bluebunch wheatgrass/sandberg bluegrass. Idaho fescue/bluebunch wheatgrass is always associated with these habitat types.

This habitat type group is of minor extent on plateaus or rolling uplands at elevations of 3,800 to 5,000 feet. Average annual precipitation is 10 to 15 inches.

Mountain grassland and shrubland contains habitat types on which rough fescue, Idaho fescue, bluebunch wheatgrass, and big sagebrush are the dominant plants (Mueggler, 1980). The major habitat types are rough fescue/Idaho fescue, rough fescue/bluebunch wheatgrass, Idaho fescue/bluebunch wheatgrass, big sagebrush/rough fescue, and big sagebrush/Idaho fescue.

This habitat type group is of major extent at elevations of 4,000 to 7,500 feet.

Alpine meadows are forb-rich grasslands on mountain ridges above timberline. Tufted hairgrass, Idaho fescue, rough fescue, and sedges are the dominant grasses or grasslike plants. The major habitat type is Idaho fescue/tufted hairgrass.

This vegetative group is of very minor extent on mountain ridges at elevations of 8,000 to 9,500 feet.

Wet shrubland and meadows contain habitat types and community types that are found on soils with fluctuating water tables. Vegetation is sedge grassland or willow, Sitka alder, or bog birch with understories dominated by sedges. Tufted hairgrass/carex species is the major habitat type in wet meadows. Willow, Sitka alder, or bog birch community types dominate wet shrublands.

How this Survey was Made

The survey area is mountainous and heavily forested. Mapping techniques used in other survey areas were impractical because of the difficult access. The mapping techniques used relied heavily on plotting delineation boundaries using features visible on aerial photography. Most commonly these were features of landforms or natural vegetation. Geologic maps and elevation were also used to plot delineation boundaries. Observations were made along field transects and traverses through representative delineations of map units. Relationships between properties important to survey objectives and features visible on aerial photography were observed. Features used to plot delineation boundaries were sometimes revised as a result of field checking. Reliable relationships between photographic features and map unit properties were established. These properties were observed and described in the field. Physical and chemical properties of soils that cannot be measured with field techniques are derived from laboratory characterization of soils within the survey area and similar soils in adjacent areas.

Table 2 lists the most important features used to plot map unit delineation boundaries. The map units in this survey are described in the sections "General Soil Map Units" and "Soil Series and Detailed Soil Map Units."

General Soil Map Units

The general soil map shows broad areas with similar parent material, topography, soil patterns, and climate. Typically, a map unit consists of three or four major soils and some minor soils. The general soil map can be used to compare the suitability of large areas for common land uses. The map is not suitable for planning use of small areas because of its small scale.

F. Soils on Stream Flood Plains, Terraces, and Alluvial Fans

The landscape is characterized by gently sloping flood plains and terraces or sloping alluvial fans. Dominant slope gradients are 0 to 10 percent on flood plains and terraces and 10 to 25 percent on alluvial fans. Flood plains and terraces are near perennial streams. Alluvial fans are where mountain streams enter basins or large valleys. Soils form in stratified alluvial deposits. This map unit is at 3,800 to 6,000 feet elevation. Average annual precipitation is 10 to 25 inches. Vegetation is forest, grassland or mixed forest, and mountain grassland or shrubland. This map unit occupies about 1 percent of the survey area. It is about 60 percent Borolls, 15 percent Typic Argiborolls, 15 percent Aquolls, and 10 percent minor soils.

Borolls are on stream flood plains and terraces. They are subject to an occasional hazard of flooding. Typic Argiborolls are on alluvial fans. Aquolls are on flood plains and terraces. They have water tables at or near the surface and are subject to an occasional hazard of flooding. Typic Ustochrepts are minor soils on alluvial fans.

Timber productivity is moderate. Range forage productivity is moderate to high. Flooding and high water tables limit use on flood plains and terraces. Borolls and Aquolls are in riparian areas and are potentially important as wildlife habitat and watershed.

G. Soils Underlain by Granitic Bedrock, Warm

The landscape is characterized by rolling uplands, mountain slopes, and ridges, or moraines, with dominant slope gradients of 10 to 60 percent and

slope gradients up to 90 percent on included structural breaklands. Bedrocks are weakly to moderately weathered. Moderately weathered bedrocks decompose to coarse sand and fine gravel when exposed by excavation. Soils have moderately coarse or coarse textured substrata. This map unit is at 4,500 to 6,000 feet elevation. Average annual precipitation is 15 to 20 inches. Vegetation is lower, mixed forest and mountain grassland or shrubland. This map unit occupies about 3 percent of the survey area. It is about 50 percent Typic Ustochrepts, 20 percent Mollic Eutroboralfs, 20 percent Typic Haploborolls, and 10 percent minor soils and rock outcrop.

Typic Ustochrepts are under forests on upper slopes and ridges. They have sandy subsoils and substrata and light-colored surface layers. Mollic Eutroboralfs are under forests on lower slopes and in draws. They have loamy subsoils and thin, dark-colored surface layers. Typic Haploborolls are in grasslands. They have thick, dark-colored surface layers and sandy subsoils. Typic Argiborolls, Typic Ustochrepts, and rock outcrop are of minor extent.

Timber productivity is moderate for forests. Moisture stress limits forest regeneration. Forest understories have moderate forage productivity. Grassland and shrubland forage productivity is moderate. Steepness of slope limits tractor operation and livestock access to forage on part of the unit. Logging and roads have erosion hazards in most places.

AG. Soils Underlain by Granitic and Rhyolitic Bedrock, Cool

The landscape is characterized by mountain slopes, mountain ridges, and moraines with dominant slope gradients of 10 to 60 percent. This map unit is at 5,500 to 8,000 feet elevation. Average annual precipitation is 20 to 30 inches. Vegetation is mainly upper mixed, lower subalpine and upper subalpine forest with some mountain grassland or shrubland. This map unit occupies about 12 percent of the survey area. It is about 50 percent Typic Cryochrepts, 20 percent Typic Cryoboralfs, 10 percent Argic

Cryoborolls, 10 percent Andic Cryochrepts, and 10 percent minor soils and rock outcrop.

Typic Cryochrepts, Typic Cryoboralfs, and Andic Cryochrepts are under forest. Typic Cryochrepts and Andic Cryochrepts do not have subsoil clay accumulations. Andic Cryochrepts have volcanic ash-influenced loess surface layers 7 to 10 inches thick, and Typic Cryochrepts have loess surface layers 2 to 7 inches thick. Typic Cryoboralfs have subsoil clay accumulations.

Argic Cryoborolls are under mountain grassland and shrubland. Lithic Cryochrepts and rock outcrop are of minor extent on ridges.

Timber productivity is moderate to high in forests. Forest understories have low forage productivity. Mountain grassland and shrubland have high forage productivity. Steep slopes limit tractor operation and livestock access to forage on part of the unit. Roads have erosion hazards in most places.

B. Soils Underlain by Metasedimentary and Basaltic Rocks, Warm

The landscape is characterized by mountain slopes and ridges, structural benches, and glacial trough walls. Dominant slope gradients are 0 to 40 percent on structural benches and mountain ridges, 25 to 60 percent on mountain slopes, and 60 to 90 percent on glacial trough walls. Bedrock is weakly weathered. Soils have moderately coarse to moderately fine textures. This map unit is at 4,000 to 6,000 feet elevation. Average annual precipitation is 15 to 25 inches. Vegetation is lower, mixed forest and mountain grassland or shrubland. This map unit occupies about 42 percent of the survey area. It is about 55 percent Typic Ustochrepts, 30 percent Lithic Ustochrepts, and 15 percent rock outcrop and minor soils.

Typic Ustochrepts are 20 to 60 inches or more deep over bedrock. Lithic Ustochrepts are 4 to 20 inches deep over bedrock. Typic Eutroboralfs, Typic Haploborolls, and Lithic Argiborolls are included minor soils. Rock outcrop is also included.

Timber productivity is low in forests. Moisture stress limits forest regeneration. Forest understory forage productivity is moderate. Forage productivity is moderate in mountain grassland and shrubland. Steep slopes limit tractor operation and livestock access to forage on part of the unit. Erosion hazards are slight to moderate for logging and roads.

AB. Soils Underlain by Metasedimentary and Basaltic Rocks, Cool

The landscape is characterized by mountain slopes and ridges, structural benches, and glacial

trough walls. Dominant slope gradients are 0 to 40 percent on structural benches and mountain ridges, 25 to 60 percent on mountain slopes, and 60 to 90 percent on glacial trough walls. Bedrock is weakly weathered. Soils have moderately coarse to moderately fine textures. This map unit is at 5,500 to 9,000 feet elevation. Average annual precipitation is 20 to 40 inches. Vegetation is mainly upper mixed, lower subalpine and upper subalpine forest with some mountain grassland or shrubland. This map unit occupies about 31 percent of the survey area. It is about 50 percent Typic Cryochrepts, 25 percent Typic Cryoboralfs, 10 percent Argic Cryoborolls, and 15 percent minor soils and rock outcrop.

Typic Cryochrepts are most common on higher-elevation forested mountain slopes and ridges and do not have subsoil clay accumulations. Typic Cryoboralfs are most common on lower-elevation forested moraines and mountain slopes and have subsoil clay accumulations. Argic Cryoborolls are under mountain grassland or shrubland. Andic Cryochrepts are minor soils on higher-elevation mountain ridges and slopes or moraines. Typic Cryumbrepts are minor soils on alpine ridges. Rock outcrop is on some mountain slopes and trough walls.

Timber productivity is moderate to high in upper, mixed and lower subalpine forests and low in upper subalpine forests. Forest regeneration is limited by grass competition on many southerly aspects and by harsh climate at higher elevations. Forest understory forage productivity is mainly low. Steep slopes limit tractor operation and livestock access to forage on part of the unit. Forage productivity is high in mountain grassland and shrubland.

L. Soils Underlain by Limestone

The landscape is characterized by mountain slopes and ridges, dip slopes, and structural breaklands. Dominant slope gradients are 0 to 40 percent on dip slopes, 25 to 60 percent on mountain slopes, and 60 to 90 percent on structural breaklands. Soils have medium to moderately fine textures and calcareous substrata. This map unit is at 4,000 to 7,000 feet elevation. Vegetation is dominantly lower, mixed or upper, mixed forest. There are minor amounts of mountain grassland or shrubland and upper subalpine forest. This map unit occupies about 11 percent of the survey area. It is about 30 percent Typic Cryochrepts, 15 percent Calcic Cryoborolls, 15 percent Mollic Cryoboralfs, 15 percent Typic Ustochrepts, 10 percent Lithic Ustochrepts, and 15 percent rock outcrop and minor soils.

Typic Cryochrepts, Calcic Cryoborolls, and Mollic Cryoboralfs are on higher-elevation mountain slopes, dip slopes, and structural breaklands. Vegetation is mainly upper, mixed forest with some mountain grassland or shrubland. Typic Cryochrepts have light-colored surface layers; Calcic Cryoborolls have thick, dark-colored surface layers; and Mollic Cryoboralfs have thin, dark-colored surface layers.

Typic Ustochrepts and Lithic Ustochrepts are on lower-elevation mountain slopes, dip slopes, and breaklands. Vegetation is mainly lower, mixed forest. Typic Ustochrepts are 20 to 60 inches or more deep over bedrock. Lithic Ustochrepts are 4 to 20 inches deep over bedrock.

Rock outcrop is on structural breaklands and mountain slopes. Typic Calciborolls are included on lower-elevation dip slopes.

Timber productivity is low on lower-elevation mountain slopes, dip slopes, and breaklands. Moisture stress limits forest regeneration. Timber productivity is moderate on higher-elevation mountain slopes, dip slopes, and structural breaklands. Grass competition frequently limits forest regeneration. Forest understories frequently have moderate forage productivity. Grasslands and shrublands have high forage productivity. Steep slopes limit tractor operation and livestock access to forage on mountain slopes and structural breaklands. Erosion hazards are slight to moderate for logging and slight for roads. Structural breaklands are on the lower flanks of mountains and frequently form canyons with scenic limestone outcrops.

Soil Series and Detailed Soil Map Units

This section describes each map unit in detail. The descriptions, along with the soil maps, can be used to determine the suitability and potential of a unit for major land uses within the survey area, to plan land use and development of resources, and to help protect and maintain the quality of the environment. The acreage of each map unit is given in Table 10. More information for each map unit is given in the "Use and Management" section. Many of the terms used to describe map units are defined in the "Glossary."

Most soils are mapped at the family level of taxonomy, but a few are mapped at higher levels. Map units in which soils were mapped at the family level are named using subgroup reference taxa for brevity. Table 3 gives the soil taxonomic units by map unit.

The map unit description format presents information in sections. The content of each section is described below. An introductory paragraph summarizes map unit properties. It describes landform, elevation, vegetation, and the parent material source for lower soil layers.

Landform describes properties of the landform in the map unit. Slope gradients, the pattern and density of drainageways, and properties of channel gradients are given. Seeps, springs, lakes, and other landform features are described when present.

Vegetation and *Habitat Types* describe the typical existing vegetation and the composition and distribution of habitat types. Major and similar habitat types are in the same habitat type group and have similar interpretive values for survey objectives. Included dissimilar habitat types have productivity similar to that of the major habitat types, but they can have different stand composition. Highly dissimilar habitat types have significantly different potential productivity or limitations to forest regeneration than the major habitat types.

Geology describes the bedrock underlying the map unit or the properties of the geologic deposits in which the soils have formed. The major bedrock or deposit and others, which can be included in mapping, are given. The use of geology in defining,

describing, and interpreting map units is described in "General Nature of the Survey Area."

Characteristics of the Soils describes the soil properties that are of particular importance to use and management. The properties given are the same for the dominant soils and the similar soils in the unit. The texture of the surface layer; the thickness of the surface layer when it is loess that has been influenced by volcanic ash; the content of rock fragments in the subsoil; drainage; and depth to bedrock, if less than 60 inches, are important properties in this survey area. When the map unit is a complex, the most important properties of the soils and any relationship of the soils to topographic position or vegetation are described.

Map Unit Composition describes the soils that are similar and dissimilar to the dominant soils. It gives the percentage of the map unit typically occupied by the dominant and similar soils and by the dissimilar soils. The location and principal interpretive difference are given for dissimilar soils.

Representative Profile of the Soils describes the dominant soils in the map unit. It is not necessarily the same as the representative pedon for the taxa.

Management gives suitability and limitations for common land uses. Timber, range, roads, watershed, and wildlife are described.

12A—Typic Cryoboralfs, till substratum

This map unit is on moraines. Elevation ranges from 4,800 to 7,400 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in glacial drift.

Landform

Dominant slopes have gradients of 10 to 25 percent. Moraines are rolling glacial till deposits in valley bottoms. They have a deranged drainage pattern. There are small ponds in some areas. Streams originating at higher elevations flow through these valleys.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are blue huckleberry, twinflower, kinnikinnick, and dwarf huckleberry.

Habitat Types

Subalpine fir/dwarf huckleberry is the major habitat type. Subalpine fir/queencup beadlily, subalpine fir/twinflower, and subalpine fir/blue huckleberry are similar habitat types. These habitat types occupy 85 percent of the map unit.

Subalpine/grouse whortleberry, a dissimilar habitat type, is at higher elevations and has lower timber productivity. It occupies 15 percent of the unit.

Geology

This map unit is underlain by compact loamy glacial till.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 35 to 50 percent rounded rock fragments.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have light-colored surface layers and subsoil clay accumulation. Similar soils in this map unit are Mollic Cryoboralfs, loamy-skeletal, mixed or Typic Cryochrepts, loamy-skeletal, mixed. They have dark-colored surface layers or do not have subsoil clay accumulations. These soils occupy 85 percent of the unit.

Included in this unit are 15 percent dissimilar soils and rock outcrop. Dissimilar soils are Typic Cryofluvents, sandy-skeletal, mixed. They are along streams. They have coarse-textured subsoils and are subject to an occasional flooding hazard. Lithic Cryoboralfs, loamy-skeletal, mixed are on knolls. They are 4- to 20-inches deep over bedrock and are less productive timber sites. Rock outcrop is on knolls.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown stony loam surface layers 9-inches thick. The upper part of the subsoil is brown very stony loam 7-inches thick. The lower part of the subsoil is calcareous, dense, brittle dark yellowish-brown very stony sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 50 to 85 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Frost pockets limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to slough on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred deer and elk summer range and elk winter range. Delineations near Lincoln are preferred spring habitat for grizzly bear.

12B—Typic Cryochrepts and Typic Cryoboralfs, till substratum, hilly

This map unit is on moraines. Elevation ranges from 6,000 to 7,400 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in glacial till.

Landform

Dominant slopes have gradients of 25 to 40 percent. Moraines are hilly glacial till deposits in valley bottoms and on lower valley side slopes. They have a deranged drainage pattern in valley

bottoms and a subparallel drainage pattern on lower valley side slopes. There are small ponds in some areas. Streams originating at higher elevations flow through these valleys.

Vegetation

Vegetation consists of a lodgepole-pine forest with some spruce and subalpine fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, and pinegrass. *Menziesia* is included on northerly aspects.

Habitat Types

Subalpine fir/*menziesia* is the major habitat type on northerly aspects. Subalpine fir/beargrass is the major habitat type on southerly aspects. These habitat types occupy 90 percent of the map unit. Subalpine fir/blue huckleberry, a dissimilar habitat type, is on southerly aspects at lower elevations and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by compact loamy glacial till.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 0- to 10-inches thick. Subsoils contain 35 to 50 percent rounded rock fragments. Soil properties vary with elevation. Soils at lower elevations have subsoil clay accumulations; soils at higher elevations do not.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed are at higher elevations. They have loess surface layers 0- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick.

Typic Cryoboralfs, loamy-skeletal, mixed are at lower elevations. They have loess surface layers 0- to 7-inches thick. Similar soils are Andeptic Cryoboralfs, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. Every delineation has one of these soils and may have all of them.

Dissimilar soils and rock outcrop make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on knolls. They have bedrock at 4- to 20-inches and

have lower timber productivity. Rock outcrop is on knolls.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown gravelly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly loam 36-inches thick. The lower part of the subsoil is dense, brittle yellowish-brown very cobbly loam to depths of 60 inches or more.

Typic Cryoboralfs, loamy-skeletal, mixed have brown gravelly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly loam 17-inches thick. The lower part of the subsoil is calcareous, dense, brittle dark yellowish-brown very cobbly loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 80 cubic feet per acre. Slope steepness limits tractor operation on parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Frost pockets limit forest regeneration. On northerly aspects, shrub competition limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to slough on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion

hazard. Water bars and vegetative cover can help to control erosion.

12C—Andic Cryochrepts, moraines

This map unit is on moraines. Elevation ranges from 6,000 to 8,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper subalpine forest. Soils formed in glacial till.

Landform

Dominant slopes have gradients of 15 to 40 percent. Moraines are rolling or hilly glacial till deposits in valley bottoms and cirque basins. They have a deranged drainage pattern. There are small ponds in some areas. Streams originating at higher elevations flow through valley bottoms.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine, whitebark pine, Engelmann spruce, and subalpine fir. Dominant understory species are beargrass, grouse whortleberry, smooth woodrush, and menziesia.

Habitat Types

Subalpine fir-whitebark pine/grouse whortleberry and subalpine fir/woodrush are the major habitat types. These habitat types occupy 90 percent of the map unit.

Subalpine fir/menziesia and subalpine fir/grouse whortleberry, which are dissimilar habitat types, are at lower elevations and have higher timber productivity. They occupy 10 percent of the map unit.

Geology

This map unit is underlain by moderately coarse-textured and coarse-textured glacial till derived from granitic rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. They are 40- to 60-inches deep over bedrock. Subsoils contain 35 to 50 percent rounded rock fragments. Granitic boulders are scattered upon the surface.

Map Unit Composition

Andic Cryochrepts, loamy-skeletal, mixed have loess surface layers that have been influenced by volcanic ash. These surface layers are 7- to 10-inches thick. Similar soils are Typic Cryochrepts, loamy-

skeletal, mixed. They have loess surface layers 2- to 7-inches thick. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Typic Cryorthents, sandy-skeletal, mixed and Andeptic Cryoboralfs, loamy-skeletal, mixed. Typic Cryorthents, sandy-skeletal, mixed are on knolls. They have coarse-textured subsoils that are erodible on road cut and fill slopes. Andeptic Cryoboralfs, loamy-skeletal, mixed are on lower slopes and in depressions. They have subsoil clay accumulations and higher timber productivity. Rock outcrop is on knolls.

Representative Profile of the Soils

Andic Cryochrepts, loamy-skeletal, mixed have dark yellowish-brown loam upper surface layers 8-inches thick. The lower surface layer is brown very cobbly sandy loam 8-inches thick. The subsoil is brown very cobbly sandy loam overlying bedrock at 50 inches.

Management

Timber

Potential annual production is 20 to 50 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. The harsh subalpine climate and frost pockets limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface. The harsh subalpine climate limits revegetation of road cut and fill slopes. Adapted species should be used for revegetation.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Steep tractor-skid trails, cable-yarding

corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for deer and elk.

12D—Typic Cryoboralfs, moderately coarse-textured till substratum

This map unit is on moraines. Elevation ranges from 5,500 to 7,500 feet. Average annual precipitation is 18 to 25 inches. Vegetation is upper, mixed forest. Soils formed in glacial till.

Landform

Dominant slopes have gradients of 25 to 50 percent. Moraines are hilly glacial till deposits in valley bottoms. They have a deranged drainage pattern. Some areas have small ponds. Streams originating at higher elevations flow through these valleys.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce, subalpine fir, and Douglas-fir. Dominant understory species are twinflower, grouse whortleberry, and pinegrass.

Habitat Types

Subalpine fir/grouse whortleberry, pinegrass phase, and subalpine fir/twinflower are the major habitat types. These habitat types occupy 85 percent of the map unit.

Subalpine fir/menziesia, a dissimilar habitat type, is on northerly aspects. Brush competition limits forest regeneration. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by moderately coarse-textured and coarse-textured glacial till derived from granitic rocks.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from moderately coarse to medium. Subsoils contain 35 to 50 percent rounded rock fragments.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have subsoil clay accumulations. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed. They occupy

100 percent of the unit and do not have subsoil clay accumulations.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly sandy clay loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown very cobbly sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. Slope steepness limits tractor operation on parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition and frost pockets limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

13A—Typic Cryoboralfs, medium-textured and moderately fine-textured till substratum

This map unit is on moraines or glaciated mountain ridges. Elevation ranges from 4,400 to 6,000 feet. Average annual precipitation is 20 to

30 inches. Vegetation is upper, mixed forest. Soils formed in glacial till.

Landform

Dominant slopes have gradients of 10 to 25 percent. Moraines or glaciated mountain ridges are rolling or hilly glacial till deposits. They have a deranged drainage pattern. Some areas have small ponds. Streams originating at higher elevations flow through moraines.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are snowberry, white spirea, blue huckleberry, and pinegrass.

Habitat Types

Douglas-fir/snowberry, pinegrass phase, and Douglas-fir/pinegrass are the major habitat types. Douglas-fir/blue huckleberry and Douglas-fir/twinflower are similar habitat types. These habitat types occupy 90 percent of the map unit.

Subalpine fir/menziesia, a dissimilar habitat type, is in frost pockets at higher elevations and has lower timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by compact medium-textured and moderately fine-textured glacial till derived from basaltic and metasedimentary rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers and subsoil clay accumulations. Subsoils contain 35 to 50 percent rounded rock fragments.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have light-colored surface layers and subsoil clay accumulations. Similar soils are Mollic Cryoboralfs, loamy-skeletal, mixed and Typic Cryoboralfs, clayey-skeletal, mixed. They have dark-colored surface layers or clayey subsoils. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Typic Cryofluvents, sandy-skeletal, mixed. These soils are along streams in valley bottoms. They have sandy subsoils and are subject to an occasional flooding hazard.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly clay loam 20-inches thick. The lower part of the subsoil is calcareous, dense, brittle dark yellowish-brown very cobbly clay loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition and frost pockets in valley bottoms limit forest regeneration.

Range

This unit is well suited to transitory range. The forest understory produces little forage under a forest canopy, but production increases to 225 pounds per acre when the canopy is removed.

Roads

Material exposed by road construction tends to slough on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

In valley bottoms, the major watershed management concern is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

14—Typic Cryochrepts, colluvial deposits

This map unit is in basins and on toeslopes. Elevation ranges from 5,500 to 6,800 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed forest. Soils formed in colluvial deposits.

Landform

Dominant slopes have gradients of 25 to 50 percent. Basins and toeslopes have slightly concave slopes with hummocky microrelief. The drainage pattern is parallel, and drainageways are weakly incised and closely spaced. Seeps and springs are common on lower slopes.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce, Douglas-fir, and subalpine fir. Dominant understory species are pinegrass, blue huckleberry, and twinflower.

Habitat Types

Subalpine fir/twinflower and spruce/twinflower are the major habitat types. Douglas-fir/pinegrass is a similar habitat type. These habitat types occupy 90 percent of the map unit.

Subalpine fir/sweetscented bedstraw, a dissimilar habitat type, is on wet soils around seeps and springs. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by colluvial deposits derived from basaltic and metasedimentary rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 35 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed do not have subsoil clay accumulation. Similar soils are Typic Cryoboralfs, loamy-skeletal, mixed. They have subsoil clay accumulations and occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Aquic Cryoborolls. They are around seeps and springs. They have dark-colored surface layers and are wet.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly loam 36-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. Slope steepness limits tractor operation on parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred summer range for deer and elk.

14A—Argic Cryoborolls, colluvial slopes

This map unit is in basins and on toeslopes. Elevation ranges from 4,800 to 7,000 feet. Average annual precipitation is 15 to 20 inches. Vegetation is upper, mixed forest. Soils formed in colluvial deposits.

Landform

Dominant slopes have gradients of 10 to 40 percent. Basins and toeslopes have slightly concave slopes with hummocky microrelief. The drainage pattern is parallel with weakly incised, closely spaced first- and second-order drainageways. Seeps and springs are common.

Vegetation

Vegetation consists of a Douglas-fir forest with some lodgepole pine. Dominant understory species are white spirea, kinnikinnick, snowberry, and pinegrass.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass are the major habitat types. These habitat types occupy 85 percent of the map unit.

Douglas-fir/Idaho fescue, a dissimilar habitat type, is on ridges and has lower timber productivity and higher forage productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by colluvial deposits derived from metasedimentary rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 40 to 60 percent angular rock fragments.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed have thick dark-colored surface layers. Similar soils are Mollic Cryoboralfs, loamy-skeletal, mixed. They have thin dark-colored surface layers. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Aquic Cryoborolls, loamy-skeletal, mixed. They are near seeps and springs, have mottled subsoil colors, and are seasonally wet.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very cobbly clay loam 16-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. The terrain is well suited to tractor operation. Grass competition limits forest regeneration.

Range

The forest understory produces little forage under a forest canopy, but production increases to 200 pounds per acre when the canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

14B—Typic Cryoboralfs, colluvial basins and toeslopes

This map unit is on basins and toeslopes. Elevation ranges from 4,800 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in colluvial deposits.

Landform

Dominant slopes have gradients of 10 to 25 percent. Basins and toeslopes have slightly concave slopes with hummocky microrelief. The drainage pattern is subparallel with weakly incised first- and second-order drainageways. Seeps and springs are common.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine, with some subalpine fir and spruce. Dominant understory species are blue huckleberry, twinflower, pinegrass, and dwarf huckleberry.

Habitat Types

Subalpine fir/twinflower and spruce/twinflower are the major habitat types. Subalpine fir/dwarf huckleberry is a similar habitat type. These habitat types occupy 90 percent of the map unit. Forest openings containing alder and sedge meadows are dissimilar community types. They are around seeps and springs and occupy 10 percent of the map unit.

Geology

This map unit is underlain by colluvial deposits derived from limestone, basaltic, and metasedimentary rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 15 to 50 percent angular rock fragments.

Map Unit Composition

Typic Cryoboralfs, clayey-skeletal, mixed have light-colored surface layers and 35 to 50 percent rock fragments in the subsoil. Similar soils are Typic Cryoboralfs, fine, mixed and Argic Cryoboralfs, clayey-skeletal, mixed. They have 15 to 35 percent rock fragments in the subsoil or thick dark-colored surface layers. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Aquic Cryoboralfs, fine, mixed. These soils are near seeps and springs. They have mottled subsoil colors and are wet.

Representative Profile of the Soils

Typic Cryoboralfs, clayey-skeletal, mixed have brown cobbly silt loam surface layers 4-inches thick. The upper part of the subsoil is dark yellowish-brown and brown very cobbly silty clay loam 23-inches thick. The lower part of the subsoil is brown very cobbly silty clay loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition limits forest regeneration.

Range

This unit is well suited to transitory range. The forest understory produces little forage under a forest canopy, but production increases to 200 pounds per acre when the canopy is removed.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

14C—Typic Cryochrepts, colluvial toeslopes and basins

This map unit is in basins and on toeslopes. Elevation ranges from 5,600 to 7,000 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in colluvial deposits.

Landform

Dominant slopes have gradients of 10 to 40 percent. Basins and toeslopes have slightly concave slopes with hummocky microrelief. The drainage pattern is parallel with weakly incised first- and second-order drainageways. Seeps and springs are common.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce and subalpine fir. Dominant understory species are grouse whortleberry, beargrass, and menziesia.

Habitat Types

Subalpine fir/beargrass, grouse whortleberry phase, and subalpine fir/grouse whortleberry are the major habitat types. Subalpine fir/menziesia is a similar habitat type. These habitat types occupy 90 percent of the map unit. Subalpine fir/bluejoint, a dissimilar habitat type, is on wet soils around seeps and springs. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by colluvial deposits derived from basaltic and metasedimentary rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately coarse-textured surface layers. Subsoils contain 40 to 80 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed do not have subsoil clay accumulations. Similar soils are Typic Cryoboralfs, loamy-skeletal, mixed. They have subsoil clay accumulations. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Typic Cryaquepts, loamy-skeletal, mixed. They are near seeps and springs, have mottled subsoil colors, and are wet.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly loam 36-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. The terrain is well suited to tractor operation.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred summer range for deer and elk.

15—Mollic Cryoboralfs, landslides

This map unit is on landslides. Elevation ranges from 5,000 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in landslide deposits.

Landform

Dominant slopes have gradients of 10 to 40 percent. Landslides are hummocky land surfaces characterized by a regular pattern of mounds and depressions. Indicators of movement such as large cracks, slip scars, and lobate-shaped deposits are present. The drainage pattern is deranged with weakly incised low-order drainageways that divert runoff into bogs.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir, Engelmann spruce, subalpine fir, and lodgepole pine. Dominant understory species are pinegrass, blue huckleberry, and twinflower.

Habitat Types

Subalpine fir/twinflower, subalpine fir/menziesia, and spruce/twinflower are the major habitat types on northerly aspects. Douglas-fir/pinegrass and subalpine fir/blue huckleberry are the major habitat types on southerly aspects. These habitat types occupy 90 percent of the map unit. Mountain meadows, quaking aspen, and subalpine fir/bluejoint are dissimilar community and habitat types. They are found near bogs and occupy 15 percent of the map unit.

Geology

This map unit is underlain by landslide deposits derived from limestone, basaltic, and metasedimentary rocks.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately fine-textured surface layers and subsoil clay accumulations. Subsoils have 15 to 50 percent angular rock fragments.

Map Unit Composition

Mollic Cryoboralfs, clayey-skeletal, mixed have thin dark-colored surface layers and 35 to 50 percent rock fragments in the subsoil. Similar soils are Typic Cryoboralfs, clayey-skeletal, mixed and Mollic Cryoboralfs, fine, mixed. They have light-colored surface layers or 15 to 35 percent rock fragments in the subsoil. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Typic Cryaquolls, clayey-skeletal, mixed. These soils are in bogs. They have mottled subsoil colors and are wet.

Representative Profile of the Soils

Mollic Cryoboralfs, clayey-skeletal, mixed have dark-brown silty clay loam surface layers 9-inches thick. The upper part of the subsoil is brown and light yellowish-brown very gravelly silty clay loam and silty clay 30-inches thick. The lower part of the subsoil is light yellowish-brown very gravelly silty clay loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 50 to 80 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition limits forest regeneration.

Range

This unit is well suited to transitory range. The forest understory produces little forage under a forest canopy, but production increases to 200 pounds per acre when the canopy is removed.

Roads

This unit contains bogs. Excavation can intercept large amounts of ground water. Road construction can increase the frequency of landslides. Slope stability should be evaluated before locating roads. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for elk.

15C—Typic Eutroboralfs, landslides

This map unit is on landslides. Elevation ranges from 4,500 to 5,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is lower, mixed forest. Soils formed in landslide deposits.

Landform

Dominant slopes have gradients of 10 to 40 percent. Landslides are hummocky land surfaces characterized by a regular pattern of mounds and depressions. Indicators of movement such as large cracks, slip scars, and lobate-shaped deposits are present. The drainage pattern is deranged with weakly incised low-order drainageways that divert

runoff into bogs. Seeps and springs are common in some areas.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir, ponderosa pine, and lodgepole pine. Dominant understory species are pinegrass, blue huckleberry, snowberry, kinnikinnick, and white spirea.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass, kinnikinnick phase, are the major habitat types. These habitat types occupy 85 percent of the map unit. Douglas-fir/twinflower and Douglas-fir/dwarf huckleberry are dissimilar habitat types. They are on northerly aspects or on benches and occupy 15 percent of the map unit. Ponderosa pine does not grow well.

Geology

This map unit is underlain by landslide deposits derived from soft, well-weathered metasedimentary and volcanic rocks.

Characteristics of the Soils

Soils in this map unit have moderately fine-textured and fine-textured surface layers and subsoil clay accumulations. Subsoils contain 15 to 35 percent angular rock fragments.

Map Unit Composition

Typic Eutroboralfs, fine, mixed have light-colored surface layers. Similar soils are Mollic Cryoboralfs, fine, mixed. They have dark-colored surface layers. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Typic Haplaquolls, fine, mixed, frigid. They are near seeps and springs. They have dark-colored surface layers, mottled soil colors, and are wet.

Representative Profile of the Soils

Typic Eutroboralfs, fine, mixed have brown silty clay loam surface layers 3-inches thick. The upper part of the subsoil is dark yellowish-brown silty clay loam and gravelly silty clay 23-inches thick. The lower part of the subsoil is calcareous yellowish-brown gravelly silty clay loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by puddling soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition limits forest regeneration.

Range

The forest understory produces little forage under a forest canopy, but production increases to 225 pounds per acre when the canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. Material exposed by road construction tends to slough on steep cutbanks. Unsurfaced roads rut when wet.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Some delineations are preferred winter range for elk.

21—Lithic Ustochrepts-Typic Ustochrepts complex, limestone substratum

This map unit is on mountain slopes. Elevation ranges from 3,500 to 6,600 feet. Average annual precipitation is 15 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with closely spaced, moderately incised low-order drainageways that have V-shaped draw bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir, ponderosa pine, and limber pine. Dominant understory species are snowberry, bluebunch wheatgrass, white spirea, and bitterbrush.

Habitat Types

Ponderosa pine/bluebunch wheatgrass, Douglas-fir/bluebunch wheatgrass, and ponderosa pine/bitterbrush are the major habitat types. These habitat types occupy 85 percent of the map unit. Douglas-fir/twinflower, a dissimilar habitat type, is on northerly aspects and has higher timber productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 40 to 60 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid are 4- to 20-inches deep over bedrock. These soils occupy 55 percent of the unit.

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid are 20- to 40-inches deep over bedrock and have light-colored surface layers. Similar soils are Typic Calciborolls, loamy-skeletal, carbonatic. They have dark-colored surface layers. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar inclusions occupy 10 percent of this map unit. Dissimilar inclusions are rock outcrop and rubble land.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous very dark-gray very gravelly loam surface layers 2-inches thick. The subsoil is calcareous brown very gravelly loam overlying fractured limestone at 19 inches.

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous dark-brown very gravelly loam

surface layers 6-inches thick. The subsoil is calcareous brown extremely gravelly loam overlying fractured limestone at 36 inches.

Management

Timber

Potential annual production is 10 to 20 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 500 pounds of forage per acre under a forest canopy and 750 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Hard rock frequently limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred winter range for elk.

22—Lithic Ustochrepts, limestone substratum

This map unit is on dip slopes. Elevation ranges from 3,500 to 6,600 feet. Average annual precipitation is 15 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 10 to 25 percent. Dip slopes are long, smooth, linear slopes that generally conform to the dip of the underlying bedrock. These slopes generally are wider at their base and gradually taper upward. The drainage pattern is dendritic with widely spaced and weakly incised drainageways.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and ponderosa pine. Dominant understory species are rough fescue, Idaho fescue, and bluebunch wheatgrass.

Habitat Types

Douglas-fir/rough fescue and ponderosa pine/Idaho fescue are the major habitat types. Douglas-fir/pinegrass, kinnikinnick phase, is a similar habitat type. These habitat types occupy 100 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have calcareous medium-textured surface layers, ranging from 10- to 20-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments and are calcareous.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid have dark-colored surface layers. Similar soils are Lithic Calciborolls, loamy-skeletal, carbonatic. They have dark-colored surface layers. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Typic Ustochrepts, loamy-skeletal, carbonatic, frigid. These soils are on lower slopes. They are 20- to 40-inches deep over bedrock and have higher timber and forage productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous very dark-gray gravelly loam surface layers 2-inches thick. Subsoil is calcareous brown very gravelly loam overlying fractured limestone at 19 inches.

Management

Timber

Potential annual production is 10 to 20 cubic feet per acre. The terrain is well suited to tractor operation. Grass competition and moisture stress limit forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 500 pounds of forage per acre under a forest canopy and 800 pounds per acre when the forest canopy is removed.

Roads

Hard rock frequently limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

26—Typic Ustochrepts-Mollic Eutroboralfs complex, bouldery, granitic substratum

This map unit is on rolling uplands. Elevation ranges from 4,500 to 5,500 feet. Average annual precipitation is 15 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Rolling uplands have broadly rounded ridgetops with side slopes ranging from straight to convex. The drainage pattern is dendritic with closely spaced, weakly incised first- and second-order drainageways that have broad, concave bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and ponderosa pine with some lodgepole pine. Dominant understory species are white spirea, snowberry, pinegrass, and kinnikinnick.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass, kinnikinnick phase, are the major habitat types. Ponderosa pine/bluebunch wheatgrass is a similar habitat type. These habitat types occupy 85 percent of the map unit. Idaho fescue/bluebunch wheatgrass habitat type and quaking aspen groves are dissimilar habitat and community types in draws. They occupy 15 percent of the map unit.

Geology

This map unit is underlain by moderately weathered granite, granite-diorite, and diorites. These types of bedrock produce sandy and loamy material when weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to coarse. Subsoils contain 0 to 35 percent rounded rock fragments. Soils range from 20-inches to more than 60-inches deep over bedrock. Large granitic boulders are scattered upon the surface in areas. Soil properties vary with topography. Soils on ridges and upper slopes have coarse-textured subsoils and do not have subsoil clay accumulations. Soils on lower slopes and in draws have moderately fine-textured subsoils with clay accumulations.

Map Unit Composition

Typic Ustochrepts, sandy, mixed, frigid are on ridges and upper slopes and have moderately coarse-textured subsoils. Similar soils are Typic Ustipsamments, sandy, mixed, frigid. They have coarse-textured subsoils. These soils occupy 60 percent of the unit.

Mollic Eutroboralfs, fine-loamy, mixed are on lower slopes and in draws and have thin dark-colored surface layers. Similar soils are Typic Argiborolls, fine-loamy, mixed. They have thick dark-colored surface layers. These soils occupy 30 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion. It is on ridgetops and occupies 10 percent of the map unit.

Representative Profile of the Soils

Typic Ustochrepts, sandy, mixed, frigid have dark-brown gravelly sandy loam surface layers 2-inches thick. The upper part of the subsoil is dark yellowish-brown gravelly sandy loam 14-inches thick. The lower part of the subsoil is olive-brown gravelly loamy sand 14-inches thick. The substratum is moderately weathered granite to depths of 60 inches or more.

Mollic Eutroboralfs, fine-loamy, mixed have dark-brown sandy loam surface layer 6-inches thick. Subsoil is dark yellowish-brown and brown sandy clay loam and sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. The terrain is suited to tractor operation, but boulders limit operation on parts of the unit. Tractor operation can reduce soil productivity by displacing soil surface layers; operation should be carefully managed to minimize the area affected. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 300 pounds of forage per acre under a forest canopy and 450 pounds per acre when the forest canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Cut and fill material is sandy and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Some delineations in the Elkhorn Mountains are preferred winter range for mule deer.

29—Lithic Ustochrepts, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 3,500 to 5,200 feet. Average annual precipitation is 15 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes, ranging from

straight to convex, have narrow ridgetops. The drainage pattern is dendritic with closely spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of an open-grown ponderosa-pine forest with some Douglas-fir. Dominant understory species are bluebunch wheatgrass, bitterbrush, and Idaho fescue.

Habitat Types

Douglas-fir/Idaho fescue, Douglas-fir/bluebunch wheatgrass, ponderosa pine/bluebunch wheatgrass, and ponderosa pine/bitterbrush are the major habitat types. These habitat types occupy 85 percent of the map unit. Douglas-fir/snowberry, a dissimilar habitat type, is on northerly aspects and along drainageways and has higher timber productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain mainly by moderately hard, laminated shales. Some quartzites and sandstones are included. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 4- to 20-inches deep over bedrock. Subsoils contain 50 to 80 percent angular rock fragments.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, mixed, frigid do not have subsoil clay accumulations. Similar soils are Lithic Eutroboralfs, loamy-skeletal, mixed. They have subsoil clay accumulations and occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of the map unit. Dissimilar soils are Typic Ustochrepts, loamy-skeletal, mixed, frigid. These soils are on lower slopes and along drainageways. They are 20- to 40-inches deep over bedrock and have higher timber productivity. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown very gravelly loam surface layers

7-inches thick. Subsoil is brown extremely gravelly loam overlying laminated shale at 18 inches.

Management

Timber

Potential annual production is 10 to 20 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 500 pounds of forage per acre under a forest canopy and 775 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Some delineations are preferred winter range for elk.

29A—Lithic Ustochrepts-Typic Ustochrepts complex, structural benches

This map unit is on structural benches. Elevation ranges from 3,800 to 5,000 feet. Average annual precipitation is 10 to 15 inches. Vegetation is dry grassland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Structural benches are gently sloping with short, steep slopes along intermittent drainageways. The drainage pattern is dendritic with widely spaced, moderately incised low-order drainageways that have broad, concave bottoms.

Vegetation

Vegetation consists of grassland dominated by bluebunch wheatgrass, Sandberg bluegrass, blue grama, needleandthread, and western needlegrass. Some areas have scattered ponderosa pine, common juniper, and skunkbrush sumac.

Habitat Types

Idaho fescue/bluebunch wheatgrass and Idaho fescue/western wheatgrass are the major grassland habitat types. These habitat types occupy 85 percent of the map unit. Western wheatgrass/blue grama, a dissimilar habitat type, is at lower elevations and has lower forage productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain mainly by argillites, siltites, and quartzites. Sandstones and shales are in some areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. Subsoils contain 10 to 80 percent angular rock fragments and are calcareous in areas. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, mixed, frigid are 4- to 20-inches deep over bedrock and have 35 to 80 percent rock fragments in the subsoil. Similar soils are Lithic Ustochrepts, fine-loamy, mixed, frigid. They have 10 to 35 percent rock fragments in the subsoil. These soils occupy 55 percent of the unit.

Typic Ustochrepts, loamy-skeletal, mixed, frigid are 20- to 40-inches deep over bedrock. They have 35 to 80 percent rock fragments in the subsoil and thin dark-colored surface layers. Similar soils are Typic Haploborolls, loamy-skeletal, mixed and Typic Ustochrepts, fine-loamy, mixed, frigid. These soils have thick dark-colored surface layers or 10 to 35 percent rock fragments in the subsoil. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion on steep slopes along drainageways and occupies 10 percent of the unit.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown extremely gravelly loam surface layers 7-inches thick. Subsoil is calcareous brown extremely gravelly loam overlying fractured quartzite at 18 inches.

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark reddish-brown very channery loam surface layers 8-inches thick. Subsoil is calcareous dark reddish-brown very channery and extremely channery loam overlying fractured argillite at 30 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

This unit is well suited to livestock grazing. Forage production is 300 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

29B—Typic Ustochrepts, structural benches

This map unit is on structural benches. Elevation ranges from 4,000 to 4,800 feet. Average annual precipitation is 10 to 15 inches. Vegetation is lower, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Structural benches are gently sloping with short, steep slopes along drainageways. The drainage pattern is dendritic with widely spaced, moderately incised low-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of ponderosa pine with some areas of Douglas-fir. Dominant understory species are rough fescue, Idaho fescue, and bluebunch wheatgrass.

Habitat Types

Douglas-fir/rough fescue and ponderosa pine/Idaho fescue, rough fescue phase, are the major habitat types. These habitat types occupy 90 percent of the unit. Douglas-fir/snowberry, a dissimilar habitat type, is on northerly aspects along drainageways and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain mainly by argillites, siltites, and quartzites. Sandstones and shales are in some areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. They are 20- to 40-inches deep over bedrock. Subsoils contain 20 to 60 percent angular rock fragments.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, mixed, frigid have 35 to 60 percent rock fragments in the subsoil and do not have subsoil clay accumulations. Similar soils are Typic Ustochrepts, fine-loamy, mixed, frigid and Typic Eutroboralfs, loamy-skeletal, mixed. They have 20 to 35 percent rock fragments in the subsoil or subsoil clay accumulations. These soils occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, mixed, frigid. These soils are on steep slopes along drainageways. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on steep slopes.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark reddish-brown very gravelly loam surface layers 8-inches thick. Subsoil is calcareous dark reddish-brown very gravelly loam and extremely gravelly loam overlying fractured argillite bedrock at 35 inches.

Management

Timber

Potential annual production is 20 to 30 cubic feet per acre. The terrain is well suited to tractor operation. Grass competition and moisture stress limit forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 500 pounds of forage per acre under a forest canopy and 775 pounds per acre when the forest canopy is removed.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

29C—Lithic Argiborolls, rolling uplands

This map unit is on rolling uplands. Elevation ranges from 4,500 to 5,000 feet. Average annual precipitation is 10 to 15 inches. Vegetation is dry grassland. Soils formed in material derived from metasedimentary and basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Rolling uplands have broadly rounded ridgetops with side slopes ranging from straight to convex. The drainage pattern is dendritic and consists of widely spaced first- and second-order drainageways that have concave bottoms.

Vegetation

Dominant vegetation consists of bluebunch wheatgrass, Sandberg bluegrass, blue grama, Idaho fescue, and scattered limber pine. Douglas-fir and skunkbrush sumac are near rock outcrop.

Habitat Types

Idaho fescue/bluebunch wheatgrass and bluebunch wheatgrass/Sandberg bluegrass are the major habitat types. These habitat types occupy

90 percent of the map unit. Bitterbrush/bluebunch wheatgrass and bluebunch wheatgrass/blue grama, which are dissimilar habitat types, are on ridge crests and southerly aspects and have lower forage productivity. They occupy 10 percent of the map unit.

Geology

This map unit is underlain mainly by argillites, siltites, quartzites, and basalts. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured dark-colored surface layers, ranging from 7- to 20-inches deep over bedrock. Subsoils contain 35 to 80 percent angular rock fragments.

Map Unit Composition

Lithic Argiborolls, loamy-skeletal, mixed have subsoil clay accumulations. Similar soils are Lithic Haploborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Typic Argiborolls, loamy-skeletal, mixed and Borollic Calciorthis, loamy-skeletal, carbonatic. Typic Argiborolls, loamy-skeletal, mixed are in draws. They are 20- to 40-inches deep over bedrock and have higher forage productivity. Borollic Calciorthis, loamy-skeletal, carbonatic are at lower elevations. They are in a drier climate and have lower forage productivity. Rock outcrop is on ridge crests.

Representative Profile of the Soils

Lithic Argiborolls, loamy-skeletal, mixed have very dark grayish-brown surface layers. The upper surface layer is silt loam 4-inches thick. The lower surface layer is sandy clay loam 3-inches thick. Subsoil is dark yellowish-brown very stony sandy clay loam overlying bedrock at 19 inches.

Management

Timber

This map unit contains only scattered stands of trees and is poorly suited to timber management.

Range

This unit is well suited to livestock grazing. Forage production is 500 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

31—Typic Ustochrepts and Typic Calciborolls, limestone substratum

This map unit is on mountain slopes. Elevation ranges from 4,500 to 7,200 feet. Average annual precipitation is 15 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, weakly incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a Douglas-fir forest. Dominant understory species are rough fescue, Idaho fescue, and bluebunch wheatgrass.

Habitat Types

Douglas-fir/snowberry, bluebunch wheatgrass phase; Douglas-fir/rough fescue; and Douglas-fir/pinegrass, bluebunch wheatgrass phase, are the major habitat types. These habitat types occupy 85 percent of the unit. Rough fescue/bluebunch wheatgrass, a dissimilar habitat type, is in small meadows. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 40 to 60 percent

angular rock fragments and are calcareous. Soil properties are not obviously associated with surface features. Soils with thin and thick dark-colored surface layers are both present.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid have thin dark-colored surface layers.

Typic Calciborolls, loamy-skeletal, carbonatic have thick dark-colored surface layers. Every delineation has at least one of these soils and may have both.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid. These soils are on upper slopes and ridges. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on upper slopes and ridges.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous dark-brown very gravelly loam surface layers 6-inches thick. The upper part of the subsoil is calcareous brown extremely gravelly loam 20-inches thick. The lower part of the subsoil is calcareous brown extremely gravelly silt loam overlying fractured limestone at 37 inches.

Typic Calciborolls, loamy-skeletal, carbonatic have calcareous dark-brown gravelly silt loam surface layers 9-inches thick. Subsoil is calcareous brown very gravelly and extremely gravelly silt loam overlying fractured limestone at 35 inches.

Management

Timber

Potential annual production is 30 to 50 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces little forage under a forest canopy, but production increases to 225 pounds per acre when the canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Hard rock frequently limits excavation. Excavation of hard rock produces extremely stony cut and fill material. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill

material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred winter range for elk.

32—Mollic Cryoboralfs-Calcic Cryoborolls complex, dip slopes

This map unit is on dip slopes. Elevation ranges from 6,000 to 7,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 10 to 40 percent. Dip slopes have very broad ridgetops with slopes that generally conform to the dip of the underlying bedrock. The drainage pattern is dendritic with widely spaced, weakly incised first- and second-order drainageways that have concave bottoms.

Vegetation

Vegetation consists of a Douglas-fir forest with some lodgepole pine. Dominant understory species are Idaho fescue, bluebunch wheatgrass, rough fescue, and pinegrass.

Habitat Types

Douglas-fir/rough fescue and Douglas-fir/pinegrass are the major habitat types. These habitat types occupy 90 percent of the map unit. Rough fescue/bluebunch wheatgrass, a dissimilar habitat type, is in small meadows. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately fine-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 40 to 80 percent angular rock fragments and are

calcareous. Soil properties are not obviously associated with landscape features. Soils with light-colored or thin dark-colored surface layers and with thick dark-colored surface layers are both present.

Map Unit Composition

Mollic Cryoboralfs, loamy-skeletal, mixed have thin dark-colored surface layers. Similar soils are Typic Cryoboralfs, loamy-skeletal, mixed and Calcic Cryoborolls, loamy-skeletal, carbonatic. Typic Cryoboralfs, loamy-skeletal, mixed have light-colored surface layers. These soils occupy 50 percent of the unit. Calcic Cryoborolls, loamy-skeletal, carbonatic have thick dark-colored surface layers. These soils occupy 35 percent of the map unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, carbonatic. They are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Mollic Cryoboralfs, loamy-skeletal, mixed have dark-brown silt loam upper surface layers 8-inches thick. The lower surface layer is pale-brown gravelly silt loam 4-inches thick. The subsoil is brown very gravelly silt loam 20-inches thick. The lower part of the subsoil is calcareous pale-brown extremely gravelly silt loam overlying fractured limestone at 37 inches.

Calcic Cryoborolls, loamy-skeletal, carbonatic have dark-brown very gravelly silt loam surface layers 11-inches thick. Subsoil is calcareous dark-brown and light yellowish-brown very gravelly and extremely gravelly silt loam and loam overlying fractured limestone at 38 inches.

Management

Timber

Potential annual production is 30 to 40 cubic feet per acre. The terrain is well suited to tractor operation. Grass competition and moisture stress limit forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 300 pounds of forage per acre under a forest canopy and 550 pounds per acre when the forest canopy is removed.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

32A—Calcic Cryoborolls, dip slopes

This map unit is on dip slopes. Elevation ranges from 5,000 to 7,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 10 to 25 percent. Dip slopes are very broad ridgetops with slopes that generally conform to the dip of the underlying bedrock. The drainage pattern is dendritic with widely spaced, weakly incised first- and second-order drainageways that have concave bottoms.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, and big sagebrush. Some areas have small stands of Douglas-fir.

Habitat Types

Rough fescue/Idaho fescue and big sagebrush/Idaho fescue are the major habitat types. These habitat types occupy 85 percent of the unit. Douglas-fir/rough fescue, a dissimilar habitat type, supports Douglas-fir stands. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 60 to 80 percent angular rock fragments and are calcareous.

Map Unit Composition

Calcic Cryoborolls, loamy-skeletal, carbonatic occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, carbonatic. They are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower forage productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Calcic Cryoborolls, loamy-skeletal, carbonatic have dark-brown very gravelly silt loam surface layers 11-inches thick. Subsoil is calcareous dark yellowish-brown and light yellowish-brown very gravelly and extremely gravelly silt loam overlying fractured limestone at 38 inches.

Management**Timber**

This map unit contains only scattered stands of trees and is poorly suited to timber management.

Range

This unit is well suited to livestock grazing. Forage production is 1,100 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

32B—Typic Cryochrepts-Lithic Cryochrepts-Rock outcrop complex, dip slopes

This map unit is on dip slopes. Elevation ranges from 4,400 to 7,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes are on southerly aspects with gradients of 40 to 60 percent. Dip slopes are long, smooth, linear slopes that generally conform to the dip of the underlying bedrock. These slopes generally are wider at their base and gradually taper upward. The drainage pattern is subparallel with widely spaced, weakly incised low-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a Douglas-fir forest with some areas of limber pine and lodgepole pine. Dominant understory species are snowberry, bluebunch wheatgrass, kinnikinnick, and common juniper.

Habitat Types

Douglas-fir/snowberry, Douglas-fir/common juniper, and Douglas-fir/white spirea are the major habitat types. These habitat types occupy 100 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 60 to 80 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, carbonatic are 20- to 40-inches deep over bedrock and do not have subsoil clay accumulations. Similar soils are Typic Cryoboralfs, loamy-skeletal, mixed. These soils have subsoil clay accumulations and occupy 40 percent of the unit.

Lithic Cryochrepts, loamy-skeletal, carbonatic are 4- to 20-inches deep over bedrock and occupy 30 percent of the map unit. Rock outcrop is present throughout the unit and occupies 30 percent of it. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, carbonatic have very dark grayish-brown extremely gravelly silt loam surface layers 4-inches thick. Subsoil is calcareous brown and pale-brown very gravelly silty clay loam and silt loam overlying fractured bedrock at 37 inches.

Lithic Cryochrepts, loamy-skeletal, carbonatic have very dark grayish-brown gravelly silty clay loam surface layers 5-inches thick. Subsoil is calcareous dark yellowish-brown very gravelly silt loam overlying fractured limestone at 14 inches.

Management

Timber

Potential annual production is 25 to 40 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 150 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Hard rock frequently limits excavation. Excavation of hard rock produces extremely stony cut and fill material. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

34—Typic Cryochrepts-Typic Cryoboralfs complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 4,200 to 6,500 feet. Average annual precipitation is 15 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes are on northerly aspects with gradients of 40 to 60 percent. These mountain slopes have side slopes ranging from straight to convex. The drainage pattern is subparallel with moderately spaced, weakly incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a Douglas-fir forest with some areas of ponderosa pine. Dominant understory species are snowberry, pinegrass, ninebark, twinflower, and common juniper.

Habitat Types

Douglas-fir/twinflower and Douglas-fir/ninebark are the major habitat types. These habitat types occupy 90 percent of the map unit. Douglas-fir/bluebunch wheatgrass, a dissimilar habitat type, is on westerly aspects and has lower timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain mainly by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately fine-textured surface layers, ranging from 20-inches to more than 60-inches deep over bedrock. Subsoils contain 35 to 70 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils with and without subsoil clay accumulations are both present.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed do not have subsoil clay accumulations. These soils occupy 50 percent of the unit.

Typic Cryoboralfs, loamy-skeletal, mixed have subsoil clay accumulations and light-colored surface layers. Similar soils are Argic Cryoborolls, loamy-skeletal, mixed. They have dark-colored surface layers and occupy 40 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly clay loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly clay loam 16-inches thick. The lower part of the subsoil is calcareous yellowish-brown very cobbly clay loam overlying fractured bedrock at 40 inches.

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown very cobbly clay loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly clay loam 12-inches thick. The lower part of the subsoil is calcareous dark yellowish-brown very cobbly clay loam overlying fractured bedrock at 40 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass and brush competition stress limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

36—Typic Cryoboralfs, bouldery, granitic substratum

This map unit is on rolling uplands. Elevation ranges from 5,000 to 6,400 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 25 to 40 percent. Rolling uplands have broadly rounded ridgetops with side slopes ranging from straight to convex. The drainage pattern is dendritic with moderately spaced, first- and second-order drainageways that have concave bottoms.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of Douglas-fir. Dominant understory

species are snowberry, pinegrass, twinflower, and blue huckleberry.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass are the major habitat types on southerly aspects. Douglas-fir/twinflower is the major habitat type on northerly aspects. These habitat types occupy 90 percent of the map unit. Douglas-fir/rough fescue, a dissimilar habitat type, is on southerly aspects. It supports ponderosa pine and has lower timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by moderately and weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers, ranging from 20-inches to more than 60-inches deep over bedrock. Subsoils contain 15 to 35 percent rounded rock fragments. Boulders are scattered upon the surface in areas.

Map Unit Composition

Typic Cryoboralfs, fine-loamy, mixed have light-colored surface layers. Similar soils are Mollic Cryoboralfs, fine-loamy, mixed. These soils have dark-colored surface layers. Mollic Cryoboralfs, fine-loamy, mixed occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of the unit. Dissimilar soils are Typic Cryochrepts, coarse-loamy, mixed. These soils are on upper slopes and ridges. They have sandy subsoils and lower timber productivity. Rock outcrop is on upper slopes and ridges.

Representative Profile of the Soils

Typic Cryoboralfs, fine-loamy, mixed have brown coarse sand surface layers 7-inches thick. The lower surface layer is brown gravelly coarse sandy loam 16-inches thick. The upper part of the subsoil is dark yellowish-brown gravelly sandy clay loam 34-inches thick. The lower part of the subsoil is dark yellowish-brown very gravelly sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. The terrain is suited to tractor operation, but boulders limit operation on parts of the unit. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to ravel on steep cutbanks.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

36A—Argic Cryoborolls, granitic substratum

This map unit is on rolling uplands. Elevation ranges from 4,700 to 7,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Rolling uplands have broadly rounded ridgetops with side slopes ranging from straight to convex. The drainage pattern is dendritic with moderately spaced first- and second-order drainageways that have broad, slightly concave bottoms.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, big sagebrush, and a variety of forbs and low shrubs.

Habitat Types

Rough fescue/Idaho fescue, rough fescue/bluebunch wheatgrass, and big sagebrush/rough fescue are the major habitat types. These habitat types occupy 90 percent of the unit. Douglas-fir/Idaho fescue, a dissimilar habitat type, is scattered throughout the unit and supports Douglas-fir forest. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by moderately and weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy to sandy material when weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers, ranging from 40- to 60-inches deep over bedrock. Subsoils contain 15 to 50 percent rounded rock fragments.

Map Unit Composition

Argic Cryoborolls, fine-loamy, mixed have subsoil clay accumulations and 15 to 35 percent rock fragments in the subsoil. Similar soils are Typic Cryoborolls, coarse-loamy, mixed and Argic Cryoborolls, loamy-skeletal, mixed. These soils do not have subsoil clay accumulations or have 35 to 50 percent rock fragments in the subsoil. They occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, coarse-loamy, mixed. They are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on upper slopes and ridges.

Representative Profile of the Soils

Argic Cryoborolls, fine-loamy, mixed have very dark grayish-brown gravelly sandy loam surface layers 10-inches thick. The upper part of the subsoil is brown and dark yellowish-brown gravelly sandy clay loam 23-inches thick. The lower part of the subsoil is yellowish-brown gravelly sandy clay loam overlying weathered granitic bedrock at 45 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production is 600 pounds per acre in an average year. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

36B—Typic Cryoborolls-Aquolls complex, granitic substratum

This map unit is on mountain slopes. Elevation ranges from 5,500 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest and wet forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes are on northerly aspects with gradients of 10 to 40 percent. These mountain slopes have side slopes ranging from straight to convex. The drainage pattern is subparallel with widely spaced, weakly incised first- and second-order drainageways.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce. Dominant understory species are twinflower, blue huckleberry, grouse whortleberry, and pinegrass.

Habitat Types

Subalpine fir/twinflower and subalpine fir/blue huckleberry are the major habitat types on uplands. These habitat types occupy 75 percent of the unit. Spruce/sweetscented bedstraw is the major habitat

type in wet draws. This habitat type occupies 25 percent of the unit.

Geology

This map unit is underlain by moderately and weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy to sandy material when weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers. Subsoils contain 15 to 30 percent rounded rock fragments. Soil properties vary with topographic position. Soils on uplands are well drained. Soils in draws have fluctuating water tables and are wet.

Map Unit Composition

Typic Cryoboralfs, fine-loamy, mixed have light-colored surface layers. Similar soils are Mollic Cryoboralfs, fine-loamy, mixed and Aquolls, fine-loamy, mixed. Mollic Cryoboralfs, fine-loamy, mixed have thin dark-colored surface layers. These soils occupy 65 percent of the unit. Aquolls, fine-loamy, mixed are in wet draws. These soils occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion on ridges and upper slopes and occupies 10 percent of the unit.

Representative Profile of the Soils

Typic Cryoboralfs, fine-loamy, mixed have brown gravelly sandy loam surface layers 23-inches thick. The upper part of the subsoil is dark yellowish-brown gravelly sandy clay loam 34-inches thick. The lower part of the subsoil is dark yellowish-brown very gravelly sandy loam to depths of 60 inches or more.

No one profile can represent Aquolls, but one of the most common follows. Aquolls have very dark grayish-brown gravelly sandy loam surface layers 10-inches thick. Subsoil is dark grayish-brown gravelly loam and sandy loam mottled with reddish-brown 16-inches thick. Substratum is dark-gray gravelly sandy loam and loamy sand mottled with yellowish-brown to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Wet areas with low strength limit tractor operation in wet draws. Rutting and puddling of the soil can reduce soil productivity. Grass competition limits forest regeneration. Trees are susceptible to windthrow in wet draws.

Range

On uplands, the forest understory produces little forage and is poorly suited to livestock grazing. In wet draws, the forest understory produces 250 pounds of forage per acre under a forest canopy and 500 pounds per acre when the forest canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

This unit contains wet soils. Excavation can intercept large amounts of ground water.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

37—Argic Cryoborolls-Lithic Cryoborolls complex, basaltic substratum

This map unit is on rolling uplands. Elevation ranges from 5,200 to 7,000 feet. Average annual precipitation is 15 to 20 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Rolling uplands have broadly rounded ridgetops and side slopes ranging from straight to convex. The drainage pattern is dendritic with moderately spaced, weakly incised first- and second-order drainageways that have broad concave bottoms.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, and a variety of forbs and low shrubs. Big sagebrush is included in areas.

Habitat Types

Rough fescue/Idaho fescue and big sagebrush/Idaho fescue are the major habitat types. These habitat types occupy 90 percent of the unit. Douglas-fir/Idaho fescue, a dissimilar habitat type, is along draws and supports Douglas-fir forest. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured, dark-colored surface layers. Subsoils contain 35 to 60 percent angular rock fragments. Soil properties vary with topographic position. Soils on lower slopes are 20- to 40-inches deep over bedrock. Soils on upper slopes and ridges are 4- to 20-inches deep over bedrock.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed are on lower slopes. They have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 65 percent of the unit.

Lithic Cryoborolls, loamy-skeletal, mixed are on upper slopes and ridges and occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion on upper slopes and ridges and occupies 10 percent of the unit.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown cobbly loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown very cobbly clay loam 16-inches thick. The lower part of the subsoil is brown extremely cobbly loam overlying fractured bedrock at 40 inches.

Lithic Cryoborolls, loamy-skeletal, mixed have very dark-brown cobbly loam surface layers 5-inches thick.

Subsoil is dark-brown and dark yellowish-brown very cobbly loam overlying fractured bedrock at 15 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production is 450 pounds per acre in an average year. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Hard rock occasionally limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred winter range for elk.

39—Typic Ustochrepts, steep

This map unit is on mountain slopes. Elevation ranges from 4,800 to 6,800 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of an open-grown Douglas-fir forest with some areas of lodgepole pine. Dominant understory species are snowberry, Idaho fescue, bluebunch wheatgrass, and kinnikinnick.

Habitat Types

Douglas-fir/snowberry, bluebunch wheatgrass phase, and Douglas-fir/Idaho fescue are the major habitat types. These habitat types occupy 90 percent of the unit. Douglas-fir/bluebunch wheatgrass, a dissimilar habitat type, is at lower elevations and supports ponderosa pine. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately coarse-textured surface layers, ranging from 20- to 60-inches deep over bedrock. Subsoils contain 35 to 80 percent angular rock fragments.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, mixed, frigid do not have subsoil clay accumulations. Similar soils are Typic Eutroboralfs, loamy-skeletal, mixed. They have subsoil clay accumulations. These soils occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, mixed, frigid. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark reddish-brown very channery sandy loam surface layers 8-inches thick. The upper part of the subsoil is calcareous dark reddish-brown very channery sandy loam 18-inches thick. The lower part of the subsoil is calcareous dark reddish-brown extremely channery sandy loam overlying fractured bedrock at 47 inches.

Management

Timber

Potential annual production is 20 to 40 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 300 pounds of forage per acre under a forest canopy and 475 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred winter range for elk.

39A—Lithic Cryoborolls-Argic Cryoborolls complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 4,200 to 6,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 25 to 40 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, big sagebrush, and a variety of forbs and low shrubs. Scattered limber pine, Douglas-fir, or ponderosa pine are sometimes present.

Habitat Types

Idaho fescue/bluebunch wheatgrass and big sagebrush/Idaho fescue are the major habitat types.

Rough fescue/bluebunch wheatgrass is a similar habitat type. These habitat types occupy 85 percent of the unit. Rough fescue/Idaho fescue, a dissimilar habitat type, is at higher elevations and has higher forage productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured, dark-colored surface layers. Subsoils contain 35 to 60 percent angular rock fragments. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Lithic Cryoborolls, loamy-skeletal, mixed are 4- to 20-inches deep over bedrock and occupy 50 percent of the unit.

Argic Cryoborolls, loamy-skeletal, mixed are 20- to 40-inches deep over bedrock and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 40 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion throughout and occupies 10 percent of the unit.

Representative Profile of the Soils

Lithic Cryoborolls, loamy-skeletal, mixed have very dark-brown loam surface layers 5-inches thick. The upper part of the subsoil is dark-brown very channery loam 6-inches thick. The lower part of the subsoil is dark yellowish-brown extremely channery loam overlying fractured argillite at 15 inches.

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very cobbly loam 16-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam overlying fractured sandstone at 40 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production is 550 pounds per acre in an average year. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred winter range for elk.

39B—Lithic Ustochrepts-Typic Ustochrepts complex, steep

This map unit is on mountain slopes. Elevation ranges from 5,000 to 6,500 feet. Average annual precipitation is 15 to 20 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes are on southerly aspects with slope gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, big sagebrush, and a variety of forbs and low shrubs. There are scattered Douglas-fir and Rocky Mountain juniper in some places.

Habitat Types

Idaho fescue/bluebunch wheatgrass and big sagebrush/Idaho fescue are the major habitat types. Big sagebrush/bluebunch wheatgrass is a similar habitat type. These habitat types occupy 85 percent of the map unit. Bluebunch wheatgrass/blue grama and bluebunch wheatgrass/Sandberg bluegrass, which are dissimilar habitat types, are at lower elevations and have lower forage productivity. Douglas-fir/Idaho fescue and Douglas-fir/bluebunch wheatgrass are present throughout and support open-grown forest. They occupy 15 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in some areas. These types of bedrock produce loamy materials when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 40 to 80 percent angular rock fragments. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, mixed, frigid are 4- to 20-inches deep over bedrock and have thin dark-colored surface layers. Similar soils are Lithic Haploborolls, loamy-skeletal, mixed and have thick dark-colored surface layers. These soils occupy 50 percent of the unit.

Typic Ustochrepts, loamy-skeletal, mixed, frigid are 20- to 40-inches deep over bedrock and have thin dark-colored surface layers. Similar soils are Typic Haploborolls, loamy-skeletal, mixed and have thick dark-colored surface layers. These soils occupy 40 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and rubble land are dissimilar inclusions in the unit. They are present throughout and occupy 10 percent of the map unit.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown extremely gravelly loam surface layers 7-inches thick. Subsoil is brown extremely

gravelly loam overlying fractured bedrock at 18 inches.

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark reddish-brown very gravelly loam surface layers 8-inches thick. The upper part of the subsoil is dark reddish-brown very gravelly loam 18-inches thick. The lower part of the subsoil is dark reddish-brown extremely gravelly loam overlying fractured bedrock at 37 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production is 400 pounds per acre in an average year. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

39C—Argic Cryoborolls, mountain ridges, dry

This map unit is on mountain ridges. Elevation ranges from 5,500 to 7,000 feet. Average annual precipitation is 15 to 20 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Mountain ridges are very broad undissected ridgetops with convex side slopes.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber

oatgrass, western needlegrass, big sagebrush, and a variety of forbs and low shrubs. There may be scattered Douglas-fir on lower slopes.

Habitat Types

Rough fescue/Idaho fescue and big sagebrush/Idaho fescue are the major habitat types. These habitat types occupy 90 percent of the map unit. Douglas-fir/Idaho fescue, a dissimilar habitat type, is on the lee side of ridges and supports open-grown forest. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured, dark-colored surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, mixed. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower forage productivity. Rock outcrop is present throughout the map unit.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very cobbly loam 16-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam overlying fractured bedrock at 40 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

This unit is well suited to livestock grazing. Forage production is 450 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

41—Typic Cryochrepts and Calcic Cryoborolls, steep, cool

This map unit is on mountain slopes. Elevation ranges from 5,500 to 7,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes are on northerly aspects with slope gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage patterns are subparallel and dendritic with widely spaced, weakly incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a Douglas-fir forest. Dominant understory species are twinflower, heartleaf arnica, and western meadowrue.

Habitat Types

Subalpine fir/twinflower is the major habitat type. Spruce/twinflower is a similar habitat type. These habitat types occupy 100 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep

over bedrock. Subsoils contain 40 to 60 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils with thin and thick dark-colored surface layers are both present.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, carbonatic have thin dark-colored surface layers.

Calcic Cryoborolls, loamy-skeletal, carbonatic have thick dark-colored surface layers. Every delineation has at least one of these soils and may have both.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, carbonatic. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, carbonatic have very dark grayish-brown extremely gravelly silt loam surface layers 4-inches thick. The upper part of the subsoil is brown very gravelly silty clay loam 13-inches thick. The lower part of the subsoil is calcareous pale-brown very gravelly silt loam overlying fractured limestone at 38 inches.

Calcic Cryoborolls, loamy-skeletal, carbonatic have calcareous dark-brown very gravelly silt loam surface layers 11-inches thick. Subsoil is calcareous dark yellowish-brown and light yellowish-brown very gravelly and extremely gravelly silt loam and loam overlying fractured limestone at 38 inches.

Management

Timber

Potential annual production is 40 to 50 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less.

Range

The forest understory produces little forage under a forest canopy, but production increases to 300 pounds per acre when the canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Hard rock occasionally limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because

of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

44—Typic Cryochrepts, steep

This map unit is on mountain slopes. Elevation ranges from 5,200 to 7,000 feet. Average annual precipitation is 25 to 30 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes ranging from straight to convex. The drainage pattern is parallel with widely spaced, weakly incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a lodgepole-pine forest with some spruce, subalpine fir, and Douglas-fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, and blue huckleberry.

Habitat Types

Subalpine fir/blue huckleberry and subalpine fir/beargrass, blue huckleberry phase, are the major habitat types. These habitat types occupy 100 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in some areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately fine-textured surface layers, ranging from 20- to 60-inches deep over bedrock. Subsoils contain 40 to 80 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed do not have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed and Typic

Paleborafls, loamy-skeletal, mixed. They have subsoil clay accumulations. These soils occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly loam 6-inches thick. The lower part of the subsoil is yellowish-brown extremely cobbly loam overlying fractured bedrock at 40 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred summer range for deer and elk.

46—Typic Cryorthents, extremely bouldery

This map unit is on mountain slopes and ridges. Elevation ranges from 5,100 to 7,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is lower subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. These mountain slopes and ridges are very broad ridgetops with convex side slopes.

Vegetation

Vegetation consists of an open-grown lodgepole-pine forest. The dominant understory species is grouse whortleberry.

Habitat Types

Scree is the major community type. It occupies 100 percent of the map unit.

Geology

This map unit is underlain by weakly weathered granitic rocks.

Characteristics of the Soils

The soil surface is 50 to 90 percent covered by large granitic boulders. Soils in this map unit are coarse textured.

Map Unit Composition

Typic Cryorthents, sandy-skeletal, mixed occupy 100 percent of the unit.

Representative Profile of the Soils

Typic Cryorthents, sandy-skeletal, mixed have very dark grayish-brown extremely bouldery sand surface layers 5-inches thick. The substratum is yellowish-brown extremely bouldery sand to depths of 60 inches or more.

Management

Timber

Large granitic boulders severely limit timber management, livestock grazing, and road construction in this map unit. The main value of this unit is watershed. It has a high water yield.

47—Typic Cryoborafls and Mollic Cryoborafls, basaltic substratum

This map unit is on mountain slopes. Elevation ranges from 5,200 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper,

mixed forest. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 25 to 40 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of open-grown to dense stands of Douglas-fir and lodgepole pine. Dominant understory species in open-grown stands are Idaho fescue, elk sedge, and heartleaf arnica. Dominant understory species under dense forests are pinegrass and snowberry.

Habitat Types

Douglas-fir/pinegrass and Douglas-fir/snowberry are the major habitat types. Douglas-fir/elk sedge is a similar habitat type. These habitat types occupy 85 percent of the map unit. Douglas-fir/Idaho fescue, a dissimilar habitat type, is on ridges and has lower timber productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 60-inches deep over bedrock. Subsoils contain 35 to 60 percent angular rock fragments. Soil properties are not obviously associated with landscape features. Soils with light-colored and with thin dark-colored surface layers are both present.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have light-colored surface layers and 28 to 35 percent clay in the subsoil. Similar soils are Typic Cryoboralfs, clayey-skeletal mixed. They have 35 to 50 percent clay in the subsoil.

Mollic Cryoboralfs, loamy-skeletal, mixed have thin dark-colored surface layers. Every delineation has at least one of these soils and may have all.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on upper slopes and ridges. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown extremely cobbly coarse sandy loam overlying fractured basalt at 25 inches.

Mollic Cryoboralfs, loamy-skeletal, mixed have dark-brown cobbly loam surface layers 8-inches thick. The upper part of the subsoil is brown very cobbly loam 20-inches thick. The lower part of the subsoil is pale-brown extremely cobbly loam overlying basalt at 40 inches.

Management

Timber

Potential annual production is 30 to 50 cubic feet per acre. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 300 pounds of forage per acre under a forest canopy and 500 pounds per acre when the forest canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for elk.

47B—Typic Cryoboralfs, basaltic substratum, cool

This map unit is on mountain slopes. Elevation ranges from 5,000 to 7,000 feet. Average annual

precipitation is 20 to 25 inches. Vegetation is lower subalpine forest. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes are on northerly aspects with slope gradients of 25 to 50 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and Douglas-fir. Dominant understory species are grouse whortleberry, twinflower, and dwarf huckleberry.

Habitat Types

Subalpine fir/twinflower is the major habitat type. Douglas-fir/twinflower and subalpine fir/dwarf huckleberry are similar habitat types. These habitat types occupy 90 percent of the map unit. Subalpine fir/menziesia, a dissimilar habitat type, is at higher elevations. Brush competition limits forest regeneration. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 40- to 60-inches deep over bedrock. Subsoils contain 35 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have 18 to 35 percent clay in the subsoil. Similar soils are Typic Cryoboralfs, clayey-skeletal, mixed. They have 36 to 50 percent clay in the subsoil. These soils occupy 85 percent of the unit.

Dissimilar soils make up 15 percent of this map unit. Dissimilar soils are Typic Cryochrepts, loamy-skeletal, mixed and Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on upper slopes and ridges. They do not have subsoil clay accumulations and have lower timber productivity.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown very cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown extremely cobbly loam overlying fractured basalt at 40 inches.

Management

Timber

Potential annual production is 40 to 65 cubic feet per acre. Slope steepness limits tractor operation on parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes. Grass competition limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to slough on steep cutbanks.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

48—Dystric Cryochrepts, rhyolitic substratum

This map unit is on mountain slopes. Elevation ranges from 5,500 to 7,000 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from rhyolitic rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have smooth, undissected or weakly dissected side slopes ranging from straight to convex.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of subalpine fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, and menziesia.

Habitat Types

Subalpine fir/beargrass and subalpine fir/grouse whortleberry are the major habitat types on southerly aspects. Subalpine fir/menziesia is the major habitat type on northerly aspects. These habitat types occupy 100 percent of the map unit.

Geology

This map unit is underlain by rhyolites and tuffs. These types of bedrock produce loamy and sandy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured or moderately coarse-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 35 to 80 percent rounded rock fragments.

Map Unit Composition

Dystric Cryochrepts, sandy-skeletal, mixed have thin subsoils. Similar soils are Dystric Cryochrepts, loamy-skeletal, mixed. They have thick subsoils. These soils occupy 85 percent of the unit.

Dissimilar soils make up 15 percent of the map unit. Dissimilar soils are Typic Cryoboralfs, loamy-skeletal, mixed and Lithic Cryochrepts. Typic Cryoboralfs, loamy-skeletal, mixed are on concave lower slopes. They have subsoil clay accumulations and higher timber productivity. Lithic Cryochrepts are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Dystric Cryochrepts, sandy-skeletal, mixed have brown very gravelly sandy loam surface layers 6-inches thick. The upper part of the subsoil is brown very gravelly sandy loam 8-inches thick. The lower part of the subsoil is brown extremely cobbly coarse loamy sand overlying rhyolite at 38 inches.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Brush competition on northerly aspects limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Hard rock frequently limits excavation. Material exposed by road construction tends to ravel on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface. Cut and fill material is sandy and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

49—Typic Cryoboralfs and Mollic Cryoboralfs, steep

This map unit is on mountain slopes. Elevation ranges from 4,400 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 25 to 50 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are snowberry, pinegrass, white spirea, and common juniper.

Habitat Types

Douglas-fir/snowberry, pinegrass phase, and Douglas-fir/pinegrass are the major habitat types. These habitat types occupy 85 percent of the map unit. Douglas-fir/twinflower and Douglas-fir/ninebark, which are dissimilar habitat types, are on some steep northerly aspects and in draws. They have higher timber productivity and occupy 15 percent of the map unit.

Geology

This map unit is underlain mainly by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 40- to over 60-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments. Soil properties are not obviously associated with landscape features. Soils with light-colored and with thin dark-colored surface layers are both present.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have light-colored surface layers and subsoil clay accumulations within 24 inches of the surface. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed or Typic Paleboralfs, loamy-skeletal, mixed. They do not have subsoil clay accumulations or have subsoil clay accumulations more than 24-inches deep.

Mollic Cryoboralfs, loamy-skeletal, mixed have thin dark-colored surface layers. Every delineation has at least one of these soils and may have all.

Dissimilar soils and rock outcrop make up 10 percent of this map unit. Dissimilar soils are Lithic Cryoboralfs, loamy-skeletal, mixed. These soils are on upper slopes and ridges. They are 10- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on upper slopes and ridges.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown extremely gravelly silt loam overlying fractured bedrock at 45 inches.

Mollic Cryoboralfs, loamy-skeletal, mixed have dark-brown silt loam upper surface layers 8-inches thick. The lower surface layer is pale-brown gravelly silt loam 4-inches thick. The upper part of the subsoil is brown very gravelly silt loam 20-inches thick. The lower part of the subsoil is pale-brown extremely gravelly silt loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation on

parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes. Grass competition limits forest regeneration.

Range

The forest understory produces 75 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for elk and deer and winter range for elk.

49A—Argic Cryoborolls, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 5,800 to 7,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, big sagebrush, and a variety of forbs and low shrubs. Small stands of Douglas-fir or lodgepole pine are in areas.

Habitat Types

Rough fescue/Idaho fescue and big sagebrush/rough fescue are the major habitat types. Idaho fescue/bluebunch wheatgrass is a similar habitat type. These habitat types occupy 85 percent of the map unit. Douglas-fir/rough fescue or Douglas-fir/snowberry, which are dissimilar habitat types, occupy 15 percent of the map unit. They support forest.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have dark-colored surface layers ranging in texture from medium to moderately fine. They are 20- to 40-inches deep over bedrock. Subsoils contain 35 to 60 percent angular rock fragments.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, mixed. These soils are on convex knolls. They are 4- to 20-inches deep over bedrock and have lower forage productivity.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very cobbly loam 16-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam overlying fractured sandstone at 40 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production is 1,000 pounds per acre in an average year. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

49B—Typic Cryoborolls-Typic Cryochrepts complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 5,000 to 7,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, moderately incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and Douglas-fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, blue huckleberry, pinegrass, and menziesia.

Habitat Types

Subalpine fir/beargrass, blue huckleberry phase, is the major habitat type on southerly aspects. Subalpine fir/menziesia is the major habitat type on northerly aspects. These habitat types occupy 85 percent of the map unit.

Dissimilar habitat types make up 15 percent of the map unit. Subalpine fir/grouse whortleberry is at higher elevations and has lower timber productivity. Subalpine fir/twinflower is on northerly aspects and forest regeneration is not limited by brush competition.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Surface layers can form in loess that has been influenced by volcanic ash. These layers are 2- to 7-inches thick. They are 20- to 60-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments. Soil properties vary with topographic position. Soils on lower and mid slopes

have subsoil clay accumulations. Soils on upper slopes and on ridges do not have subsoil clay accumulations.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed are on lower and mid slopes. They have light-colored surface layers. Similar soils are Mollic Cryoboralfs, loamy-skeletal, mixed. They have thin dark-colored surface layers. These soils occupy 65 percent of the unit.

Typic Cryochrepts, loamy-skeletal, mixed are on upper slopes and ridges and occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion on upper slopes and ridges and occupies 10 percent of the unit.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown channery loam surface layers 9-inches thick. The upper part of the subsoil is brown very channery clay loam 12-inches thick. The lower part of the subsoil is dark yellowish-brown extremely channery loam overlying fractured argillite at 45 inches.

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very channery loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying fractured argillite at 40 inches.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Brush competition on northerly aspects limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for deer and elk.

51—Lithic Cryochrepts-Rock outcrop complex, limestone substratum

This map unit is on mountain ridges. Elevation ranges from 7,400 to 8,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper subalpine forest. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 10 to 25 percent. Mountain ridges are very broad with convex side slopes. The drainage pattern is dendritic with weakly incised, widely spaced first- and second-order drainageways that have concave bottoms.

Vegetation

Vegetation consists of an open-grown mixed forest of subalpine fir, limber pine, spruce, and whitebark pine. Dominant understory species are grouse whortleberry, elk sedge, and Idaho fescue.

Habitat Types

Whitebark pine-subalpine fir is the major habitat type. It occupies 90 percent of the map unit. Subalpine fir/grouse whortleberry, a dissimilar habitat type, is at lower elevations and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 4- to 20-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments and are calcareous.

Map Unit Composition

Lithic Cryochrepts, loamy-skeletal, carbonatic occupy 75 percent of the unit. Rock outcrop is present throughout the unit and occupies 15 percent of it. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Typic Cryochrepts, loamy-skeletal, carbonatic. These soils are on concave lower slopes. They are 20- to 40-inches deep over bedrock and have higher forage productivity.

Representative Profile of the Soils

Lithic Cryochrepts, loamy-skeletal, carbonatic have very dark grayish-brown very gravelly silty clay loam surface layers 5-inches thick. The subsoil is calcareous dark yellowish-brown very gravelly silty clay loam overlying fractured limestone at 18 inches.

Management

Timber

Potential annual production in forested areas is 5 to 20 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop. The terrain is well suited to tractor operation. Moisture stress and the harsh subalpine climate limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Hard rock frequently limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. The harsh subalpine climate also limits revegetation of road cut and fill slopes. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

54—Lithic Cryoborolls, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 6,000 to 7,500 feet. Average annual

precipitation is 20 to 30 inches. Vegetation is a mosaic of mountain grassland and upper subalpine forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes. These ridgetops are exposed to strong winds.

Vegetation

Mountain grasslands occupy 75 percent of the unit. Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, and a variety of forbs. Upper subalpine forest occupies 25 percent of the unit. Vegetation consists of an open-grown limber-pine forest. Forest understories are dominated by Idaho fescue, bluebunch wheatgrass, and common juniper.

Habitat Types

Rough fescue/Idaho fescue is the major habitat type in mountain grasslands. Big sagebrush/rough fescue is a similar habitat type. Limber pine/common juniper is the major habitat type in open-grown forest.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 4- to 20-inches deep over bedrock. Subsoils contain 40 to 80 percent angular rock fragments.

Map Unit Composition

Lithic Cryoborolls, loamy-skeletal, mixed have thick dark-colored surface layers. Similar soils are Lithic Cryochrepts, loamy-skeletal, mixed. They have thin dark-colored surface layers. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Argic Cryoborolls, loamy-skeletal, mixed. These soils are on concave lower slopes. They are 20- to 40-inches deep over bedrock and have higher forage productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Lithic Cryoborolls, loamy-skeletal, mixed have very dark-brown loam surface layers 5-inches thick. The upper part of the subsoil is dark-brown very channery loam 6-inches thick. The lower part of the subsoil is dark yellowish-brown extremely channery loam overlying fractured argillite at 15 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production in mountain grasslands is 500 pounds per acre in an average year. The forest understory produces 300 pounds of forage per acre under a forest canopy and 500 pounds when the forest canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems. Plant growth begins later in the spring months than on lower elevation ranges. Grazing should be delayed until the vegetation is ready and the soils are dry enough to withstand trampling by livestock.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

56—Typic Cryochrepts-Lithic Cryochrepts-Rock outcrop complex, bouldery, granitic substratum

This map unit is on mountain ridges. Elevation ranges from 7,400 to 8,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and whitebark pine. Dominant understory species are grouse whortleberry, elk sedge, menziesia, and smooth woodrush.

Habitat Types

Subalpine fir-whitebark pine/grouse whortleberry is the major habitat type. Whitebark pine-subalpine fir is a similar habitat type. These habitat types occupy 90 percent of the map unit.

Forested scree community types are on rock outcrop and occupy 15 percent of the unit. Subalpine fir/grouse whortleberry, a dissimilar habitat type, is at lower elevations and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers that have been influenced by volcanic ash. These surface layers are 4- to 7-inches thick. Subsoils contain 40 to 60 percent subrounded rock fragments. Soil properties vary with distance from rock outcrop. Soils near rock outcrop are 10- to 20-inches deep over bedrock. Other soils range from 20-inches to more than 60-inches deep over bedrock. Boulders are scattered upon the surface in areas.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed are near rock outcrop. These soils occupy 55 percent of the unit.

Lithic Cryochrepts, loamy-skeletal, mixed are near rock outcrop. These soils occupy 20 percent of the unit. Rock outcrop is present throughout the unit and occupies 15 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers that have been influenced by volcanic ash. These surface layers are 7- to 10-inches thick. Andic Cryochrepts have higher timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very

cobbly sandy loam 16-inches thick. The lower part of the subsoil is yellowish-brown very cobbly sandy loam overlying granitic bedrock at 40 inches.

Lithic Cryochrepts, loamy-skeletal, mixed have dark-brown cobbly loam surface layers 6-inches thick. The subsoil is dark yellowish-brown very cobbly sandy loam overlying granitic bedrock at 17 inches.

Management

Timber

Potential annual production in forested areas is 20 to 30 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop. The terrain is suited to tractor operation, but boulders limit operation on parts of the unit. The harsh subalpine climate limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Hard rock occasionally limits excavation. Excavation of hard rock produces extremely stony cut and fill material. Unsurfaced roads are rough and difficult to blade because of large stones in areas. The harsh subalpine climate limits revegetation of road cut and fill slopes. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

56A—Typic Cryochrepts-Rubble land complex, steep

This map unit is on mountain slopes. Elevation ranges from 6,000 to 7,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed and lower subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have undissected side slopes ranging from straight to convex.

Vegetation

Vegetation consists of a lodgepole-pine forest. Dominant understory species are elk sedge, grouse whortleberry, and pinegrass.

Habitat Types

This unit is a complex of habitat types. Douglas-fir/pinegrass is the major habitat type on lower slopes. It occupies 40 percent of the unit. Subalpine fir/grouse whortleberry is the major habitat type on upper slopes. It occupies 35 percent of the unit. Forested scree community types are on rubble land and rock outcrop and occupy 25 percent of the unit.

Geology

This map unit is underlain by weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have cobbly or bouldery moderately coarse-textured surface layers, ranging from 40- to 60-inches deep over bedrock. Subsoils contain 10 to 50 percent subrounded rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have 35 to 50 percent rock fragments in the subsoil. Similar soils have 10 to 35 percent rock fragments in the subsoil. They are Typic Cryochrepts, coarse-loamy, mixed. These soils occupy 60 percent of the unit.

Rubble land and rock outcrop are present throughout the unit and occupy 25 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 15 percent of this map unit. Dissimilar soils are Andic Cryochrepts, loamy-skeletal, mixed and Lithic Cryochrepts, loamy-skeletal, mixed. Andic Cryochrepts, loamy-skeletal, mixed are on upper slopes. They have loess surface layers that have been influenced by volcanic ash. These surface layers have higher timber productivity. Lithic Cryochrepts, loamy-skeletal, mixed are near rubble land. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown extremely cobbly sandy loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown extremely cobbly sandy loam 16-inches thick. The lower part of the subsoil is

yellowish-brown extremely cobbly sandy loam overlying granitic bedrock at 40 inches.

Management

Timber

Potential annual production in forested areas is 30 to 50 cubic feet per acre on lower slopes and 20 to 40 cubic feet per acre on upper slopes. The productivity of this map unit is reduced by rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Surface cobbles limit natural forest regeneration and planting. Long, narrow cutting units that are repeatedly seeded naturally can overcome this limitation.

Range

The forest understory produces 100 pounds of forage per acre under a forest canopy and 200 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

57—Typic Cryochrepts-Rubble land complex, basaltic substratum

This map unit is on mountain ridges. Elevation ranges from 5,800 to 7,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is lower subalpine forest. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of spruce, subalpine fir, and Douglas-fir.

Dominant understory species are grouse whortleberry, pinegrass, and elk sedge.

Habitat Types

Subalpine fir/grouse whortleberry is the major habitat type. Subalpine fir/pinegrass is a similar habitat type. These habitat types occupy 75 percent of the unit. Scree community types are on rubble land and rock outcrop and occupy 25 percent of the unit.

Geology

This map unit is underlain by weakly weathered basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. They are 20- to 60-inches deep over bedrock. Subsoils contain 35 to 70 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed are 20- to 60-inches deep over bedrock and have loess surface layers that have been influenced by volcanic ash. These surface layers are 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 65 percent of the unit.

Rubble land and rock outcrop are present throughout the unit and occupy 25 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are near rubble land. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown extremely cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown extremely cobbly loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely cobbly loam overlying fractured basalt at 40 inches.

Management

Timber

Potential annual production in forested areas is 20 to 40 cubic feet per acre. The productivity of this map unit is reduced by rubble land. The terrain is well suited to tractor operation. Surface cobbles limit natural forest regeneration and planting. Long, narrow cutting units that are repeatedly seeded naturally can overcome this limitation. Grass competition limits forest regeneration.

Range

The forest understory produces 100 pounds of forage per acre under a forest canopy and 200 pounds per acre when the forest canopy is removed. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Hard rock occasionally limits excavation. Excavation of hard rock produces extremely stony cut and fill material. Unsurfaced roads are rough and difficult to blade because of large stones in areas.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

57A—Typic Cryochrepts-Rubble land complex, basaltic substratum, cold

This map unit is on mountain ridges. Elevation ranges from 7,200 to 9,000 feet. Average annual precipitation is 25 to 30 inches. Vegetation is upper subalpine forest. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and whitebark pine. Dominant understory species are grouse whortleberry, elk sedge, menziesia, and smooth woodrush.

Habitat Types

Subalpine fir-whitebark pine/grouse whortleberry and whitebark pine-subalpine fir are the major habitat

types. These habitat types occupy 65 percent of the forested part of the unit. Scree community types are on rubble land and rock outcrop and occupy 25 percent of the unit. Subalpine fir/grouse whortleberry, a dissimilar habitat type, is at lower elevations and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 7-inches thick. They are 20- to 60-inches deep over bedrock. Subsoils contain 35 to 70 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 65 percent of the unit.

Rubble land and rock outcrop are present throughout the unit and occupy 25 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are near rubble land. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown extremely cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown extremely cobbly loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely cobbly loam overlying fractured basalt at 40 inches.

Management

Timber

Potential annual production in forested areas is 20 to 30 cubic feet per acre. The productivity of this map unit is reduced by rubble land. The terrain is well suited to tractor operation. Surface cobbles limit

natural forest regeneration and planting. Long, narrow cutting units that are repeatedly seeded naturally can overcome this limitation. The harsh subalpine climate limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Hard rock occasionally limits excavation. Excavation of hard rock produces extremely stony cut and fill material. Unsurfaced roads are rough and difficult to blade because of large stones in areas. The harsh subalpine climate limits revegetation of road cut and fill slopes.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

58—Andic Cryochrepts, rhyolitic substratum

This map unit is on mountain ridges. Elevation ranges from 6,000 to 7,200 feet. Average annual precipitation is 20 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from rhyolitic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of spruce and subalpine fir. Dominant understory species are beargrass, elk sedge, and grouse whortleberry.

Habitat Types

Subalpine fir/grouse whortleberry and subalpine fir/beargrass are the major habitat types. These habitat types occupy 85 percent of the map unit. Included in this unit are dissimilar habitat types. Subalpine fir/menziesia is in moist depressions and has higher timber productivity. Subalpine fir-whitebark pine/grouse whortleberry is at higher elevations and has lower timber productivity. These dissimilar habitat types occupy 15 percent of the map unit.

Geology

This map unit is underlain by rhyolites and tuffs. These types of bedrock produce sandy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. They are 20- to 40-inches deep over bedrock. Subsoils contain 15 to 45 percent subrounded rock fragments.

Map Unit Composition

Andic Cryochrepts, loamy-skeletal, mixed have loess surface layers 7- to 10-inches thick and 35 to 45 percent rock fragments in the subsoil. Similar soils are Dystric Cryochrepts, loamy-skeletal, mixed and Andic Cryochrepts, coarse-loamy, mixed. These soils have loess surface layers 2- to 7-inches thick or 15 to 35 percent rock fragments in the subsoil. They occupy 85 percent of the unit.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are present throughout the map unit. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Andic Cryochrepts, loamy-skeletal, mixed have dark yellowish-brown loam surface layers 8-inches thick. The upper part of the subsoil is brown very cobbly coarse sandy loam 8-inches thick. The lower part of the subsoil is brown very cobbly coarse sandy loam overlying fractured rhyolite at 37 inches.

Management

Timber

Potential annual production is 30 to 50 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Unsurfaced roads are rough and difficult to blade because of large stones in areas.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

59—Typic Cryochrepts, channery-Typic Cryochrepts, extremely cobbly, complex mountain ridges

This map unit is on mountain ridges. Elevation ranges from 5,700 to 7,200 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of spruce, subalpine fir, and Douglas-fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, pinegrass, and menziesia.

Habitat Types

Subalpine fir/beargrass and subalpine fir/pinegrass are the major habitat types on southerly aspects. Subalpine fir/grouse whortleberry is a similar habitat type. Subalpine fir/menziesia is the major habitat type on northerly aspects. These habitat types occupy 85 percent of the unit. Subalpine fir/twinflower, a dissimilar habitat type, is at lower elevations and has higher timber productivity. It occupies 15 percent of the unit.

Geology

This map unit is underlain by argillites and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately coarse-textured loess surface layers that have been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. They are 40- to 60-inches deep over bedrock. Subsoils contain 40 to 70 percent rock fragments. Soil properties vary with underlying bedrock. Soils formed in material derived from argillite have channery silt loam surface layers. Soils formed in quartzite have extremely cobbly sandy loam surface layers.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed with channery surface layers form in material derived from argillite. Surface layers form in loess deposits 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 45 percent of the unit.

Typic Cryochrepts, loamy-skeletal, mixed with extremely cobbly surface layers form in material derived from quartzite. These soils occupy 45 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on ridgetops. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed with channery surface layers have dark-brown channery silt loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying fractured argillite at 42 inches.

Typic Cryochrepts, loamy-skeletal, mixed with extremely cobbly surface layers have reddish-brown extremely cobbly sandy loam surface layers 4-inches thick. The upper part of the subsoil is light reddish-brown extremely cobbly sandy loam 16-inches thick. The lower part of the subsoil is light reddish-brown extremely cobbly sandy loam overlying fractured quartzite at 45 inches.

Management

Timber

Potential annual production is 30 to 50 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation on channery surface layers can

reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Surface cobbles limit natural forest regeneration and planting on soils with extremely cobbly surface layers. Repeated natural seeding from adjacent forest stands can overcome the limitation. Long, narrow cutting units are repeatedly seeded naturally.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

59A—Andic Cryochrepts, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 7,200 to 8,500 feet. Average annual precipitation is 25 to 30 inches. Vegetation is upper subalpine forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and whitebark pine with some areas of Engelmann spruce and subalpine fir. Dominant understory species are grouse whortleberry, elk sedge, menziesia, smooth woodrush, and beargrass.

Habitat Types

Subalpine fir/smooth woodrush, subalpine fir-whitebark pine/grouse whortleberry, and white bark pine-subalpine fir are the major habitat types. These habitat types occupy 85 percent of the map unit. Subalpine fir/grouse whortleberry, a dissimilar habitat type, is at lower elevations and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured loess surface layers that have been influenced by volcanic ash. These surface layers are 4- to 10-inches thick. Subsoils contain 50 to 80 percent angular rock fragments.

Map Unit Composition

Andic Cryochrepts, loamy-skeletal, mixed have loess surface layers that have been influenced by volcanic ash. These surface layers are 7- to 10-inches thick. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers that have been influenced by volcanic ash. These surface layers are 4- to 7-inches thick. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on ridgetops.

Representative Profile of the Soils

Andic Cryochrepts, loamy-skeletal, mixed have dark yellowish-brown loam surface layers 8-inches thick. The upper part of the subsoil is reddish-brown channery loam 8-inches thick. The lower part of the subsoil is reddish-brown very channery loam overlying fractured argillite at 36 inches.

Management

Timber

Potential annual production is 20 to 30 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. The harsh subalpine climate limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices. The harsh subalpine climate limits revegetation of road cut and fill slopes. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

59B—Typic Cryochrepts-Rock outcrop complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 6,000 to 8,500 feet. Average annual precipitation is 25 to 30 inches. Vegetation is upper, mixed forest and lower subalpine forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have undissected side slopes ranging from straight to convex.

Vegetation

Vegetation consists of a mosaic of dense forest and open-grown forest. On upper slopes, the forest is lodgepole pine; on lower slopes it is mixed lodgepole pine and Douglas-fir. Dominant understory species are pinegrass, elk sedge, and grouse whortleberry.

Habitat Types

Subalpine fir/grouse whortleberry is the major habitat type in dense upper slope forests. Subalpine fir/elk sedge is the major habitat type in open-grown upper slope forests. Douglas-fir/pinegrass is the major habitat type in dense lower slope forests. Douglas-fir/elk sedge is the major habitat type in open-grown lower slope forests. These habitat types occupy 65 percent of the unit. Forested scree community types are on rock outcrop and rubble land and occupy 25 percent of the unit. Subalpine fir-whitebark pine/grouse whortleberry, a dissimilar habitat type, is at higher elevations and has lower timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas.

These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 4- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 65 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 25 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very channery loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying fractured argillite at 30 inches.

Management

Timber

Potential annual production on lower slopes is 30 to 50 cubic feet per acre and 20 to 40 cubic feet per acre on upper slopes. The productivity of this map unit is reduced by rock outcrop. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition on lower slopes limits forest regeneration.

Range

The forest understory produces 100 pounds of forage per acre under a forest canopy and 300 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

69—Typic Cryumbrepts, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 8,000 to 9,500 feet. Average annual precipitation is 30 to 40 inches. Vegetation is alpine meadows. Soils formed in material derived from metasedimentary, granitic, and basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Dominant vegetation consists of Idaho fescue, tufted hairgrass, rough fescue, and a variety of alpine forbs.

Habitat Types

Idaho fescue/tufted hairgrass is the major habitat type. Rough fescue/Idaho fescue is a similar habitat type. These habitat types occupy 90 percent of the unit. Tufted hairgrass/carex species, a dissimilar habitat type, is in depressions with wet soils. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by hard, noncalcareous igneous or metamorphic rocks.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from moderately coarse to moderately fine. They are 20- to 40-inches deep over bedrock. Subsoils contain 35 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryumbrepts, loamy-skeletal, mixed have thick dark-colored surface layers. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed. They have thin dark-colored surface layers. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed and Aquic Cryumbrepts, loamy-skeletal, mixed. Lithic Cryochrepts, loamy-skeletal, mixed are on convex knolls. They are 4- to 20-inches deep over bedrock and have lower forage productivity. Aquic Cryumbrepts, loamy-skeletal, mixed are in depressions. They are wet and have low strength. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Typic Cryumbrepts, loamy-skeletal, mixed have dark-brown sandy loam surface layers 10-inches thick. The subsoil is dark yellowish-brown very gravelly sandy loam overlying bedrock at 30 inches.

Management**Timber**

This map unit contains only scattered trees and is poorly suited to timber management.

Range

Forage production is 550 pounds per acre in an average year. Plant growth begins later in the spring months than on lower elevation ranges. Grazing should be delayed until vegetation is ready and the soils are dry enough to withstand trampling by livestock.

Roads

The harsh subalpine climate limits revegetation of road cut and fill slopes. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

76—Typic Cryochrepts, bouldery, granitic substratum, steep

This map unit is on glaciated mountain slopes. Elevation ranges from 6,000 to 7,500 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 25 to 50 percent. Glaciated mountain slopes have straight side

slopes and convex ridgetops. The drainage pattern is dendritic with widely spaced, moderately incised first- and second-order drainageways that have concave bottoms. Drainage bottoms are mantled with glacial till.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of Engelmann spruce and subalpine fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, pinegrass, and menziesia.

Habitat Types

Subalpine fir/beargrass, subalpine fir/grouse whortleberry, and subalpine fir/menziesia are the major habitat types. These habitat types occupy 100 percent of the unit.

Geology

This map unit is underlain by moderately and weakly weathered granite, granodiorite, and diorites. These types of bedrock produce loamy material when weathered. Moderately weathered rocks decompose to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have medium-textured and moderately coarse-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick and range from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 35 to 50 percent rock fragments. Boulders are scattered upon the surface in areas.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 80 percent of the unit.

Dissimilar soils make up 20 percent of this map unit. Dissimilar soils are Typic Cryoboralfs, loamy-skeletal, mixed and Lithic Cryochrepts, loamy-skeletal, mixed. Typic Cryoboralfs, loamy-skeletal, mixed are in depressions. They have subsoil clay accumulations and higher timber productivity. Lithic Cryochrepts, loamy-skeletal, mixed are on ridges. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown gravelly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very gravelly sandy loam 16-inches thick. The lower part of the subsoil is yellowish-brown very gravelly sandy loam overlying granitic bedrock at 45 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation on parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes. Boulders limit tractor operation on parts of the unit. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Some delineations are preferred summer range for deer and elk.

76A—Typic Cryochrepts, bouldery, granitic substratum

This map unit is on glaciated mountain ridges. Elevation ranges from 6,500 to 7,500 feet. Average annual precipitation is 25 to 30 inches. Vegetation is

lower subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Glaciated mountain ridges are rolling, undissected, and broad with widely spaced depressions.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce and subalpine fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, pinegrass, and menziesia.

Habitat Types

Subalpine fir/beargrass and subalpine fir/grouse whortleberry are the major habitat types. These habitat types occupy 85 percent of the unit. Subalpine fir/menziesia, a dissimilar habitat type, is in depressions and on northerly aspects. This habitat type has higher timber productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by granite, granite-diorite, and diorites. These types of bedrock produce loamy and sandy material when weathered. The bedrock is weakly weathered under knolls and moderately weathered under depressions. Depressions can contain thin deposits of glacial till-like material derived from the underlying rock. Moderately weathered bedrock under depressions decomposes to coarse sand and gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick and range from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 35 to 50 percent rounded rock fragments. Boulders are scattered upon the surface in areas.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, sandy-skeletal, mixed. These soils are on knolls. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown gravelly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very gravelly sandy loam 16-inches thick. The lower part of the subsoil is yellowish-brown very gravelly sandy loam overlying granitic bedrock at 50 inches.

Management

Timber

Potential annual production is 30 to 50 cubic feet per acre. The terrain is well suited to tractor operation, but boulders limit operation on parts of the unit. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

77—Typic Cryochrepts-Lithic Cryochrepts complex, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 6,500 to 7,500 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Mountain ridges are undissected and very broad with convex side slopes.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce and subalpine fir. Dominant understory species are beargrass, elk sedge, and grouse whortleberry.

Habitat Types

Subalpine fir/beargrass, grouse whortleberry phase, and subalpine fir/grouse whortleberry, grouse whortleberry phase, are the major habitat types. These habitat types occupy 90 percent of the unit. Subalpine fir/grouse whortleberry, pinegrass phase, is a dissimilar habitat type on southerly exposures and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. Subsoils contain 50 to 70 percent angular rock fragments. Soil properties are not obviously associated with landscape features. Soils 20- to 40-inches and 4- to 20-inches deep over bedrock are both present.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed are 20- to 40-inches deep over bedrock and have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 45 percent of the unit.

Lithic Cryochrepts, loamy-skeletal, mixed are 4- to 20-inches deep over bedrock. These soils occupy 40 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Typic Cryoboralfs, loamy-skeletal, mixed. These soils are in depressions. They have subsoil clay accumulations and higher timber productivity. Rock outcrop is on convex knolls.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 4-inches thick. The subsoil is yellowish-brown very cobbly loam overlying fractured basalt at 30 inches.

Lithic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 6-inches thick. The subsoil is dark yellowish-brown very cobbly loam overlying basalt at 17 inches.

Management

Timber

Potential annual production is 20 to 40 cubic feet per acre. The terrain is well suited to tractor operation.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

77A—Argic Cryoborolls-Lithic Cryoborolls complex, basaltic substratum, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 6,000 to 7,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is mountain grassland and shrubland. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Mountain ridges are undissected and very broad with convex side slopes.

Vegetation

Dominant vegetation consists of Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, and a variety of forbs and low shrubs. Scattered Douglas-fir, lodgepole pine, or limber pine are near delineation boundaries.

Habitat Types

Rough fescue/Idaho fescue is the major habitat type. Rough fescue/bluebunch wheatgrass is a similar habitat type. These habitat types occupy 100 percent of the unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have dark-colored medium-textured surface layers. Subsoils contain 25 to 60 percent angular rock fragments. Soil properties are not obviously associated with landscape features. Soils 20- to 40- and 4- to 20-inches deep over bedrock are both present in this map unit.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed are 20- to 40-inches deep over bedrock and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 75 percent of the unit.

Lithic Cryoborolls, loamy-skeletal, mixed are 4- to 20-inches deep over bedrock. These soils occupy 15 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion on ridgetops and occupies 10 percent of the unit.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown loam surface layers 10-inches thick. The upper part of the subsoil is dark yellowish-brown very cobbly loam 16-inches thick. The lower part of the subsoil is yellowish-brown very cobbly loam overlying fractured basalt at 40 inches.

Lithic Cryoborolls, loamy-skeletal, mixed have very dark-brown loam surface layers 5-inches thick. The upper part of the subsoil is dark-brown very cobbly loam 6-inches thick. The lower part of the subsoil is dark yellowish-brown extremely cobbly loam overlying fractured basalt at 15 inches.

Management

Timber

This map unit contains only scattered trees and is poorly suited to timber management.

Range

This unit is well suited to livestock grazing. Forage production is 1,100 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

77B—Typic Cryochrepts, basaltic substratum, steep

This map unit is on mountain slopes. Elevation ranges from 6,000 to 7,200 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage patterns are subparallel and dendritic with moderately spaced, moderately incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of Engelmann spruce, subalpine fir, and Douglas-fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, and menziesia.

Habitat Types

Subalpine fir/beargrass and subalpine fir/grouse whortleberry are the major habitat types. These habitat types occupy 85 percent of the unit. Subalpine fir/menziesia is on northerly aspects and subalpine fir/blue huckleberry is on southerly aspects. These dissimilar habitat types have higher timber productivity and occupy 15 percent of the map unit.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. They are 20- to 60-inches deep over bedrock. Subsoils contain 35 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 85 percent of the unit.

Dissimilar soils make up 15 percent of this map unit. Dissimilar soils are Typic Cryoboralfs, loamy-skeletal, mixed and Lithic Cryochrepts, loamy-skeletal, mixed. Typic Cryoboralfs, loamy-skeletal, mixed are on lower slopes. They have subsoil clay accumulations and higher timber productivity. Lithic Cryochrepts, loamy-skeletal, mixed are on upper slopes and ridge points. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly loam 28-inches thick. The lower part of the subsoil is yellowish-brown extremely cobbly loam overlying fractured basalt at 44 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Hard rock occasionally limits excavation. Excavation of hard rock produces extremely stony cut and fill material. Unsurfaced roads are rough and difficult to blade because of large stones in areas.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

79—Typic Cryochrepts, mountain slopes, metasedimentary substratum

This map unit is on mountain slopes. Elevation ranges from 5,600 to 7,200 feet. Average annual precipitation is 25 to 30 inches. Vegetation is lower subalpine forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have undissected side slopes ranging from straight to convex.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce, subalpine fir, and Douglas-fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, blue huckleberry, and menziesia.

Habitat Types

Subalpine fir/beargrass is the major habitat type on southerly aspects and subalpine fir/menziesia is the major habitat type on northerly aspects. Subalpine fir/grouse whortleberry is a similar habitat type. These habitat types occupy 90 percent of the unit. Subalpine fir/blue huckleberry, a dissimilar habitat type, is on southerly aspects and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in some areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. They are 20- to 40-inches deep over bedrock. Subsoils contain 35 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 80 percent of the unit.

Dissimilar soils make up 20 percent of this map unit. Dissimilar soils are Typic Cryoboralfs, loamy-skeletal, mixed and Lithic Cryochrepts, loamy-

skeletal, mixed. Typic Cryoboralfs, loamy-skeletal, mixed are on lower slopes. They have subsoil clay accumulations and higher timber productivity. Lithic Cryochrepts, loamy-skeletal, mixed are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown channery loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very channery loam 20-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying fractured argillite at 38 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Brush competition on northerly aspects limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

79B—Typic Cryoboralfs-Typic Cryochrepts complex, structural benches

This map unit is on structural benches. Elevation ranges from 5,500 to 6,800 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Structural benches are gently sloping to sloping with dominant slope gradients of 10 to 25 percent. There are short, steep slopes along drainageways with dominant slope gradients of 40 to 60 percent. The drainage pattern is dendritic with widely spaced,

moderately incised low-order drainageways with V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and Douglas-fir. Dominant understory species are blue huckleberry, elk sedge, pinegrass, and grouse whortleberry.

Habitat Types

Subalpine fir/blue huckleberry is the major habitat type at higher elevations, and Douglas-fir/blue huckleberry is the major habitat type at lower elevations. These habitat types occupy 90 percent of the unit. Tufted hairgrass/carex species, a dissimilar habitat type, is in wet meadows in depressions on benches. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. Thin deposits of glacial till are in depressions on benches. These types of bedrock produce loamy materials when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 40 to 80 percent subrounded rock fragments. Soil properties vary with topographic position. Soils in depressions on benches have subsoil clay accumulations. Soils on knolls and on steep slopes along drainageways do not have subsoil clay accumulations.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed are in depressions on benches. These soils occupy 50 percent of the unit.

Typic Cryochrepts, loamy-skeletal, mixed are on knolls and on steep slopes along drainageways. These soils occupy 40 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed and Aquolls. Lithic Cryochrepts, loamy-skeletal, mixed are on knolls on benches. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Aquolls are in depressions on benches. They are wet and have low strength.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly clay loam 20-inches thick. The lower part of the subsoil is dark yellowish-brown extremely cobbly loam overlying fractured argillite at 50 inches.

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown cobbly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly loam 28-inches thick. The lower part of the subsoil is yellowish-brown extremely cobbly loam overlying fractured argillite at 44 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition limits forest regeneration.

Range

The forest understory produces 100 pounds of forage per acre under a forest canopy and 300 pounds per acre when the forest canopy is removed.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

80—Cirqueland

This map unit is cirque headwalls and basins. Elevation ranges from 6,000 to 9,500 feet. Average annual precipitation is 30 to 45 inches. The unit is mostly barren, glacially scoured hard metasedimentary bedrock. Small areas of shallow soils are in bedrock fractures and depressions. Included soils support grass and shrubs with some scattered subalpine fir and whitebark pine. Dominant slopes have gradients ranging from 40 percent to more than 60 percent. This map unit is not suitable for

most land uses. It has limited value for watershed, wildlife habitat, or some recreational uses.

86—Typic Ustochrepts-Rock outcrop complex, glacial trough walls, granitic substratum

This map unit is on glacial trough walls. Elevation ranges from 5,500 to 8,200 feet. Average annual precipitation is 25 to 40 inches. Vegetation is upper, mixed forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 60 to 90 percent. Glacial trough walls are U-shaped walls of glaciated valleys. Slopes are straight on the upper half of the valley wall and concave on the lower half. Glacial trough walls have avalanche paths with small debris fans at the base. The drainage pattern is parallel with closely spaced, weakly incised low-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are snowberry, pinegrass, Idaho fescue, bluebunch wheatgrass, and kinnikinnick.

Habitat Types

Douglas-fir/snowberry, bluebunch wheatgrass phase, and Douglas-fir/pinegrass, bluebunch wheatgrass phase, are the major habitat types on stable soils. Douglas-fir/Idaho fescue is a similar habitat type. It occurs at lower elevations. These habitat types occupy 50 percent of the unit. Forested scree community types are on rock outcrop and rubble land. They occupy 40 percent of the unit. Subalpine fir/pinegrass and subalpine fir/grouse whortleberry are dissimilar habitat types. They are at higher elevations and have higher timber productivity. They occupy 10 percent of the map unit.

Geology

This map unit is underlain by weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers. Subsoils contain 35 to 80 percent subrounded rock fragments.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, mixed, frigid have thin subsoils. Similar soils are Typic Ustorthents, loamy-skeletal, mixed, frigid. They do not have subsoils. These soils occupy 50 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 40 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, mixed, frigid. These soils are near rock outcrop and on ridgetops. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark grayish-brown very gravelly sandy loam surface layers 8-inches thick. The upper part of the subsoil is dark-brown very gravelly sandy loam 18-inches thick. The lower part of the subsoil is dark-brown extremely gravelly sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 10 to 30 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 100 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Slope steepness increases the quantity of material excavated. Hard rock frequently limits excavation. Material exposed by road construction tends to ravel on steep cutbanks. Avalanches can increase maintenance costs. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard. Cut and fill material

is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

87—Typic Ustochrepts-Rock outcrop complex, glacial trough walls

This map unit is on glacial trough walls. Elevation ranges from 5,200 to 7,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is lower, mixed forest. Soils formed in material derived from metasedimentary or basaltic rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 60 to 90 percent. Glacial trough walls are U-shaped walls of glaciated valleys. Slopes are straight on the upper half of the valley wall and concave on the lower half. Glacial trough walls have avalanche paths with small debris fans at their base. The drainage pattern is parallel with closely spaced, weakly incised first-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir, lodgepole pine, ponderosa pine, and limber pine. Dominant understory species are snowberry, pinegrass, Idaho fescue, bluebunch wheatgrass, kinnikinnick, and beargrass.

Habitat Types

Douglas-fir/snowberry, bluebunch wheatgrass phase; Douglas-fir/pinegrass, bluebunch wheatgrass phase; and Douglas-fir/bluebunch wheatgrass are the major habitat types on stable soils. These habitat types occupy 45 percent of the unit. Forested scree community types are on rock outcrop and rubble land and occupy 40 percent of the unit. Subalpine fir/pinegrass and subalpine fir/beargrass are dissimilar habitat types. They are at higher elevations and have higher timber productivity. They occupy 15 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, quartzites, basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured or medium-textured surface layers. Subsoils contain 40 to 80 percent angular rock fragments.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, mixed, frigid have thin subsoils. Similar soils are Typic Ustorthents, loamy-skeletal, mixed, frigid. They do not have subsoils. These soils occupy 50 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 40 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, mixed, frigid. These soils are near rock outcrop and on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark reddish-brown very channery loam surface layers 8-inches thick. The upper part of the subsoil is calcareous dark reddish-brown very channery loam 18-inches thick. The lower part of the subsoil is calcareous dark reddish-brown extremely channery loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 10 to 30 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 200 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Slope steepness increases the quantity of material excavated. Avalanches can increase maintenance costs. Large stones can roll from cutbanks onto road surfaces, causing a traffic hazard. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

89—Typic Cryochrepts-Rock outcrop complex, glacial trough walls, granitic substratum

This map unit is on glacial trough walls. Elevation ranges from 5,500 to 8,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed forest and lower subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes are on northerly aspects with gradients of 60 to 90 percent. Glacial trough walls are U-shaped walls of glaciated valleys. Slopes are straight on the upper half of the valley wall and concave on the lower half. Glacial trough walls have avalanche paths with small debris fans at their base. The drainage pattern is parallel with closely spaced, weakly incised first-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a lodgepole-pine forest with some areas of Engelmann spruce, subalpine fir, and Douglas-fir. Dominant understory species are beargrass, elk sedge, grouse whortleberry, and menziesia.

Habitat Types

Subalpine fir/menziesia is the major habitat type on upper slopes, and subalpine fir/twinflower is the major habitat type on lower slopes. These habitat types occupy 50 percent of the unit. Forested scree community types are on rock outcrop and rubble land and occupy 40 percent of the unit. Subalpine fir/elk sedge, a dissimilar habitat type, is at lower elevations near rock outcrop and has lower timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. Subsoils contain 35 to 50 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 45 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 40 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 15 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed and Typic Cryoboralfs, loamy-skeletal, mixed. Lithic Cryochrepts, loamy-skeletal, mixed are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Typic Cryoboralfs, loamy-skeletal, mixed are on lower slopes and in draws. They have subsoil clay accumulations and higher timber productivity.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown gravelly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very gravelly sandy loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely gravelly sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 30 to 50 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Brush competition on upper slopes limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Slope steepness increases the quantity of material excavated. Hard rock frequently limits excavation. Avalanches can increase maintenance costs. Material exposed by road construction tends to ravel on steep cutbanks. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

90—Andic Cryochrepts-Typic Cryoboralfs complex, glacial trough walls

This map unit is on glacial trough walls. Elevation ranges from 5,500 to 7,800 feet. Average annual precipitation is 25 to 35 inches. Vegetation is upper, mixed forest and lower subalpine forest. Soils formed in material derived from metasedimentary and basaltic rocks.

Landform

Dominant slopes are on northerly aspects with gradients of 60 to 90 percent. Glacial trough walls are undissected U-shaped walls of glaciated valleys. Slopes are straight on the upper half of the valley wall and concave on the lower half. The drainage pattern is parallel with moderately spaced, weakly incised drainageways that have V-shaped bottoms. Glacial trough walls have avalanche paths with small debris fans at their base.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine, subalpine fir, and Douglas-fir. Dominant

understory species are beargrass, elk sedge, grouse whortleberry, pinegrass, and menziesia.

Habitat Types

Subalpine fir/menziesia is the major habitat type on upper slopes and subalpine fir/twinflower is the major habitat type on lower slopes. Subalpine fir/queencup beadlily is a similar habitat type. These habitat types occupy 90 percent of the unit. Subalpine fir/beargrass, a dissimilar habitat type, is on southerly aspects and has lower timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, quartzites or basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered. There are thin deposits of compact loamy glacial till on lower slopes.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 12-inches thick and range from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 35 to 50 percent angular rock fragments. Soil properties vary with topographic position. Soils on upper slopes do not have subsoil clay accumulations. Soils on lower slopes have subsoil clay accumulations.

Map Unit Composition

Andic Cryochrepts, loamy-skeletal, mixed are on upper slopes and have loess surface layers 7- to 12-inches thick. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 2- to 7-inches thick. These soils occupy 70 percent of the unit.

Typic Cryoboralfs, loamy-skeletal, mixed are formed in glacial till deposits on lower slopes and have loess surface layers 2- to 7-inches thick. Similar soils are Andeptic Cryoboralfs, loamy-skeletal, mixed. They have loess surface layers 7- to 12-inches thick. These soils occupy 15 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Andic Cryochrepts, loamy-skeletal, mixed have dark yellowish-brown silt loam upper surface layers 8-inches thick. The lower surface layer is brown very cobbly loam 8-inches thick. The subsoil is brown very cobbly loam overlying fractured bedrock at 50 inches.

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly silt loam surface layers 4-inches thick. The upper part of the subsoil is brown very cobbly loam 9-inches thick. The lower part of the subsoil is dark yellowish-brown very cobbly loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 30 to 50 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Brush competition on upper slopes limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Slope steepness increases the quantity of material excavated. Material exposed by road construction on lower slopes tends to slough on steep cutbanks. Avalanches can increase maintenance costs. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for elk.

91—Rock outcrop

This map unit is on extremely steep structural breaklands. It is mostly exposed bedrock and rubble land. Bedrock can be granitic, basaltic, metasedimentary, rhyolitic, or limestone rocks. Soils on small colluvial slopes below rock outcrop comprise 10 percent of this map unit. These soils support scattered Douglas-fir, limber pine, or ponderosa pine. This map unit is not suitable for timber, range, or roads.

92—Typic Ustochrepts-Rock outcrop complex, limestone substratum

This map unit is on structural breaklands. Elevation ranges from 4,500 to 7,000 feet. Average annual precipitation is 10 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes are on southerly aspects with gradients of 60 to 90 percent. The shapes of the slopes are controlled by the underlying bedrock. The dip of underlying rock strata is roughly perpendicular to slopes. The drainage pattern is subparallel with closely spaced, moderately incised drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir, ponderosa pine, and limber pine. Dominant understory species are snowberry, pinegrass, Idaho fescue, bluebunch wheatgrass, and kinnikinnick.

Habitat Types

Douglas-fir/white spirea, Douglas-fir/bluebunch wheatgrass, and Douglas-fir/kinnikinnick are the major habitat types. These habitat types occupy 45 percent of the unit. Douglas-fir/snowberry, bluebunch wheatgrass phase, is a dissimilar habitat type in draws and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have calcareous medium-textured surface layers. Subsoils contain 40 to 80 percent angular rock fragments and are calcareous.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid have thin subsoils. Similar soils are Typic Ustorthents, loamy-skeletal, carbonatic, frigid. They do not have subsoils. These soils occupy 45 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 45 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of the map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid. These soils are near rock outcrop. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous dark-brown very gravelly loam surface layers 6-inches thick. The subsoil is calcareous brown extremely gravelly loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 10 to 30 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 500 pounds of forage per acre under a forest canopy and 775 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Slope steepness increases the quantity of material excavated. Hard rock frequently limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Some delineations are preferred winter range for mule deer. The rock outcrop in this unit is preferred nesting habitat for raptors.

94—Lithic Ustochrepts-Rock outcrop complex, metasedimentary substratum

This map unit is on structural breaklands. Elevation ranges from 4,500 to 6,000 feet. Average annual precipitation is 10 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 60 to 90 percent. The shapes of the slopes are controlled by the underlying bedrock. The dip of underlying rock strata is roughly perpendicular to slopes. The drainage pattern is dendritic with closely spaced, moderately incised drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir, ponderosa pine, and limber pine. Dominant understory species are snowberry, bluebunch wheatgrass, white spirea, and kinnikinnick.

Habitat Types

Douglas-fir/Idaho fescue; Douglas-fir/snowberry, bluebunch wheatgrass phase; and Douglas-fir/bluebunch wheatgrass are the major habitat types. These habitat types occupy 45 percent of the unit. Forested scree communities are on rock outcrop and rubble land and occupy 40 percent of the unit. Included in this unit are 15 percent dissimilar habitat types. Douglas-fir/snowberry and Douglas-fir/ninebark are in draws and on northerly aspects and have higher timber productivity.

Geology

This map unit is underlain by argillites, siltites, and quartzites. It is underlain by basalt in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 4- to 20-inches deep over bedrock. Subsoils contain 50 to 80 percent angular rock fragments.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, mixed, frigid have thin dark-colored surface layers. Similar soils are Lithic Haploborolls, loamy-skeletal, mixed. They

have dark-colored surface layers. These soils occupy 45 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 35 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 20 percent of this map unit. Dissimilar soils are Typic Ustochrepts, loamy-skeletal, mixed, frigid and Typic Haploborolls, loamy-skeletal, mixed. These soils are on lower slopes. They are 20- to 60-inches deep over bedrock and have higher timber productivity.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown extremely gravelly loam surface layers 7-inches thick. The subsoil is brown extremely gravelly loam overlying fractured bedrock at 18 inches.

Management

Timber

Potential annual production in forested areas is 10 to 30 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 300 pounds of forage per acre under a forest canopy and 425 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Slope steepness increases the quantity of material excavated. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

94A—Lithic Cryochrepts-Rock outcrop complex, structural breaklands

This map unit is on structural breaklands. Elevation ranges from 5,400 to 7,500 feet. Average annual precipitation is 20 to 35 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary and basaltic rocks.

Landform

Dominant slopes are on southerly aspects with gradients of 60 to 90 percent. The shapes of the slopes are controlled by the underlying bedrock. The dip of underlying rock strata is roughly perpendicular to slopes. The drainage pattern is dendritic or subparallel with widely spaced, weakly incised low-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of an open-grown forest of Douglas-fir, limber pine, and lodgepole pine. Dominant understory species are elk sedge, Idaho fescue, and beargrass.

Habitat Types

Douglas-fir/Idaho fescue, subalpine fir/elk sedge, and limber pine/Idaho fescue are the major habitat types on stable soils. These habitat types occupy 65 percent of the unit. Forested scree community types are on rock outcrop and rubble land and occupy 35 percent of the unit. Subalpine/beargrass, a dissimilar habitat type, is on northerly aspects and has higher timber productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by argillites, siltites, quartzites, basalts, and andesites. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 4- to 20-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments.

Map Unit Composition

Lithic Cryochrepts, loamy-skeletal, mixed have thin dark-colored surface layers. Similar soils are Lithic Cryoborolls, loamy-skeletal, mixed. They have thick dark-colored surface layers. These soils occupy 55 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 35 percent. The

components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Typic Cryochrepts, loamy-skeletal, mixed. These soils are on lower slopes. They are 20- to 60-inches deep over bedrock and have higher timber productivity.

Representative Profile of the Soils

Lithic Cryochrepts, loamy-skeletal, mixed have dark-brown very gravelly loam surface layers 6-inches thick. The subsoil is dark yellowish-brown very gravelly loam overlying fractured bedrock at 17 inches.

Management

Timber

Potential annual production in forested areas is 20 to 30 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 250 pounds of forage per acre under a forest canopy and 450 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Slope steepness increases the quantity of material excavated. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

95—Typic Cryochrepts-Lithic Cryochrepts-Rock outcrop complex, limestone substratum

This map unit is on structural breaklands. Elevation ranges from 3,800 to 6,500 feet. Average annual

precipitation is 10 to 20 inches. Vegetation is upper, mixed forest. Soils formed in material derived from limestone.

Landform

Dominant slopes are on northerly aspects with gradients of 60 to 90 percent. The shapes of the slopes are controlled by the underlying bedrock. The dip of underlying rock strata is roughly perpendicular to slopes. The drainage pattern is subparallel with widely spaced, weakly incised low-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a Douglas-fir forest. Dominant understory species are twinflower, pinegrass, heartleaf arnica, and wintergreen.

Habitat Types

Douglas-fir/twinflower and spruce/twinflower are the major habitat types. These habitat types occupy 85 percent of the unit. Forested scree community types are on rock outcrop and rubble land and occupy 15 percent of the unit.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have thin dark-colored medium-textured surface layers. Subsoils contain 40 to 60 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils 20- to 60-inches and 4- to 20-inches deep over bedrock are both present.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, carbonatic are 20- to 60-inches deep over bedrock. These soils occupy 65 percent of the unit.

Lithic Cryochrepts, loamy-skeletal, carbonatic are 4- to 20-inches deep over bedrock. These soils occupy 20 percent of the unit.

Rock outcrop and rubble land are present throughout the unit and occupy 15 percent. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, carbonatic have very dark grayish-brown extremely gravelly silt loam surface layers 4-inches thick. The upper part of the subsoil is calcareous brown very gravelly silty clay loam 13-inches thick. The lower part of the subsoil is calcareous very pale-brown very gravelly loam overlying fractured limestone at 37 inches.

Lithic Cryochrepts, loamy-skeletal, carbonatic have very dark grayish-brown extremely gravelly silt loam surface layers 5-inches thick. The subsoil is calcareous dark yellowish-brown very gravelly silt loam overlying fractured limestone at 14 inches.

Management

Timber

Potential annual production in forested areas is 40 to 60 cubic feet per acre. The productivity of this map unit is reduced by rock outcrop and rubble land. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition limits forest regeneration.

Range

The forest understory produces little forage under a forest canopy, but production increases to 250 pounds per acre when the canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Slope steepness increases the quantity of material excavated. Hard rock frequently limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

97—Typic Cryochrepts, structural breaklands

This map unit is on structural breaklands. Elevation ranges from 4,000 to 6,500 feet. Average annual

precipitation is 15 to 20 inches. Vegetation is lower subalpine forest and upper, mixed forest. Soils formed in material derived from metasedimentary or basaltic rocks.

Landform

Dominant slopes are on northerly aspects with gradients of 60 to 90 percent. The shapes of the slopes are controlled by the underlying bedrock. The dip of underlying rock strata is roughly perpendicular to slopes. The drainage pattern is dendritic or subparallel, and drainageways are widely spaced and weakly incised.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine. Dominant understory species are twinflower, ninebark, heartleaf arnica, and wintergreen.

Habitat Types

Subalpine fir/twinflower is the major habitat type on upper slopes, and Douglas-fir/ninebark is the major habitat type on lower slopes. These habitat types occupy 100 percent of the unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales or basalts, tuffs, andesites, and breccias are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 40 to 80 percent angular rock fragments.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed do not have subsoil clay accumulations. Similar soils are Typic Cryoboralfs, loamy-skeletal, mixed. They have subsoil clay accumulations. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is present throughout the unit.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very channery loam surface layers 4-inches thick. The upper part of the subsoil is

yellowish-brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying argillite at 40 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Slope steepness increases the quantity of material excavated. Large stones can roll from steep cutslopes onto road surfaces, causing a traffic hazard.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

100—Borolls, flood plains and terraces

This map unit is on flood plains and terraces. Elevation ranges from 3,800 to 5,500 feet. Average annual precipitation is 10 to 20 inches. Vegetation consists of upper, mixed forest; lower subalpine forest; and mountain grassland and shrubland. Soils formed in alluvial deposits.

Landform

Dominant slopes have gradients of 0 to 10 percent. Flood plains and low terraces are nearly level alluvial deposits bordering streams. The flood plains are subject to flooding hazard. Low terraces are separated from flood plains by short, steep risers.

Vegetation

Vegetation can be mixed forests of Douglas-fir, Engelmann spruce, subalpine fir, lodgepole pine, and cottonwood; or it can be grasslands and shrublands dominated by Idaho fescue, rough fescue, sagebrush, and shrubby cinquefoil; or it can be mosaics of forest and grassland or shrubland.

Habitat Types

Subalpine fir/twinflower and spruce/twinflower are the major forest habitat types on low terraces. Rough

fescue/Idaho fescue and big sagebrush/Idaho fescue are the major grassland and shrubland habitat types. The flood plain part of the unit has riparian community types that must be identified on site.

Geology

This unit is underlain by stratified alluvial deposits of sand, silt, and gravel.

Characteristics of the Soils

Soils are subject to short periods of flooding hazard during spring snowmelt. Soils on flood plains have fluctuating water tables that can rise to within 30 inches of the surface in the spring months. Soils are texturally stratified.

Map Unit Composition

Borolls have thick dark-colored surface layers. Similar soils are Fluvents. They have light-colored or thin dark-colored surface layers. These soils occupy 90 percent of the unit.

Dissimilar soils and riverwash make up 10 percent of this map unit. Dissimilar soils are Aquolls. These soils are in abandoned channels. They are wet and have low strength. Riverwash is in stream channels.

Representative Profile of the Soils

No one profile can represent Borolls in this unit, but a description of one of the most common soils follows. Borolls have black to dark-brown stratified gravelly silt loam and extremely gravelly sandy loam surface layers 16-inches thick. The substratum is dark-brown and brown stratified extremely gravelly sandy loam and gravelly silt loam to depths of 60 inches or more.

Management

Timber

Onsite evaluation is required to determine potential productivity of forested sites. The terrain is well suited to tractor operation. Frost pockets limit forest regeneration. Trees are susceptible to windthrow because of fluctuating water tables.

Range

Onsite evaluation is required to determine forage productivity. Livestock prefer this map unit and tend to overutilize forage before grazing adjacent uplands.

Roads

Onsite evaluation is required to determine suitability for road construction. Floods can damage bridges and culverts.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Most delineations are riparian areas and are potentially important to wildlife, fisheries, and watershed. Conservation practices to protect riparian values may be required when managing adjacent uplands.

Wildlife

Forested parts of this unit in delineations near Lincoln are preferred habitat for grizzly bear in the spring months.

101—Aquolls, flood plains and terraces

This map unit is on flood plains and terraces. Elevation ranges from 4,000 to 6,500 feet. Average annual precipitation is 15 to 30 inches. Vegetation is wet shrubland, wet meadows, or wet forest. Soils formed in alluvium or glacial outwash.

Landform

Dominant slopes have gradients of 0 to 10 percent. Flood plains and terraces are nearly level alluvial deposits bordering streams. Low terraces are separated from flood plains by short, steep risers.

Vegetation

Wet shrublands and wet meadows are dominated by sedges and willows or bog birch. Forests are mixed stands of Engelmann spruce, subalpine fir, and quaking aspen. Delineations can be entirely wet shrubland and wet meadows or wet forest or a mosaic of both.

Habitat Types

Subalpine fir/bluejoint, spruce/common horsetail, and spruce/sweetscented bedstraw are the major wet forest habitat types. Bog birch and willow community types dominate wet shrubland.

Geology

This map unit is underlain by stratified alluvial deposits or glacial outwash.

Characteristics of the Soils

Soils in this map unit have water tables at or near the surface during the spring and early summer months. Some are flooded for short periods during spring snowmelt.

Map Unit Composition

Aquolls have organic surface layers 2- to 16-inches thick. Similar soils are Histosols. They have organic surface layers ranging from 16-inches to more than 60-inches thick. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Borolls. These soils are near delineation boundaries. They have water tables below 30 inches and have higher strength.

Representative Profile of the Soils

No one profile can represent Aquolls in this map unit, but a description of one of the most common soils follows. Aquolls have very dark grayish-brown silt loam surface layers 10-inches thick covered by a mat of partially decomposed organic matter and plant roots. The substratum is dark-gray very cobbly sandy clay loam mottled with yellowish-brown to depths of 60 inches or more.

Management

Timber

Onsite evaluation is required to determine potential productivity of forested sites. Wet soils with low strength limit tractor operation. Rutting and puddling of the soil can reduce soil productivity. Forest regeneration can be limited by frost pockets. Trees are susceptible to windthrow because of fluctuating water tables.

Range

Onsite evaluation is required to determine forage productivity. The unit contains wet soils on which livestock can trample vegetation and puddle soil surface layers.

Roads

This unit contains wet soils. Excavation can intercept large amounts of ground water. Unsurfaced roads rut when wet.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Most delineations are riparian areas and are potentially important to wildlife, fisheries, and watershed. Conservation practices may be required to protect riparian values when managing adjacent uplands.

Wildlife

Some delineations are preferred moose habitat. Forested parts of this unit in delineations near Lincoln are preferred habitat for grizzly bear in the spring months.

110—Typic Argiborolls and Typic Ustochrepts, alluvial fans

This map unit is on alluvial fans. Elevation ranges from 4,000 to 6,000 feet. Average annual precipitation is 15 to 25 inches. Vegetation consists of mountain grassland and shrubland. Soils formed in alluvial deposits.

Landform

Dominant slopes have gradients of 10 to 25 percent. Alluvial fans are fan-shaped alluvial deposits where steep mountain streams enter valleys or mountain basins.

Vegetation

Dominant vegetation consists of rough fescue, Idaho fescue, bluebunch wheatgrass, bitterbrush, and big sagebrush. Some delineations are open-grown ponderosa-pine forest with bunchgrass understories.

Habitat Types

Big sagebrush/rough fescue, rough fescue/Idaho fescue, and rough fescue/bluebunch wheatgrass are the major habitat types in most delineations. Ponderosa pine/Idaho fescue is the major habitat type in forested delineations.

Geology

This map unit is underlain by stratified alluvial deposits of sand, silt, and gravel.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 35 to 80 percent rounded rock fragments. Substrata are calcareous. Thick dark-colored surface layers and thin dark-colored surface layers are both present.

Map Unit Composition

Typic Argiborolls, loamy-skeletal, mixed have thick dark-colored surface layers and subsoil clay accumulations. Similar soils are Typic Calciborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations.

Typic Ustochrepts, loamy-skeletal, mixed, frigid have thin dark-colored surface layers. Every

delineation has at least one of these soils and may have all.

Representative Profile of the Soils

Typic Argiborolls, loamy-skeletal, mixed have black silt loam surface layers 11-inches thick. The upper part of the subsoil is brown and dark yellowish-brown very gravelly clay loam 21-inches thick. The lower part of the subsoil is calcareous brown very gravelly clay loam to depths of 60 inches or more.

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown very gravelly loam surface layers 8-inches thick. The upper part of the subsoil is calcareous dark-brown very gravelly loam 16-inches thick. The lower part of the subsoil is calcareous dark-brown very gravelly sandy loam to depths of 60 inches or more.

Management

Timber

Forested delineations have potential annual production of 20 to 40 cubic feet per acre. The terrain is well suited to tractor operation. Grass competition and moisture stress limit forest regeneration. Forested delineations are usually valuable wildlife winter range and are seldom managed for timber production.

Range

This unit is well suited to livestock grazing. Forage productivity should be determined on site.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Delineations supporting ponderosa-pine forest are preferred winter range for elk.

120—Typic Cryoboralfs-Typic Cryochrepts complex, granitic substratum

This map unit is on glaciated mountain slopes. Elevation ranges from 5,000 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is lower subalpine forest. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 25 percent. Glaciated mountain slopes are on the lower slopes of glacial valleys. These slopes have undulating to rolling topography. The drainage pattern is dendritic with widely spaced, weakly incised low-order drainageways that have concave bottoms.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Engelmann spruce and subalpine fir. Dominant understory species are beargrass, elk sedge, and grouse whortleberry.

Habitat Types

Subalpine fir/beargrass and subalpine fir/grouse whortleberry are the major habitat types on convex knolls. Subalpine fir/dwarf huckleberry is the major habitat type in depressions. These habitat types occupy 100 percent of the unit.

Geology

This map unit is underlain by weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered. Depressions contain thin deposits of friable glacial till derived from granitic rocks.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers, ranging from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 35 to 80 percent subrounded and rounded rock fragments. Soil properties vary with topographic position. Soils in depressions have subsoil clay accumulations; soils on knolls do not.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have subsoil clay accumulations. These soils occupy 45 percent of the unit.

Typic Cryochrepts, loamy-skeletal, mixed do not have subsoil clay accumulations. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on knolls. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on knolls.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown gravelly sandy loam surface layers 9-inches thick. The upper part of the subsoil is brown very gravelly sandy clay loam 20-inches thick. The lower part of the subsoil is dark yellowish-brown very gravelly sandy loam to depths of 60 inches or more.

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly sandy loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly sandy loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely cobbly sandy loam overlying granitic bedrock at 40 inches.

Management

Timber

Potential annual production is 30 to 65 cubic feet per acre. The terrain is well suited to tractor operation. Frost pockets limit forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from

unvegetated cut and fill slopes can reach drainage channels and become sediment.

130—Typic Cryoboralfs-Argic Cryoborolls complex, moraines

This map unit is on moraines. Elevation ranges from 5,000 to 6,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is a mosaic of upper, mixed forest and mountain grassland. Soils formed in glacial till.

Landform

Dominant slopes have gradients of 10 to 40 percent. Moraines are rolling or hilly glacial till deposits in valley bottoms. They have a deranged drainage pattern. There are small lakes or bogs in some places. Streams originating at higher elevations flow through these valleys.

Vegetation

Upper, mixed forest occupies 70 percent of the unit. Vegetation consists of a lodgepole-pine forest with some Douglas-fir and quaking aspen. Dominant understory species are snowberry and pinegrass. Mountain grassland occupies 30 percent of the unit. It is dominated by Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, and western needlegrass.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass are the major forest habitat types. Douglas-fir/blue huckleberry is a similar habitat type. Rough fescue/Idaho fescue and rough fescue/bluebunch wheatgrass are the major grassland habitat types. Tufted hairgrass/sedge, a dissimilar habitat type, is in wet meadows around lakes and bogs and has higher forage productivity. It occupies 10 percent of the map unit.

Geology

This map unit is underlain by friable loamy glacial till.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 40 to 60 percent rounded rock fragments. Substrata are calcareous. Soil properties vary with vegetation. Soils formed under forest have light-colored surface layers. Soils formed under grassland have thick dark-colored surface layers.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed are under forest and have light-colored surface layers. Similar soils are Mollic Cryoboralfs, loamy-skeletal, mixed. They have thin dark-colored surface layers. These soils occupy 60 percent of the unit.

Argic Cryoborolls, loamy-skeletal, mixed are under grassland and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 30 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Argiaquic Cryoborolls, fine-loamy, mixed. These soils are in wet meadows. They are wet and have low strength.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly clay loam 7-inches thick. The lower part of the subsoil is calcareous dark yellowish-brown very cobbly loam to depths of 60 inches or more.

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown cobbly loam surface layers 10-inches thick. The upper part of the subsoil is dark yellowish-brown very cobbly clay loam 16-inches thick. The lower part of the subsoil is calcareous yellowish-brown very cobbly loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 40 to 70 cubic feet per acre. The productivity of this map unit is reduced by grassland. The terrain is well suited to tractor operation. Grass competition limits forest regeneration.

Range

This unit is well suited to livestock grazing. Forest understory forage production is 100 pounds per acre under a forest canopy and 250 pounds per acre when the forest canopy is removed. In mountain grassland, forage production is 1,100 pounds in an average year.

Roads

Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

136—Aquolls-Typic Cryochrepts complex, moraines

This map unit is on moraines. Elevation ranges from 5,000 to 7,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is a mosaic of wet forest and wet meadows. Soils formed in glacial drift.

Landform

Dominant slopes have gradients of 0 to 10 percent. Moraines are rolling glacial drift deposits on glaciated mountain ridges. The drainage pattern is deranged with many bogs and small lakes. Streams often originate within the landform.

Vegetation

Wet meadow occupies 65 percent of the unit. Dominant vegetation consists of sedges, tufted hairgrass, and bluejoint. Willow and Sitka alder are near drainage channels. Wet forest occupies 35 percent of the unit. Vegetation consists of lodgepole pine. Dominant understory species are bluejoint reedgrass, grouse whortleberry, and dwarf huckleberry.

Habitat Types

Tufted hairgrass/carex species is the major wet meadow habitat type. It occupies 65 percent of the unit. Subalpine fir/bluejoint, dwarf huckleberry phase, and subalpine fir/dwarf huckleberry are the major forest habitat types. Subalpine fir/menziesia and subalpine fir/Sitka alder are similar habitat types. These habitat types occupy 35 percent of the unit.

Geology

This unit is underlain by loamy, friable glacial drift deposits.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured surface layers. Boulders are scattered upon the surface. Soil properties vary with vegetation. Soils in wet meadows have thick dark-colored surface layers and mottled colors in subsoils. Soils under forest have thin dark-colored surface layers, and subsoils are not mottled.

Map Unit Composition

Aquolls are in wet meadows and have thick dark-colored surface layers. Similar soils are Aquepts. They have thin dark-colored surface layers. These soils occupy 65 percent of the unit.

Typic Cryochrepts, loamy-skeletal, mixed are under forests. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Representative Profile of the Soils

No one pedon can represent Aquolls in this unit, but a description of one of the most common soils follows. Aquolls have very dark grayish-brown sandy clay loam surface layers 10-inches thick. The substratum is dark-gray very cobbly sandy clay loam mottled with yellowish-brown to depths of 60 inches or more.

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very cobbly sandy loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very cobbly sandy loam 36-inches thick. The lower part of the subsoil is yellowish-brown very cobbly sandy loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 40 to 60 cubic feet per acre. The productivity of this map unit is reduced by wet meadows. The terrain is well suited to tractor operation. Wet areas with low strength limit tractor operation. Rutting and puddling of the soil can reduce soil productivity. Grass competition limits forest regeneration.

Range

Forage production in wet meadows is 2,100 pounds per acre in an average year. The forest

understory produces 100 pounds of forage per acre under a forest canopy and 400 pounds per acre when the forest canopy is removed. This unit contains wet soils on which livestock can trample vegetation and puddle soil surface layers.

Roads

This unit contains wet soils. Excavation can intercept large amounts of ground water. In wet meadows, unsurfaced roads rut when wet.

Watershed

The major concern of watershed management is protection of stream channels and banks. Bridges and culverts should be carefully planned to maintain channel stability. Practices that disturb soils on or adjacent to streambanks can increase stream sediment. Most delineations are riparian areas and are potentially important to wildlife, fisheries, and watershed. Conservation practices may be required to protect riparian values when managing adjacent uplands.

Wildlife

Some delineations are preferred moose habitat.

150—Argic Cryoborolls-Mollic Cryoboralfs complex, landslides

This map unit is on landslides. Elevation ranges from 5,500 to 6,500 feet. Average annual precipitation is 20 to 25 inches. Vegetation is a mosaic of mountain grassland and upper, mixed forest. Soils formed in landslide deposits.

Landform

Dominant slopes have gradients of 10 to 40 percent. Landslides have a hummocky surface with mounds and depressions. Indicators of movement such as large cracks, slip scars, and lobate-shaped deposits are present. The drainage pattern is deranged and diverts surface runoff into ponds and bogs. Seeps and springs are common.

Vegetation

Mountain grassland occupies 75 percent of the unit. It is dominated by Idaho fescue, rough fescue, bluebunch wheatgrass, timber oatgrass, and western needlegrass. Upper, mixed forest occupies 25 percent of the unit. Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are snowberry, pinegrass, twinflower, and blue huckleberry.

Habitat Types

Rough fescue/Idaho fescue and rough fescue/bluebunch wheatgrass are the major habitat types in mountain grassland. Subalpine fir/twinflower and Engelmann spruce/twinflower are the major forest habitat types on northerly aspects or in depressions. Douglas-fir/snowberry and Douglas-fir/pinegrass are the major forest habitat types on southerly aspects. Subalpine fir/blue huckleberry is similar on southerly aspects. Included in this unit are 15 percent dissimilar habitat types and community types. Tufted hairgrass/carex species and spruce/sweetscented bedstraw habitat types and quaking aspen community types are near seeps, ponds, or bogs.

Geology

This map unit is underlain by landslide deposits derived from metasedimentary, basaltic, and limestone rocks.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to fine. Subsoils contain 35 to 50 percent angular rock fragments. Soil properties vary with vegetation. Soils formed in mountain grassland have thick dark-colored surface layers. Soils formed under forest have thin dark-colored surface layers.

Map Unit Composition

Argic Cryoborolls, clayey-skeletal, mixed are in mountain grassland. They have thick dark-colored surface layers and 35 to 50 percent clay in the subsoil. Similar soils are Argic Cryoborolls, loamy-skeletal, mixed. They have 29 to 35 percent clay in the subsoil. These soils occupy 65 percent of the unit.

Mollic Cryoboralfs, clayey-skeletal, mixed are under forest. They have thin dark-colored surface layers and 35 to 50 percent clay in the subsoil. Similar soils are Mollic Cryoboralfs, loamy-skeletal, mixed and Typic Cryoboralfs, clayey-skeletal, mixed. They have 29 to 35 percent clay in the subsoil or light-colored surface layers. These soils occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Aquolls. These soils are in

wet meadows and near seeps. They are wet and have low strength.

Representative Profile of the Soils

Argic Cryoborolls, clayey-skeletal, mixed have very dark-gray silt loam surface layers 3-inches thick. The upper part of the subsoil is dark-brown and yellowish-red very gravelly silty clay loam and clay 33-inches thick. The lower part of the subsoil is strong-brown very gravelly silty clay loam 12-inches thick. The substratum is strong-brown very gravelly silty clay loam to depths of 60 inches or more.

Mollic Cryoboralfs, clayey-skeletal, mixed have dark-brown silty clay loam surface layers 9-inches thick. The upper part of the subsoil is brown and light yellowish-brown very gravelly silty clay loam 30-inches thick. The lower part of the subsoil is light yellowish-brown very stony silty clay loam to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 50 to 80 cubic feet per acre. The productivity of this map unit is reduced by grassland. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Grass competition limits forest regeneration.

Range

In mountain grasslands, forage production is 1,100 pounds per acre in an average year. The forest understory produces little forage. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

210—Lithic Ustochrepts-Typic Ustochrepts complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 3,500 to 5,200 feet. Average annual precipitation is 15 to 20 inches. Vegetation is lower, mixed forest. Soils formed in material weathered from limestone and metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with closely spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and ponderosa pine. Dominant understory species are Idaho fescue, bluebunch wheatgrass, and kinnikinnick.

Habitat Types

Ponderosa pine/Idaho fescue and Douglas-fir/bluebunch wheatgrass are the major habitat types. These habitat types occupy 85 percent of the unit. Douglas-fir/twinflower, a dissimilar habitat type, is on northerly aspects and has higher timber productivity. It occupies 15 percent of the map unit.

Geology

This map unit is underlain by interbedded limestone and calcareous shales or argillites. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 40 to 60 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid are 4- to 20-inches deep over limestone. Similar soils are Lithic Ustochrepts, loamy-skeletal, mixed, frigid. They are underlain by shale or argillite. These soils occupy 60 percent of the unit.

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid are 20- to 40-inches deep over limestone. Similar soils are Typic Ustochrepts, loamy-skeletal, mixed, frigid. They are underlain by shale or argillite. These soils occupy 30 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion throughout the unit and occupies 10 percent of it.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous very dark-gray very gravelly loam surface layers 2-inches thick. The subsoil is calcareous brown very gravelly loam overlying fractured limestone at 19 inches.

Typic Ustochrepts, loamy-skeletal, carbonatic, frigid have calcareous dark-brown very gravelly loam surface layers 6-inches thick. The subsoil is calcareous brown extremely gravelly loam and fractured silt loam overlying limestone at 35 inches.

Management

Timber

Potential annual production is 10 to 20 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 500 pounds of forage per acre under a forest canopy and 775 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Hard rock frequently limits excavation. Unsurfaced roads are rough and difficult to blade because of large stones in areas. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

260—Typic Haploborolls-Typic Ustochrepts complex, bouldery, granitic substratum

This map unit is on rolling uplands. Elevation ranges from 4,500 to 6,000 feet. Average annual precipitation is 15 to 20 inches. Vegetation is a mosaic of lower, mixed forest and mountain grassland and shrubland. Soils formed in material weathered from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Rolling uplands have broadly rounded ridgetops and side slopes ranging from straight to convex. The drainage pattern is dendritic with moderately spaced, deeply incised low-order drainageways that have concave bottoms.

Vegetation

Lower, mixed forest occupies 50 percent of the unit. It is an open-grown to dense forest of Douglas-fir and ponderosa pine. Dominant understory species are Idaho fescue, kinnikinnick, bluebunch wheatgrass, and pinegrass. Mountain grassland and shrubland occupy 50 percent of the unit. They are dominated by Idaho fescue, bluebunch wheatgrass, timber oatgrass, western needlegrass, and big sagebrush.

Habitat Types

Douglas-fir/Idaho fescue; ponderosa pine/Idaho fescue; Douglas-fir/kinnikinnick; and Douglas-fir/pinegrass, kinnikinnick phase, are the major forest habitat types. Rough fescue/bluebunch wheatgrass, rough fescue/Idaho fescue, and big sagebrush/Idaho fescue are the major grassland and shrubland habitat types.

Geology

This map unit is underlain by moderately and weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered. Moderately weathered rock decomposes to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils in this map unit have moderately coarse-textured and coarse-textured surface layers, ranging from 20- to 60-inches deep over bedrock. Subsoils contain 10 to 35 percent rounded rock fragments. Boulders are scattered upon the surface. Soil properties vary with vegetation. Soils formed under

grassland and open-grown forest have thick dark-colored surface layers. Soils formed under dense forest have thin dark-colored surface layers.

Map Unit Composition

Typic Haploborolls, sandy, mixed are under grassland and open-grown forest and have coarse-textured subsoils. Similar soils are Typic Haploborolls, coarse-loamy, mixed. They have moderately coarse-textured subsoils. These soils occupy 45 percent of the unit.

Typic Ustochrepts, sandy, mixed, frigid are under dense forest and occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Haploborolls, sandy, mixed and Lithic Ustipsamments, sandy, mixed, frigid. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber and forage productivity. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Typic Haploborolls, sandy, mixed have very dark grayish-brown sandy loam surface layers 14-inches thick. The subsoil is brown loamy coarse sand 3-inches thick. The substratum is weathered granitic bedrock at 50 inches.

Typic Ustochrepts, sandy, mixed, frigid have dark-brown gravelly sandy loam surface layers 2-inches thick. The upper part of the subsoil is dark yellowish-brown gravelly sandy loam 14-inches thick. The lower part of the subsoil is olive-brown gravelly loamy sand 14-inches thick. The substratum is soft, moderately weathered granite to depths of 60 inches or more.

Management

Timber

Potential annual production in forested areas is 40 to 60 cubic feet per acre. The productivity of this map unit is reduced by mountain grassland and shrubland. The terrain is well suited to tractor operation, but boulders limit operation in parts of the unit. Tractor operation can reduce soil productivity by displacing soil surface layers; operation should be carefully managed to minimize the area affected. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 300 pounds of forage per acre under a forest canopy and 550

pounds per acre when the forest canopy is removed. In mountain grassland and shrubland, forage production is 700 pounds per acre in an average year. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Cut and fill material is sandy and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

Wildlife

Delineations of this unit in the Elkhorn Mountains are preferred winter range for mule deer.

290—Lithic Ustochrepts-Typic Ustochrepts complex, metasedimentary substratum

This map unit is on structural benches. Elevation ranges from 4,000 to 5,200 feet. Average annual precipitation is 10 to 15 inches. Vegetation is a mosaic of lower, mixed forest and mountain grassland and shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 30 percent. Structural benches are gently sloping or have undulating ridges with short, steep slopes along drainageways. The drainage pattern is dendritic with widely spaced, moderately incised low-order drainageways that have V-shaped bottoms.

Vegetation

Mountain grassland and shrubland occupy 70 percent of the unit. Dominant vegetation consists of bluebunch wheatgrass, Sandberg bluegrass, blue grama, needleandthread, and western needlegrass. Lower, mixed forest occupies 30 percent of the unit. Vegetation consists of a mixed forest of Douglas-fir and ponderosa pine. Dominant understory species are rough fescue, Idaho fescue, and bluebunch wheatgrass.

Habitat Types

Bluebunch wheatgrass/western wheatgrass, Idaho fescue/bluebunch wheatgrass, and Idaho fescue/western wheatgrass are the major grassland habitat types. Ponderosa pine/rough fescue, Douglas-fir/Idaho fescue, Douglas-fir/rough fescue, and ponderosa pine/rough fescue are the major forest habitat types.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers. Subsoils contain 40 to 80 percent angular rock fragments and are calcareous. Soil properties are not obviously associated with landscape features. Soils 4- to 20-inches and 20- to 40-inches deep over bedrock are both present.

Map Unit Composition

Lithic Ustochrepts, loamy-skeletal, mixed, frigid are 4- to 20-inches deep over bedrock. These soils occupy 65 percent of the unit.

Typic Ustochrepts, loamy-skeletal, mixed, frigid are 20- to 40-inches deep over bedrock. These soils occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop is a dissimilar inclusion on short, steep slopes along drainageways and occupies 10 percent of the unit.

Representative Profile of the Soils

Lithic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown extremely gravelly loam surface layers 7-inches thick. The subsoil is calcareous brown extremely gravelly loam overlying fractured quartzite at 18 inches.

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark reddish-brown very channery loam surface layers 8-inches thick. The upper part of the subsoil is calcareous dark reddish-brown very channery loam 18-inches thick. The lower part of the subsoil is calcareous dark reddish-brown extremely channery loam overlying fractured argillite at 30 inches.

Management

Timber

Potential annual production in forested areas is 10 to 30 cubic feet per acre. The productivity of this map

unit is reduced by grassland. The terrain is well suited to tractor operation. Grass competition and moisture stress limit forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 500 pounds of forage per acre under a forest canopy and 775 pounds per acre when the forest canopy is removed. In mountain grassland and shrubland, forage production is 600 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

320—Calcic Cryoborolls-Mollic Cryoboralfs complex, limestone substratum

This map unit is on mountain ridges. Elevation ranges from 5,000 to 7,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is a mosaic of upper, mixed forest and mountain grassland and shrubland. Soils formed in material derived from limestone.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad, undissected ridgetops with convex side slopes.

Vegetation

Upper, mixed forest occupies 75 percent of the unit. Vegetation consists of a Douglas-fir forest with some lodgepole pine. Dominant understory species are pinegrass, rough fescue, Idaho fescue, and bluebunch wheatgrass. Mountain grassland and shrubland occupies 25 percent of the unit. Dominant vegetation consists of rough fescue, Idaho fescue, bluebunch wheatgrass, timber oatgrass, and big sagebrush.

Habitat Types

Douglas-fir/rough fescue and Douglas-fir/pinegrass are the major forest habitat types. Rough fescue/

Idaho fescue and big sagebrush/rough fescue are the major grassland habitat types.

Geology

This map unit is underlain by limestone and calcareous sandstone. These types of bedrock produce calcareous loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. They are 20- to 40-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments. Substrata are calcareous. Soil properties are not obviously associated with landscape features. Soils with thick and thin dark-colored surface layers are both present.

Map Unit Composition

Calcic Cryoborolls, loamy-skeletal, carbonatic have thick dark-colored surface layers. These soils occupy 55 percent of the unit.

Mollic Cryoboralfs, loamy-skeletal, mixed have thin dark-colored surface layers and subsoil clay accumulations. Similar soils are Typic Cryochrepts, loamy-skeletal, carbonatic. They do not have subsoil clay accumulations. These soils occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, carbonatic. These soils are present throughout the unit. They are 4- to 20-inches deep over bedrock and have lower forage productivity. Rock outcrop is present throughout the map unit.

Representative Profile of the Soils

Calcic Cryoborolls, loamy-skeletal, carbonatic have dark-brown silt loam surface layers 11-inches thick. The subsoil is calcareous dark yellowish-brown and light yellowish-brown very gravelly and extremely gravelly silt loam and loam overlying fractured limestone at 38 inches.

Mollic Cryoboralfs, loamy-skeletal, mixed have dark-brown silt loam upper surface layers 8-inches thick. The lower surface layer is pale-brown gravelly silt loam 4-inches thick. The upper part of the subsoil is brown very gravelly silt loam 20-inches thick. The lower part of the subsoil is calcareous pale-brown extremely gravelly silt loam overlying fractured limestone at 37 inches.

Management

Timber

Potential annual production in forested areas is 30 to 40 cubic feet per acre. The productivity of this map unit is reduced by mountain grassland and shrubland. Grass competition and moisture stress limit forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 300 pounds of forage per acre under a forest canopy and 550 pounds per acre when the forest canopy is removed.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

360—Typic Cryoboralfs-Argic Cryoborolls complex, bouldery, granitic substratum

This map unit is on mountain ridges. Elevation ranges from 5,000 to 6,600 feet. Average annual precipitation is 20 to 30 inches. Vegetation is a mosaic of upper, mixed forest and mountain grassland and shrubland. Soils formed in material derived from granitic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad, undissected ridgetops with convex side slopes.

Vegetation

Upper, mixed forest occupies 65 percent of the unit. Vegetation consists of a lodgepole-pine forest with some Douglas-fir. Dominant understory species are snowberry, pinegrass, twinflower, and blue huckleberry. Mountain shrubland occupies 35 percent of the unit. Dominant species are Idaho fescue, rough fescue, bluebunch wheatgrass, big sagebrush, and timber oatgrass.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass are the major forest habitat types on southerly aspects. Douglas-fir/twinflower is the major forest habitat type on northerly aspects. Big sagebrush/rough fescue is the major shrubland habitat type.

Geology

This map unit is underlain by moderately and weakly weathered granite, granite-diorite, and diorites. These types of bedrock produce loamy material when weathered. Weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation.

Characteristics of the Soils

Soils have medium-textured and moderately coarse-textured surface layers ranging from 20-inches to more than 60-inches deep over bedrock. Subsoils contain 15 to 30 percent subrounded rock fragments. Boulders are scattered upon the surface. Soil properties vary with vegetation. Soils formed under forest have light-colored surface layers. Soils formed under shrubland have dark-colored surface layers.

Map Unit Composition

Typic Cryoboralfs, fine-loamy, mixed are under forest with light-colored surface layers and subsoil clay accumulations. Similar soils are Mollic Cryoboralfs, fine-loamy, mixed and Typic Cryochrepts, coarse-loamy, mixed. They have thin dark-colored surface layers or do not have subsoil clay accumulations. These soils occupy 50 percent of the unit.

Argic Cryoborolls, fine-loamy, mixed are under shrubland and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, coarse-loamy, mixed. They do not have subsoil clay accumulations. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, mixed. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower forage productivity. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Typic Cryoboralfs, fine-loamy, mixed have brown gravelly sandy loam upper surface layers 7-inches thick. The lower surface layer is brown gravelly sandy

loam 16-inches thick. The subsoil is dark yellowish-brown gravelly and very gravelly sandy clay loam and sandy loam to depths of 60 inches or more.

Argic Cryoborolls, fine-loamy, mixed have very dark grayish-brown gravelly sandy loam surface layers 10-inches thick. The upper part of the subsoil is brown and dark yellowish-brown gravelly sandy clay loam 23-inches thick. The lower part of the subsoil is yellowish-brown very gravelly sandy loam overlying granitic bedrock at 45 inches.

Management

Timber

Potential annual production in forested areas is 40 to 60 cubic feet per acre. The productivity of this map unit is reduced by shrubland. The terrain is well suited to tractor operation, but boulders limit operation in parts of the unit. Grass competition limits forest regeneration.

Range

The forest understory produces 100 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. Forage production in shrubland is 600 pounds per acre in an average year. Steep slopes on parts of the unit can cause livestock distribution problems.

Roads

Material exposed by road construction tends to ravel on steep cutbanks. Tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion. Road cut and fill slopes are subject to erosion hazard until vegetative cover is established. Soil eroded from unvegetated cut and fill slopes can reach drainage channels and become sediment.

380—Typic Eutroboralfs-Typic Argiborolls complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 5,200 to 7,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary and basaltic rocks.

Landform

Dominant slopes are on southerly aspects and have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are pinegrass, Idaho fescue, bluebunch wheatgrass, kinnikinnick, and elk sedge.

Habitat Types

Douglas-fir/pinegrass, bluebunch wheatgrass phase; Douglas-fir/elk sedge; and Douglas-fir/Idaho fescue are the major habitat types. These habitat types occupy 90 percent of the unit. Included in this unit are 10 percent dissimilar habitat types. Douglas-fir/blue huckleberry and Douglas-fir/twinflower are on included northerly aspects and have higher timber productivity.

Geology

This map unit is underlain by argillites, siltites, and quartzites, with dikes and sills of basaltic rocks. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine, ranging from 20-inches to more than 60-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments. Substrata are calcareous. Soil properties are not obviously associated with surface features. Soils with light-colored and with dark-colored surface layers are both present.

Map Unit Composition

Typic Eutroboralfs, loamy-skeletal, mixed have light-colored surface layers and subsoil clay accumulations 4 to 24 inches below the surface. Similar soils are Mollic Eutroboralfs, loamy-skeletal, mixed and Typic Paleboralfs, loamy-skeletal, mixed. They have thin dark-colored surface layers or subsoil clay accumulations 24 to 36 inches below the surface. These soils occupy 50 percent of the unit.

Typic Argiborolls, loamy-skeletal, mixed have dark-colored surface layers and occupy 35 percent of the

unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Argiborolls, loamy-skeletal, mixed and Typic Eutroboralfs, clayey-skeletal, mixed. Lithic Argiborolls, loamy-skeletal, mixed are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Typic Eutroboralfs, clayey-skeletal, mixed are present throughout the map unit. They have 35 to 50 percent clay in the subsoil and are subject to the hazard of landslides. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Typic Eutroboralfs, loamy-skeletal, mixed have dark grayish-brown very gravelly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very gravelly clay loam 16-inches thick. The lower part of the subsoil is calcareous brown extremely gravelly loam overlying fractured argillite at 55 inches.

Typic Argiborolls, loamy-skeletal, mixed have very dark grayish-brown gravelly loam surface layers 11-inches thick. The upper part of the subsoil is dark yellowish-brown very gravelly clay loam 21-inches thick. The lower part of the subsoil is calcareous dark yellowish-brown extremely gravelly loam overlying fractured bedrock at 45 inches.

Management

Timber

Potential annual production is 20 to 40 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Grass competition and moisture stress limit forest regeneration.

Range

The forest understory produces 275 pounds of forage per acre under a forest canopy and 450 pounds per acre when the forest canopy is removed. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill slopes generally are dry for most of the summer months. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred winter range for elk.

381—Typic Cryoboralfs, mountain slopes, steep

This map unit is on mountain slopes. Elevation ranges from 4,800 to 6,500 feet. Average annual precipitation is 20 to 30 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary and basaltic rocks.

Landform

Dominant slopes are on northerly aspects and have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms. Some delineations have small landslides with hummocky surfaces and slip scars.

Vegetation

Vegetation consists of a mixed forest of Douglas-fir and lodgepole pine. Dominant understory species are blue huckleberry, twinflower, and snowberry.

Habitat Types

Douglas-fir/twinflower and Douglas-fir/blue huckleberry are the major habitat types. Subalpine fir/twinflower is a similar habitat type. These habitat types occupy 85 percent of the unit. Included in this unit are 15 percent dissimilar habitat types. Douglas-fir/pinegrass and Douglas-fir/Idaho fescue are on included southerly aspects and have lower timber productivity.

Geology

This map unit is underlain by argillites, siltites, and quartzites, with dikes and sills of basaltic rocks. These types of bedrock produce loamy material when weathered. Landslides are associated with basaltic dikes and sills.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. They

range from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have subsoil clay accumulations 10 to 24 inches below the surface. Similar soils are Typic Paleboralfs, clayey-skeletal, mixed. They have subsoil clay accumulations 24 to 36 inches below the surface. These soils occupy 80 percent of the unit.

Dissimilar soils and rock outcrop make up 20 percent of this map unit. Dissimilar soils are Lithic Cryoboralfs, loamy-skeletal, mixed. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Rock outcrop is on upper slopes.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown cobbly loam surface layers 9-inches thick. The upper part of the subsoil is brown very cobbly loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown extremely cobbly loam overlying fractured bedrock at 50 inches.

Management

Timber

Potential annual production is 40 to 60 cubic feet per acre. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Road construction can increase the frequency of landslides. Slope stability should be evaluated before locating roads. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred winter range for elk.

390—Typic Haploborolls-Typic Eutroboralfs complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 5,000 to 7,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is a mosaic of upper, mixed forest and mountain shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. Mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation on southerly aspects consists of an open-grown Douglas-fir forest. Dominant understory species are bluebunch wheatgrass, Idaho fescue, and common juniper. Vegetation on northerly aspects consists of dense lodgepole-pine forest. Dominant understory species are snowberry and pinegrass. Vegetation on ridges is shrubland dominated by big sagebrush, rough fescue, Idaho fescue, and bluebunch wheatgrass. The unit is 50 percent Douglas-fir forest, 25 percent lodgepole-pine forest, and 25 percent shrubland.

Habitat Types

Douglas-fir/snowberry, bluebunch wheatgrass phase, and Douglas-fir/Idaho fescue are the major habitat types on southerly aspects. Douglas-fir/pinegrass and Douglas-fir/snowberry are the major habitat types on northerly aspects. Big sagebrush/rough fescue is the major habitat type on ridgetops.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 50 to 80 percent

angular rock fragments and are calcareous. Soil properties vary with vegetation and aspect. Soils formed on ridges and southerly aspects have dark-colored surface layers and do not have subsoil clay accumulations. Soils formed on northerly aspects under dense forest have light-colored surface layers and subsoil clay accumulations.

Map Unit Composition

Typic Haploborolls, loamy-skeletal, mixed are on ridges and southerly aspects. They have thick dark-colored surface layers. Similar soils are Typic Ustochrepts, loamy-skeletal, mixed, frigid. They have thin dark-colored surface layers. These soils occupy 65 percent of the unit.

Typic Eutroboralfs, loamy-skeletal, mixed are on northerly aspects and occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Haploborolls, loamy-skeletal, mixed. These soils are on upper slopes on southerly aspects and on ridges. They are 4- to 20-inches deep over bedrock and have lower forage productivity.

Representative Profile of the Soils

Typic Haploborolls, loamy-skeletal, mixed have calcareous very dark-gray gravelly loam surface layers 11-inches thick. The subsoil is calcareous very dark grayish-brown very cobbly loam overlying argillite at 27 inches.

Typic Eutroboralfs, loamy-skeletal, mixed have dark grayish-brown very gravelly loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very gravelly clay loam 16-inches thick. The lower part of the subsoil is calcareous brown extremely gravelly loam overlying argillite at 55 inches.

Management

Timber

Potential annual production is 10 to 20 cubic feet per acre on southerly aspects and 30 to 40 cubic feet per acre on northerly aspects. The productivity of this map unit is reduced by shrubland. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Moisture stress, on southerly aspects, and grass competition limit forest regeneration.

Range

The forest understory on southerly aspects produces 500 pounds of forage per acre under a forest canopy and 775 pounds per acre when the forest canopy is removed. The forest understory on northerly aspects produces 100 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. Forage production in shrubland is 600 pounds per acre in an average year. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred winter range for elk.

391—Argic Cryoborolls-Mollic Cryoboralfs complex, mountain ridges, dry

This map unit is on mountain ridges. Elevation ranges from 5,000 to 6,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is a mosaic of upper, mixed forest and mountain shrubland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad, undissected ridgetops with convex side slopes.

Vegetation

Shrubland occupies 65 percent of the unit. Dominant species are big sagebrush, rough fescue, Idaho fescue, and bluebunch wheatgrass. Upper, mixed forest occupies 35 percent of the unit. Vegetation consists of a lodgepole pine or Douglas-fir forest. Dominant understory species are Idaho fescue, bluebunch wheatgrass, pinegrass, and snowberry.

Habitat Types

Big sagebrush/rough fescue is the major habitat type in shrubland. Douglas-fir/Idaho fescue is the major habitat type in Douglas-fir stands. Douglas-fir/pinegrass is the major habitat type in lodgepole-pine stands.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments. The lower part of the subsoils are calcareous. Soil properties vary with vegetation. Soils formed under shrubland have thick dark-colored surface layers. Soils formed under forest have thin dark-colored surface layers.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed are under shrubland and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 55 percent of the unit.

Mollic Cryoboralfs, loamy-skeletal, mixed are under forest and have subsoil clay accumulations. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of the map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, mixed. These soils are in shrublands. They are 4- to 20-inches deep over bedrock and have lower forage productivity.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very cobbly loam 16-inches thick. The lower part of the subsoil is calcareous yellowish-brown extremely cobbly loam overlying fractured bedrock at 30 inches.

Mollic Cryoboralfs, loamy-skeletal, mixed have dark-brown loam upper surface layers 8-inches thick. The lower surface layer is pale-brown cobbly loam 4-

inches thick. The upper part of the subsoil is brown very cobbly loam 20-inches thick. The lower part of the subsoil is calcareous pale-brown extremely cobbly loam overlying bedrock at 35 inches.

Management

Timber

Potential annual production in forested areas is 20 to 40 cubic feet per acre. The productivity of this map unit is reduced by shrubland. The terrain is well suited to tractor operation. Grass competition limits forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 300 pounds of forage per acre under a forest canopy and 425 pounds per acre when the forest canopy is removed. Forage production in shrubland is 600 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

392—Typic Ustochrepts-Typic Cryochrepts complex, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 5,000 to 7,200 feet. Average annual precipitation is 20 to 25 inches. Vegetation is lower subalpine forest and upper, mixed forest. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 40 to 60 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms.

Vegetation

Vegetation on southerly aspects consists of an open-grown mixed Douglas-fir and lodgepole-pine

forest. Dominant understory species are Idaho fescue, elk sedge, and bluebunch wheatgrass. Vegetation on northerly aspects consists of a dense lodgepole-pine forest. Dominant understory species are beargrass, blue huckleberry, and grouse whortleberry.

Habitat Types

Douglas-fir/Idaho fescue, Douglas-fir/elk sedge, and subalpine fir/elk sedge are the major habitat types on southerly aspects. These habitat types occupy 50 percent of the unit. Subalpine fir/beargrass is the major habitat type on northerly aspects. It occupies 50 percent of the unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers, ranging from 20- to 40-inches deep over bedrock. Subsoils contain 50 to 80 percent angular rock fragments. Soil properties vary with aspect. Soils on southerly aspects are warm and dry. Soils on northerly aspects are cool and moist.

Map Unit Composition

Typic Ustochrepts, loamy-skeletal, mixed, frigid are on southerly aspects and occupy 50 percent of the unit.

Typic Cryochrepts, loamy-skeletal, mixed are on northerly aspects and occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 15 percent of this map unit. Dissimilar soils are Lithic Ustochrepts, loamy-skeletal, mixed and Typic Cryoboralfs, loamy-skeletal, mixed. Lithic Ustochrepts, loamy-skeletal, mixed are on upper slopes with southerly aspects. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Typic Cryoboralfs, loamy-skeletal, mixed are on slopes with northerly aspects. They have subsoil clay accumulations and higher timber productivity.

Representative Profile of the Soils

Typic Ustochrepts, loamy-skeletal, mixed, frigid have dark-brown very channery loam surface layers 8-inches thick. The upper part of the subsoil is yellowish-brown very channery loam 18-inches thick.

The lower part of the subsoil is olive-brown extremely channery loam overlying bedrock at 35 inches.

Typic Cryochrepts, loamy-skeletal, mixed have dark-brown very channery loam surface layers 4-inches thick. The upper part of the subsoil is yellowish-brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying bedrock at 40 inches.

Management

Timber

Potential annual production is 30 to 70 cubic feet per acre on northerly aspects and 10 to 20 cubic feet per acre on southerly aspects. Slope steepness limits tractor operation. Cable logging is safer and disturbs the soil less. Moisture stress and, on southerly aspects, grass competition limit forest regeneration.

Range

The forest understory on southerly aspects produces 300 pounds of forage per acre under a forest canopy and 425 pounds per acre when the forest canopy is removed. The forest understory on northerly aspects produces little forage and is poorly suited to livestock grazing. Steep slopes can cause livestock distribution problems.

Roads

Roads should perform well under standard location, construction, and maintenance practices. Cut and fill material is extremely stony and difficult to revegetate because of low water-holding capacity and low soil fertility. Adapted species should be used for revegetation.

Watershed

No special watershed protection measures are required for management practices commonly applied to this unit.

Wildlife

Some delineations are preferred winter range for elk.

470—Typic Cryoboralfs-Argic Cryoborolls complex, mountain ridges

This map unit is on mountain slopes and ridges. Elevation ranges from 5,500 to 7,000 feet. Average annual precipitation is 20 to 25 inches. Vegetation is a mosaic of upper, mixed forest and mountain

grassland. Soils formed in material derived from basaltic rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. These mountain slopes and ridges are undissected convex ridges.

Vegetation

Upper, mixed forest occupies 50 percent of the unit. Vegetation consists of a Douglas-fir or lodgepole-pine forest. Dominant understory species are pinegrass, snowberry, and heartleaf arnica. Mountain grassland occupies 50 percent of the unit. Dominant vegetation consists of rough fescue, Idaho fescue, and timber oatgrass.

Habitat Types

Douglas-fir/pinegrass is the major forest habitat type. Rough fescue/Idaho fescue is the major grassland habitat type.

Geology

This map unit is underlain by basalts, tuffs, andesites, and breccias. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. They are 20- to 40-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments. Soil properties vary with vegetation. Soils formed under forests have light-colored or thin dark-colored surface layers. Soils formed under grassland have thick dark-colored surface layers.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed are under forests and have light-colored surface layers. Similar soils are Mollic Cryoboralfs, loamy-skeletal, mixed. They have thin dark-colored surface layers. These soils occupy 45 percent of the unit.

Argic Cryoborolls, loamy-skeletal, mixed are under grasslands and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 40 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils and rock outcrop make up 15 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, mixed and Lithic

Cryoboralfs, loamy-skeletal, mixed. Lithic Cryoborolls, loamy-skeletal, mixed are under grassland. Lithic Cryoboralfs, loamy-skeletal, mixed are under forests. They are 4- to 20-inches deep over bedrock and have lower forage and timber productivity. Rock outcrop is on ridges.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown stony loam surface layers 9-inches thick. The upper part of the subsoil is brown very stony loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown extremely stony loam overlying fractured basalt at 26 inches.

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very stony loam 16-inches thick. The lower part of the subsoil is yellowish-brown very stony loam overlying fractured basalt at 40 inches.

Management

Timber

Potential annual production in forested areas is 30 to 60 cubic feet per acre. The productivity of this map unit is reduced by mountain grassland. The terrain is well suited to tractor operation. Grass competition limits forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 75 pounds of forage per acre under a forest canopy and 225 pounds per acre when the forest canopy is removed. In mountain grassland, forage production is 1,100 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

480—Typic Cryoboralfs, mountain slopes

This map unit is on mountain slopes. Elevation ranges from 5,000 to 6,700 feet. Average annual precipitation is 20 to 25 inches. Vegetation is upper, mixed forest. Soils formed in material derived from metasedimentary and basaltic rocks.

Landform

Dominant slopes have gradients of 25 to 50 percent. These mountain slopes have side slopes, ranging from straight to convex, and narrow ridgetops. The drainage pattern is dendritic with moderately spaced, deeply incised first- and second-order drainageways that have V-shaped bottoms. Some delineations have landslides with hummocky surfaces and slip scars.

Vegetation

Vegetation consists of a lodgepole-pine forest with some Douglas-fir, spruce, and subalpine fir. Dominant understory species are beargrass, elk sedge, and blue huckleberry.

Habitat Types

Subalpine fir/beargrass and subalpine fir/blue huckleberry are the major habitat types. These habitat types occupy 100 percent of the unit.

Geology

This map unit is underlain by argillites, siltites, and quartzites, with dikes and sills of andesites. These types of bedrock produce loamy material when weathered. Landslides are associated with andesite dikes and sills.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. They range from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 40 to 60 percent angular rock fragments.

Map Unit Composition

Typic Cryoboralfs, loamy-skeletal, mixed have subsoil clay accumulations 4 to 24 inches below the surface. Similar soils are Typic Paleboralfs, clayey-skeletal, mixed. They have subsoil clay accumulations 24 to 36 inches below the surface. These soils occupy 90 percent of the unit.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryoboralfs, loamy-skeletal, mixed. These soils are on upper slopes. They are 4- to 20-inches deep over bedrock.

Representative Profile of the Soils

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown stony loam surface layers 9-inches thick. The upper part of the subsoil is brown very stony clay loam 7-inches thick. The lower part of the

subsoil is dark yellowish-brown extremely stony clay loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 70 cubic feet per acre. Slope steepness limits tractor operation on parts of the unit. Combinations of tractor and cable logging should be considered. Cable logging is safer and disturbs the soil less on steep slopes. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

Road construction can increase the frequency of landslides. Slope stability should be evaluated before locating roads. Material exposed by road construction tends to slough on steep cutbanks.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

490—Argic Cryoborolls-Mollic Cryoboralfs complex, mountain ridges

This map unit is on mountain ridges. Elevation ranges from 6,000 to 7,000 feet. Average annual precipitation is 20 to 30 inches. Vegetation is a mosaic of upper, mixed forest and mountain grassland. Soils formed in material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 10 to 40 percent. Mountain ridges are very broad and undissected with convex side slopes.

Vegetation

Mountain grassland occupies 65 percent of the unit. Dominant vegetation consists of rough fescue, Idaho fescue, bluebunch wheatgrass, and timber oatgrass. Upper, mixed forest occupies 35 percent of the unit. Vegetation consists of a Douglas-fir or lodgepole-pine forest. Dominant understory species

are pinegrass, snowberry, heartleaf arnica, and elk sedge.

Habitat Types

Rough fescue/Idaho fescue is the major grassland habitat type. Douglas-fir/pinegrass is the major forest habitat type.

Geology

This map unit is underlain by argillites, siltites, and quartzites. Sandstones and shales are in areas. These types of bedrock produce loamy material when weathered.

Characteristics of the Soils

Soils in this map unit have surface layers ranging in texture from medium to moderately fine. They are 20- to 40-inches deep over bedrock. Subsoils contain 35 to 50 percent angular rock fragments. Soil properties vary with vegetation. Soils formed under grassland have thick dark-colored surface layers. Soils formed under forest have thin dark-colored surface layers.

Map Unit Composition

Argic Cryoborolls, loamy-skeletal, mixed are under grassland and have subsoil clay accumulations. Similar soils are Typic Cryoborolls, loamy-skeletal, mixed. They do not have subsoil clay accumulations. These soils occupy 55 percent of the unit.

Mollic Cryoboralfs, loamy-skeletal, mixed are under forest. They have thin dark-colored surface layers and subsoil clay accumulations. Similar soils are Typic Cryoboralfs, loamy-skeletal, mixed and Typic Cryochrepts, loamy-skeletal, mixed. They have light-colored surface layers or do not have subsoil clay accumulations. These soils occupy 35 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryoborolls, loamy-skeletal, mixed. These soils are under grassland. They are 4- to 20-inches deep over bedrock and have lower forage productivity.

Representative Profile of the Soils

Argic Cryoborolls, loamy-skeletal, mixed have dark-brown channery loam surface layers 10-inches thick. The upper part of the subsoil is dark-brown and dark yellowish-brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown very channery loam overlying argillite at 40 inches.

Mollic Cryoboralfs, loamy-skeletal, mixed have dark-brown channery loam upper surface layers 8-inches thick. The lower surface layer is pale-brown channery loam 4-inches thick. The upper part of the subsoil is brown very channery loam 20-inches thick. The lower part of the subsoil is pale-brown extremely channery loam overlying argillite at 40 inches.

Management

Timber

Potential annual production in forested areas is 30 to 60 cubic feet per acre. The productivity of this map unit is reduced by grassland. The terrain is well suited to tractor operation. Grass competition limits forest regeneration.

Range

This unit is well suited to livestock grazing. The forest understory produces 100 pounds of forage per acre under a forest canopy and 300 pounds per acre when the forest canopy is removed. In mountain grassland, forage production is 1,100 pounds per acre in an average year.

Roads

Roads should perform well under standard location, construction, and maintenance practices.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

790—Typic Cryochrepts-Typic Cryoboralfs complex, glaciated mountain slopes

This map unit is on glaciated mountain slopes. Elevation ranges from 4,800 to 7,500 feet. Average annual precipitation is 20 to 35 inches. Vegetation is upper, mixed forest. Soils formed in friable glacial till and material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 25 to 40 percent. Glaciated mountain slopes are in glacial valleys and lower elevation cirque basins and include lower slopes on trough walls and valley bottoms. Side slopes are straight. The drainage pattern is dendritic with widely spaced, moderately incised first- and second-order drainageways that have broad concave

bottoms. The drainage pattern on side slopes is parallel with closely spaced, weakly incised low-order drainageways that have V-shaped bottoms. There are small lakes in areas.

Vegetation

Vegetation consists of a mixed forest of lodgepole pine and Douglas-fir. Dominant understory species are beargrass, elk sedge, blue huckleberry, grouse whortleberry, pinegrass, and menziesia.

Habitat Types

Subalpine fir/beargrass, blue huckleberry phase, is the major habitat type on southerly aspects. Subalpine fir/menziesia is the major habitat type on northerly aspects. Subalpine fir/queencup beadlily is a similar habitat type. These habitat types occupy 90 percent of the unit. Tufted hairgrass/carex, a dissimilar habitat type, is in small wet meadows. It occupies 10 percent of the map unit.

Geology

Ridges and upper slopes are underlain by argillites, siltites, and quartzites. Lower slopes and draw bottoms are underlain by friable loamy glacial till.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick and range from 40-inches to more than 60-inches deep over bedrock. Subsoils contain 40 to 60 percent subrounded rock fragments. Soil properties vary with topographic position. Soils on upper slopes and ridges do not have subsoil clay accumulations and have angular rock fragments in the subsoil. Soils on lower slopes and in draw bottoms have subsoil clay accumulations and rounded rock fragments in the subsoil.

Map Unit Composition

Typic Cryochrepts, loamy-skeletal, mixed are on upper slopes and ridges and have loess surface layers 2- to 7-inches thick. Similar soils are Andic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 7- to 10-inches thick. These soils occupy 55 percent of the unit.

Typic Cryoboralfs, loamy-skeletal, mixed are on lower slopes and in draw bottoms. These soils occupy 25 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 20 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed; Typic Cryaquepts, loamy-skeletal, mixed; and Typic Cryochrepts, sandy-skeletal, mixed. Lithic Cryochrepts, loamy-skeletal, mixed are on upper slopes and ridges. They are 4- to 20-inches deep over bedrock and have lower timber productivity. Typic Cryaquepts, loamy-skeletal, mixed are in wet meadows and near lakes. They are wet and have low strength. Typic Cryochrepts, sandy-skeletal, mixed are near streams. They have sandy substrata that are erodible.

Representative Profile of the Soils

Typic Cryochrepts, loamy-skeletal, mixed have yellowish-brown loam surface layers 6-inches thick. The upper part of the subsoil is brown very channery loam 16-inches thick. The lower part of the subsoil is yellowish-brown extremely channery loam overlying fractured argillite at 45 inches.

Typic Cryoboralfs, loamy-skeletal, mixed have yellowish-brown loam surface layers 6-inches thick. The upper part of the subsoil is brown very stony loam 7-inches thick. The lower part of the subsoil is dark yellowish-brown very stony loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 40 to 80 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. Brush competition on northerly aspects limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

On lower slopes and in draw bottoms, tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a rough surface.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Wildlife

Some delineations are preferred summer range for deer and elk. Delineations of this unit near Lincoln are preferred habitat for grizzly bear in the spring months.

791—Andic Cryochrepts-Rock outcrop complex, cirque basins

This map unit is in cirque basins. Elevation ranges from 5,800 to 8,000 feet. Average annual precipitation is 25 to 35 inches. Vegetation is upper subalpine forest. Soils formed in friable glacial till and material derived from metasedimentary rocks.

Landform

Dominant slopes have gradients of 25 to 40 percent. Cirque basins are rolling to hilly. The drainage pattern is subparallel with widely spaced, weakly incised first- and second-order drainageways that have broad concave bottoms. There are small lakes in areas.

Vegetation

Vegetation consists of a mixed forest of subalpine fir, lodgepole pine, spruce, and whitebark pine. Dominant understory species are grouse whortleberry, elk sedge, menziesia, and smooth woodrush.

Habitat Type

Subalpine fir/smooth woodrush and subalpine fir-whitebark pine/grouse whortleberry are the major habitat types. These habitat types occupy 90 percent of the unit. Tufted hairgrass/sedge, a dissimilar habitat type, is near lakes. It occupies 10 percent of the map unit.

Geology

Ridges and upper slopes are underlain by argillites, siltites, and quartzites. Lower slopes and draw bottoms are underlain by friable, loamy glacial till.

Characteristics of the Soils

Soils in this map unit have medium-textured surface layers formed in loess that has been influenced by volcanic ash. These surface layers are 2- to 10-inches thick. Subsoils contain 35 to 80 percent angular to rounded rock fragments.

Map Unit Composition

Andic Cryochrepts, loamy-skeletal, mixed have loess surface layers 7- to 10-inches thick. Similar soils are Typic Cryochrepts, loamy-skeletal, mixed. They have loess surface layers 2- to 7-inches thick. These soils occupy 75 percent of the unit.

Rock outcrop is on upper slopes near delineation boundaries. Rubble land is similar. They occupy 15 percent of the unit. The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up 10 percent of this map unit. Dissimilar soils are Lithic Cryochrepts, loamy-skeletal, mixed. These soils are on upper slopes and ridges. They are 4- to 20-inches deep over bedrock and have lower timber productivity.

Representative Profile of the Soils

Andic Cryochrepts, loamy-skeletal, mixed have dark yellowish-brown loam upper surface layers 8-inches thick. The lower surface layer is brown very stony loam 8-inches thick. The subsoil is yellowish-brown very stony loam to depths of 60 inches or more.

Management

Timber

Potential annual production is 20 to 50 cubic feet per acre. The terrain is well suited to tractor operation. Tractor operation can reduce soil productivity by compacting soil surface layers; operation should be carefully managed to minimize the area affected or confined to periods when the soil is dry, frozen, or snow covered. The harsh subalpine climate limits forest regeneration.

Range

The forest understory produces little forage and is poorly suited to livestock grazing.

Roads

On lower slopes and in draw bottoms, tread erosion on unsurfaced roads tends to remove fine material. The remaining gravel and cobbles form a

rough surface. The harsh subalpine climate limits revegetation of road cut and fill slopes. Adapted species should be used for revegetation.

Watershed

Steep tractor-skid trails, cable-yarding corridors, and firebreaks are subject to erosion hazard. Water bars and vegetative cover can help to control erosion.

Use and Management of the Soils

Following is a description of the use and management of the soils in the survey area. The properties that influence the productivity and suitability of the land for a variety of resource uses are described. The criteria utilized in developing interpretations for the detailed soil map units in the survey area also are described.

Timber

Approximately 252,000 acres within the survey area are managed for timber production. Douglas fir, lodgepole pine, subalpine fir, Engelmann spruce, and ponderosa pine are the principal commercial species. About 16 million board feet of timber are harvested annually from the survey area. Forest soils have permeable surface layers with low bulk density. Logging, slash piling, and site preparation with tractors can mix, compact, and rearrange soil surface layers, thereby reducing productivity and causing erosion (Gracean, 1980).

Timber Productivity and Management

Table 4 is used in planning the use of map units for production of wood products. The table is divided into two sections, "Management Limitations" and "Productivity."

Tractor Operation gives limitation to the operation of rubber-tired and tracked vehicles to skid logs, pile brush, and coperform similar forest management practices. Properties considered limitations to tractor operations in the survey area are soil damage, slope and complex slopes, boulders, and wet areas.

A soil damage limitation is given to map units with slopes suitable for tractor operation but on which the effects of tractor operation under certain conditions can lower soil productivity. These map units have either vegetation that is lower subalpine forest, upper subalpine forest, or moist habitat types within upper, mixed forest or soils that have medium-textured or moderately fine-textured surface layers with 0 to 35 percent rock fragments. These soils are rarely dry enough to support tractors without compaction of surface layers. Restricting tractor operations to times when the soil is snow covered or frozen, or limiting

the area affected by tractor operation, can overcome this limitation. Soil productivity is highly dependent upon soil surface layers, which can be displaced or mixed by tractor operation. Limiting the area affected by tractor operation can overcome this limitation.

A slope limitation is given to map units with dominant slopes greater than 40 percent. Tractor operation on these slopes can be unsafe and cause excessive mixing and displacement of soil surface layers. Cable logging can overcome this limitation.

A complex slopes limitation is given to map units containing slopes that limit tractor operation mixed with those that do not. Map units with a combination of dominant slopes greater than 40 percent and less than 40 percent are given this limitation. Combinations of tractor and cable logging can overcome this limitation.

A boulders limitation is given to map units which contain large granitic boulders. The cost of practices requiring tractor operation is increased by this limitation.

A wet areas limitation is given to map units that contain soils with water tables and low strength. Operating tractors on these soils can rut or puddle soil surface layers and reduce soil productivity. Cable logging from adjacent well-drained soils can overcome this limitation.

Regeneration gives limitations to forest regeneration on cutover or burned soils. Properties considered limitations to forest regeneration in this survey area are frost pockets, moisture stress, stony surface, harsh climate, and grass or brush competition.

Frost pockets are low-lying areas where cold air drainages accumulate on summer nights. Frequent frosts during the growing season limit species adaptation and regeneration. This limitation is given to map units on moraines, flood plains, and low terraces.

A moisture stress limitation is given to map units with soils that are dry during the late summer months. Map units with this limitation have Douglas-fir or ponderosa-pine habitat types with bunchgrass understory or are underlain by permeable limestone bedrock. Map units on southerly aspects with

dominant slopes greater than 40 percent are also limited by solar insolation. Soil surface temperatures in unshaded areas can be lethal to seedlings during the summer months. Silvicultural prescriptions that leave live or dead shade on the site can help overcome these limitations.

A stony surface limitation is given to soils with extremely cobbly or stony surface layers. Natural regeneration and planting are limited by surface stones or cobbles. Long, narrow cutting units that are repeatedly seeded naturally can help overcome this limitation.

A harsh climate limitation is given to map units that are in upper subalpine forest. Short growing seasons, persistent snowbanks, and exposure to wind in open areas limit forest regeneration.

A grass competition or brush competition limitation is given to map units that have aggressive forest understory species that invade openings in the forest canopy. Map units with forest understory vegetation dominated by pinegrass, bluebunch wheatgrass, Idaho fescue, rough fescue, or menziesia are given this limitation.

Erosion Hazard gives the erosion hazard for skid trails, firelines, and similar types of soil disturbance resulting from logging and site preparation practices. The hazards are for soil surface layers and are relative to other map units in the survey area. The rating can be used to determine the need for erosion-control practices and to compare hazards on alternative areas. Map units rated moderate or severe are subject to a hazard of erosion unless water-barred and seeded. Erosion rates are greatest on soils rated severe.

Map units rated *slight* have loamy soil surface layers containing 35 to 85 percent angular rock fragments.

Map units rated *moderate* have loamy soil surface layers containing 15 to 35 percent angular rock fragments, 15 to 60 percent rounded rock fragments, or surface layers formed in loess that has been influenced by volcanic ash.

Map units rated *severe* have sandy surface layers or loamy surface layers containing 0 to 15 percent rock fragments that are not formed in loess that has been influenced by volcanic ash.

Non-Forest is the percentage of map unit delineation area usually occupied by rock outcrop, shrubs, or meadow plant communities. Map unit timber productivity is reduced in proportion to non-forest components.

Forest Vegetative Group is a group of habitat types with broadly similar properties. Vegetative groups have relatively narrow ranges of timber productivity

and similar limitations to forest regeneration. Vegetative groups are described in "Vegetation" in "General Nature of the Survey Area."

Potential Annual Production is the range of potential annual production attainable in a fully stocked natural stand, expressed in cubic feet per acre per year. The yields are based on habitat types (Pfister, 1977) and adjusted to account for the effects of map unit soil and site properties.

Range

The survey area provides summer range, about 41,000 animal unit months of grazing, for livestock from adjoining farms and ranches. Most of the livestock are cattle, but there are a few bands of sheep. The grazing season generally begins in mid-June and ends in mid-September, but this schedule varies with elevation. Most ranges contain dry grassland or mountain grassland and shrubland. Open-grown forests with bunchgrass understories also provide range. Densely forested areas can be used as transitory range following timber harvest or forest fires.

Range Productivity and Management

Table 5 gives limitations to livestock grazing and forage productivity. Range managers can use this information to determine suitability for livestock grazing. Onsite investigation is required for planning use of individual livestock ranges because of the need to determine the composition and vigor of the existing vegetation.

Livestock Grazing Limitations gives the limitations to livestock grazing. Steep slopes, complex slopes, low productivity, and short season are considered to be limitations in the survey area.

Steep slopes limit livestock access to forage. Map units with dominant slopes greater than 30 percent are given this limitation.

A complex slopes limitation is given to map units with combinations of dominant slopes that are less than and greater than 30 percent. Steep slopes limit livestock access to forage on part of these units.

A low productivity limitation was given to forested map units in which forest understory forage productivity is 100 pounds per acre or less after canopy removal. A short season limitation was given to map units at high elevation; these units are mountain grasslands and meadows at elevations of 6,000 to 9,500 feet. Range forage is ready for grazing later than on lower elevation ranges.

Estimated Forage Productivity gives forage production in an average year under forest canopy;

after canopy removal on forested sites; and in grasslands, shrublands, and meadows. Forage productivity is the herbage production palatable to livestock. Productivity of forest understory vegetation is based on understory vegetative composition and local estimates of individual species production and palatability to livestock (Mueggler, 1981).

Roads

Road construction is the primary engineering use of soils in forest management. About 3 to 4 miles of road are required to place a square mile of timber under management. Several standards of roads are constructed in the survey area. Arterial or collector roads generally are either 12 feet wide with ditch or 14 feet wide without ditch. Generally, rolling grades, water bars, or outsloping drain logging roads. Roads are often closed when not needed for hauling logs. Roads generally are not surfaced.

Data presented in this section is used for choosing among alternative road locations and designs. Land use planners can use this data to evaluate the feasibility of allocating land to uses requiring road access. Transportation planners can use this data to evaluate alternative routes. Design engineers can use it to plan detailed onsite investigations of soil and geology. This information does not eliminate the need for onsite investigations, testing, and analysis.

Engineering Properties and Classification

For each map unit in the survey area, Table 6 gives estimates of the engineering classification and of the range of index properties for lower soil layers. Estimates are based on field observations and laboratory test results. Laboratory tests help estimate properties that cannot be determined accurately by field observation. The ratings generally apply to soil substratum or lower subsoil material. They apply to upper subsoils when the map unit slope is less than 15 percent. Road construction on these units requires only minor excavation. The estimates can be used in planning site investigations prior to design and construction.

USDA Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined in terms of sand, silt, and clay percentages in the fraction of soil that is less than 2 millimeters in diameter. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is given according to the *Unified Soil Classification System* (ASTM, 1974). It

classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils are identified as ML, CL, OL, MH, CH, and OH. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SW-SM.

Fragments > 3 Inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage Passing Sieve Number is the percentage of the soil fraction less than 3 inches in diameter based on oven dry weight. The sieves, numbers 4, 10, and 200 (USA Standard Series), have openings of 4.76, 2.0, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and on field observations.

Liquid Limit and Plasticity Index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area and on field observations.

Road Construction and Maintenance

Table 7 shows for each map unit the kind of limitations to road construction and maintenance. This information can be used to compare construction and maintenance limitations on alternative road locations and in planning detailed onsite investigations.

Excavation gives limitations to excavation. Excavation is limited by slope, hard rock within the excavated depth, and wet soils or seeps and springs. The slope can increase the amount of excavation required for road construction. Map units with dominant slopes of 60 to 80 percent are given this limitation. Hard rock within the excavated depth increases the difficulty of excavation. Limestone and weakly weathered granitic, basaltic, and rhyolitic bedrock are considered to be hard and difficult to excavate. Map units with a rock outcrop or soil component 4 to 20 inches deep over these types of bedrock are given this limitation. Map units with dominant slopes greater than 40 percent and a soil component 20 to 40 inches deep over these types of bedrock are also given this limitation. Wet areas are concentrations of ground water that can be intercepted by excavation. Intercepted ground water can cause stability hazards and road drainage

problems. Map units containing seeps and springs or soils with water tables are given this limitation.

Cut and Fill Maintenance gives limitations to maintenance of road cutbanks. Slough and ravel limit cutbank maintenance. Cutbank slough is associated with ground water intercepted by excavation. Map units with dominant slopes greater than 15 percent are given this limitation when they contained seeps or springs or soil layers that restrict permeability. Compact glacial till, or subsoils, containing 35 to 50 percent clay is considered restrictive. Cutbank ravel is associated with friable, moderately coarse-textured or coarse-textured material containing rounded or subrounded rock fragments or laminated shale bedrock. Map units are given this limitation when dominant slopes are steeper than 15 percent and soil substrata are sand to sandy loam texture with rounded or subrounded rock fragments or the soil is underlain by laminated shale bedrock. Avalanches are associated with glacial cirque headwalls or glacial trough walls. Avalanches can damage road fills and deposit debris on road surfaces.

Native Road Surface shows limitations of fill material for use as road surface. Tread erosion, large stones, rutting, and rock fall are considered to be limitations in this survey area. Tread erosion is the removal of fine material from the road surface by sheet and rill erosion leaving a rough surface of gravel and cobble. Soils with erodible lower soil layers are given this limitation. Erosion hazards for lower soil layers are given in Table 8. Large stones cause rough road surfaces which are difficult to blade. Map units with a hard rock limitation to excavation are given this limitation. Excavation of hard rock mixes large bedrock fragments with the fill. A rutting limitation is given to map units with soil substrata containing less than 35 percent rock fragments. A rock fall limitation is given to map units with dominant slopes of 60 to 80 percent on which road cutbanks are fractured bedrock. Road cutbanks are very steep, and loose rock from the cutbanks can roll onto the road surface and cause a driving hazard. Road surfacing can overcome all limitations except rock fall.

Cut and Fill Revegetation shows limitations to establishing vegetation on road cuts and fills. A harsh climate and moisture stress are considered to be limitations in the survey area. A harsh climate limitation is given to map units with upper subalpine forest or alpine meadow vegetation. These map units are on mountain ridges at elevations of 7,200 to 9,500 feet. Short growing seasons and exposure to drying winds limit seedling establishment. A moisture stress limitation is given to map units with one of the following sets of properties. The units have hard rock

within the excavated depth, and road cuts and fills are mixtures of excavated rock and soil. They have low water-holding capacity; soil substrata are extremely channery, cobbly, or stony; or they are coarse textured. Material on road cuts and fills has low water-holding capacity and fertility, or the map unit is in a 15- to 20-inch precipitation zone. Road cuts and fills are dry during the late summer months because of low rainfall. Using adapted species can overcome all limitations. When hard rock is within excavated depth, road cut exposures of fractured rock incapable of supporting plants should be expected.

Road Sediment Hazard gives the sediment hazard for roads; the hazards are relative to other map units in the survey area. The hazard can be used to evaluate the need for erosion- and sediment-control practices and to compare hazards on alternative road locations. The erosion hazard and sediment-delivery efficiency on lower soil layers are used to rate the road sediment hazard; these ratings are given in Table 8. Subsoil erosion hazard is used for map units with dominant slopes less than 15 percent. This rating does not appear on Table 8 but was determined using the same criteria as was used for surface and lower soil layers. Map units rated *slight* have a slight road erosion hazard and a low or moderate sediment-delivery efficiency. Map units rated *moderate* have a moderate erosion hazard and a low or moderate sediment-delivery efficiency or a slight erosion hazard and high sediment-delivery efficiency. Map units rated *severe* have a moderate erosion hazard and high sediment-delivery efficiency or a severe erosion hazard.

Watershed

Water produced in the survey area is used for recreational activities, fish habitat, power generation, irrigation, and domestic water supplies. Management practices such as logging, road construction, burning, and site preparation expose soils to erosion. Eroded soil can be a source of sediment in lakes, streams, and reservoirs. Sediment can damage fish habitat, reduce reservoir capacity, and increase treatment costs for domestic water supplies. Soil and water conservation practices can help control erosion and sediment and protect uses of water.

Soil Erosion and Sediment

Table 8 gives erosion hazards for surface and lower soil layers and landform sediment-delivery efficiency. It can be used to determine which projects require onsite evaluation of soil and water conservation practices. Watershed scientists use

models to predict sediment yield from management practices.

Soil Erosion Hazards rates the relative susceptibility of exposed soil to erosion. The ratings are based on observations of erosion in the survey area and the association with combinations of soil properties. The surface layer hazard is for practices that bare the soil of vegetation and expose soil surface layers to erosion; logging skid trails, fire lines, and severely burned areas are examples of such practices. The lower layer hazard is for practices that require excavation and expose lower soil layers to erosion; road cut and fill slopes are examples of those practices.

Soil layers with an erosion hazard rated *slight* have loamy texture and 35 to 85 percent angular rock fragments. Soil layers formed in material derived from underlying rocks are associated with slight erosion hazards.

Soil layers with an erosion hazard rated *moderate* have loamy texture and have 15 to 50 percent rounded rock fragments, 15 to 35 percent angular rock fragments, or are formed in loess that has been influenced by volcanic ash.

Soil layers with an erosion hazard rated *severe* have sandy texture, or loamy or clayey texture, and less than 15 percent rock fragments.

Onsite evaluation of erosion- and sediment-control practices should be considered when hazards are moderate or severe. The difficulty of controlling erosion increases with severe erosion hazards.

Landform Sediment-Delivery Efficiency is a rating of the relative probability of eroded soil reaching a stream channel and becoming sediment. When combined with erosion hazard, this rating can be used in evaluating the sediment hazard. Overland transport of eroded soil is a complex process affected by many properties that must be evaluated onsite. This rating considers properties of landforms that affect sediment delivery. The type of landform, the steepness of the slope, and the distance between drainageways are used to make these ratings.

Map units rated *low* have either locations on mountain ridges, landslides, or glacial moraines and have no surface drainageways, or have a deranged drainage pattern, or dominant slopes of 0 to 25 percent. Most eroded soil is deposited before it reaches a drainageway channel. Less than 10 percent of the landform is close enough to a drainageway channel for eroded soil to become sediment.

Map units rated *moderate* have either dominant slopes that are 25 to 60 percent and drainageways that are moderately spaced (750 to 1,500 feet apart)

or dominant slopes that are 60 to 80 percent and drainageways that are widely spaced (1,500 to 2,500 feet apart). For eroded soil to become sediment, 10 to 40 percent of the landform must be close enough to drainageways.

Map units rated *high* have either dominant slopes that are 40 to 80 percent and drainageways that are closely spaced (100 to 750 feet apart), or locations on landforms that parallel streams. Flood plains, terraces, and some moraines are adjacent to streams. Most soil erosion is close enough to a drainageway to be a sediment hazard. For eroded soil to become sediment, 40 to 100 percent of the landform must be close enough to drainageways.

Wilderness

The Gates of the Mountains Wilderness is within the survey area. It occupies about 28,492 acres along the western flank of the Big Belt Mountain Range.

Wilderness is managed to preserve its natural character. The objective of many wilderness management practices is to minimize the effect of authorized uses on wilderness values. Various kinds of recreational uses are the most common authorized uses, but many others occur.

This soil survey can be used to plan some wilderness management practices. Trail maintenance and construction, rehabilitation of heavily used camp areas, and management of livestock grazing are examples of wilderness management practices affected by soil properties, landforms, and vegetation described in the detailed soil map units. Map unit descriptions are not site specific and do not eliminate the need for detailed onsite investigation.

The detailed soil map units are also basic ecological subdivisions of the wilderness landscape. They can be used as basic sampling units when inventorying and describing wilderness ecosystems.

Specialists in wilderness management should be consulted when using this survey to plan wilderness management.

Fire Management

Plans for wildfire control are incorporated into land management plans and fire management plans. This soil survey can be used to estimate suppression costs and to predict the effects of fire on vegetation and soils.

The map unit descriptions in the section "Soil Series and Detailed Soil Map Units" describe habitat types and their distribution within map units. Habitat

types can be used to assign map units to fire habitat type groups (Fischer, 1983). Fire habitat type groups are used to predict the responses of vegetation to fire.

Suppression costs are partially dependent on terrain and soil properties described in the detailed soil map units. The steepness of slopes, rock outcrop, and content of rock fragments in soil surface layers are some properties that affect the difficulty of fireline construction. The surface layer erosion hazards given in Table 8 can be used to plan erosion-control practices for soils exposed to erosion by fire or by fire suppression activities.

Fire management specialists should be consulted to determine which map unit properties affect specific fire management activities.

Minerals

This survey can be used to help evaluate the effects of mineral exploration on soil and vegetation and to recommend soil and water conservation practices for rehabilitating soils disturbed by mineral exploration and development. Soils, vegetation, landforms, and geology are described in the detailed soil map units. Table 7 gives limitations to excavation and revegetation of road cuts and fills. These limitations apply to many kinds of mineral exploration activities. Table 8 gives erosion hazards and landform sediment-deliver efficiency. These ratings can be used to recommend soil erosion- and sediment-control practices for mineral exploration activities.

Wildlife

The survey area contains diverse wildlife habitat and populations of many game and nongame wildlife species. Big game species include elk, moose, black bear, grizzly bear, antelope, white-tailed deer, mule deer, bighorn sheep, and mountain goat. Big game hunting is a popular recreational activity within the survey area. In 1980, an estimated 47,800 recreational visitor days were spent big game hunting in the survey area.

Wildlife management in the survey area consists of two general kinds of activities. Existing wildlife habitat values are identified, protected, and enhanced by coordinating activities such as timber harvest,

livestock grazing, road construction, and recreational uses with the use of habitat by wildlife. Habitat is also directly improved by practices such as prescribed burning to improve the quality of vegetation for wildlife use.

Soil properties, slope, elevation, aspect, and other properties of the map units in this survey directly affect the potential kind and amount of vegetation available for wildlife use. This survey can be used to help identify and inventory potential wildlife habitat. When inventorying wildlife habitat, the detailed soil map units can be used as sampling units, thereby holding relatively constant those properties affecting the potential kind and amount of vegetation. The detailed soil map units give some potential habitat values for wildlife. Actual habitat values vary with the locations of map unit delineations. Wildlife and fisheries biologists should be consulted when using this survey to evaluate habitat values of specific map unit delineations.

Recreation

Recreational uses within the survey area include hunting, fishing, camping, firewood gathering, hiking, cross-country skiing, and off-road vehicle travel. Soil properties, slope, aspect, elevation, vegetation, and other properties of map units affect suitability for various recreational uses. This survey can be used in recreational planning to identify areas suitable for a recreational use or a recreational facility. Specialists in recreational use should be consulted to determine which map unit properties affect a given recreational use. The detailed soil map units can then be used to identify suitability and limitations for that use.

Visual Quality

Visual quality is affected by many management practices. Properties of the detailed soil map units such as slope, aspect, vegetation, and soil properties affect the visual response to management practices. This survey can be used to identify limitations to maintaining visual quality. Specialists in visual management should be consulted to determine which map unit properties limit maintaining visual quality objectives.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey (NCSS) has six categories (U.S. Dep. Agric., 1975). Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. The soils of the survey area are classified according to the system. Table 9 shows the classification of soils at the suborder level. Classification is based on soil properties observed in the field or inferred from those observations and from laboratory measurements. The taxonomic 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 Inceptisol.

SUBORDER. Each order is divided into suborders primarily based on 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 Ochrept "ochros," meaning pale, plus "ept," from Inceptisol.

GREAT GROUP. Each suborder is divided into great groups based on 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 Cryochrepts ("Cryic" meaning cold, plus "Ochrept," the suborder of the Inceptisols that have a cryic temperature regime).

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 Cryochrepts.

FAMILY. Families are established within a subgroup based on physical and chemical properties that affect management. The properties are mostly those of horizons where there is much biological activity below plow depth. Among the properties considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and presence of permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the properties used as family differentia. An example is Typic Cryochrepts, loamy-skeletal, mixed.

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 substratum can differ within a series. Series were not recognized in this survey.

Several assumptions are made in classifying the soils in this survey area. This is done because criteria for classification often require laboratory data or observations not available when classification decisions are made. This is particularly true of classes dependent on temperature, moisture, and chemical data.

Soils in the survey area are in either cryic or frigid temperature regimes and both are present. The boundary between these two classes is considered the upper elevation limits of ponderosa pine. Douglas-fir/snowberry habitat type approximates the boundary between frigid and cryic regimes. Douglas-fir series habitat types with bunchgrass understory are in the frigid regime; those with shrub-dominated understories are considered cryic. Data for much of the Northern Rocky Mountains suggests this is a close, though imperfect, approximation.

Soils in the survey area are in either the udic or the ustic moisture regimes. Mountain grasslands and shrublands, open-grown Douglas-fir forests with understories dominated by bunchgrasses, and dense Douglas-fir or lodgepole pine forests with

understories dominated by snowberry, spirea, and similar shrubs were used as indicators of ustic moisture regime. All other vegetation was considered to indicate udic moisture regime. Limited soil moisture data from other survey areas indicates these are reasonable indicators of soil moisture regimes.

The identification of dystric subgroups of Cryochrepts requires laboratory data on base saturation. Upper subalpine forest vegetation and parent materials derived from rhyolitic rocks are used as indicators of dystric subgroups.

The mineralogies of most soils in the survey area are considered mixed. Carbonatic mineralogy is assumed for soils formed in material weathered from limestone.

A representative pedon for each subgroup or higher taxa used to represent soils in map units follows. Properties of taxa at higher levels than the representative pedon are briefly described.

Aquolls

Aquolls are wet soils with dark-colored surface layers. They formed on flood plains and low terraces. Aquolls are minor soils in the survey area.

Representative Pedon

0—2 inches to 0; semi-decomposed grass and grass roots.

A—0 to 10 inches; very dark grayish-brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; massive; soft, very friable, sticky, and plastic; many very fine and fine roots; slightly acid; clear smooth boundary.

Cg—10 to 60 inches; dark-gray (10YR 4/1) very cobbly sandy clay loam, light-gray (10YR 6/1) dry; common medium distinct dark-gray (N 4/0) and yellowish-brown (10YR 5/6) mottles; massive; soft, very friable, slightly sticky, and slightly plastic; common very fine roots; 40 percent cobbles; water table at 19 inches; medium acid.

Location and Setting

Lewis and Clark County, Montana, NE 1/4, Sec. 20, T. 15 N., R. 6 W., detailed soil map unit 101. The profile described is on a level flood plain. Parent material is alluvium. Elevation is 5,200 feet. Vegetation consists of a willow community with a sedge understory.

Range in Characteristics

The water table is at or near the surface from April through August. The soil is subject to the hazard of occasional flooding of short duration. Reaction is medium acid to mildly alkaline.

O horizon:

The horizon is 2- to 16-inches thick.

A horizon:

Hue is 2.5YR to 2.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is sandy loam to clay loam. Content of rock fragments ranges from 0 to 35 percent. The horizon is 10- to 20-inches thick.

Cg horizon:

Hue is 2.5YR to 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 or 2. Mottles have neutral to 7.5YR hue; value is 3 to 6 moist and 4 to 7 dry; chroma is 0 to 8 moist or dry. Texture is sand to clay. Content of rock fragments ranges from 0 to 80 percent. The horizon is texturally stratified in areas.

Boralfs

Boralfs are soils with subsoil clay accumulations and light-colored or thin dark-colored surface layers. Boralfs are usually formed in material derived from basaltic or metasedimentary rocks or glacial till derived from these rocks. A few are formed in material derived from granitic rocks or limestone. They are most common at elevations ranging from 3,500 to 7,500 feet. Average annual precipitation is 15 to 30 inches.

Cryoboralfs

Cryoboralfs are the cold Boralfs. These soils are usually at elevations ranging from 5,000 to 7,500 feet. Cold soil temperatures are expected to limit plant growth.

Mollic Cryoboralfs

Mollic Cryoboralfs are Cryoboralfs with dark-colored surface layers. They are often found under forests with understories dominated by pinegrass or bunchgrasses; they are also found under forests near a boundary with mountain grassland or shrubland. The presence of Mollic Cryoboralfs can mean that

forest and grassland boundaries have shifted and the soil developed under both kinds of vegetation. Competition from grasses often limits forest regeneration on these soils.

Mollic Cryoboralfs Clayey-Skeletal, Mixed

Representative Pedon

- O—2 inches to 0; slightly decomposed twigs and needles.
- A—0 to 9 inches; dark-brown (10YR 3/3) silty clay loam, pale-brown (10YR 6/3) dry; moderately fine granular structure; soft, very friable, sticky, and plastic; many very fine, few fine, and common medium roots; common fine continuous random interstitial pores; 10 percent pebbles; slightly acid; clear wavy boundary.
- AB—9 to 18 inches; brown (10YR 4/3) very gravelly silty clay loam, pale-brown (10YR 6/3) dry; moderate very fine granular structure; soft, very friable, sticky, and plastic; many very fine and few fine and medium roots; common fine continuous random interstitial pores; 50 percent pebbles; slightly acid; clear wavy boundary.
- Bt1—18 to 23 inches; light yellowish-brown (10YR 6/4) very gravelly silty clay loam, very pale-brown (10YR 7/3) dry; strong medium angular blocky structure; hard, friable, very sticky, and very plastic; few very fine and few fine roots; few very fine discontinuous vertical interstitial pores; common faint clay films on faces of peds; 35 percent pebbles; neutral; gradual boundary.
- Bt2—23 to 39 inches; light yellowish-brown (10YR 6/4) very gravelly silty clay loam, very pale-brown (10YR 7/3) dry; strong coarse angular blocky structure; hard, friable, sticky, and slightly plastic; few very fine roots; few very fine discontinuous vertical interstitial pores; common faint clay films on faces of peds; 40 percent pebbles; neutral; gradual wavy boundary.
- CB—39 to 60 inches; light yellowish-brown (10YR 6/4) very stony silty clay loam, very pale-brown (10YR 7/4) dry; weak medium subangular blocky structure; hard, friable, sticky, and slightly plastic; few fine discontinuous vertical interstitial pores; 45 percent stones; neutral.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 2, T. 11 N., R. 1 E., detailed soil map unit 150. The profile described is on a landslide. The slope gradient is 15 percent and has a northerly aspect. Parent

material is landslide deposits derived from limestone. Elevation is 6,460 feet. Vegetation consists of upper, mixed forest. Habitat type is subalpine fir/twinflower.

Range in Characteristics

O horizon:

The horizon is 1/2-inch to 3-inches thick.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 to 3 moist and 5 to 7 dry; chroma is 1 to 3 moist or dry. Texture is loam, silt loam, clay loam, or silty clay loam. Content of rock fragments ranges from 0 to 35 percent. Reaction is medium acid to slightly alkaline. The horizon is 6- to 9-inches thick.

AB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 5 moist or dry. Texture is silty clay loam or clay loam. Content of rock fragments ranges from 35 to 50 percent. Reaction is medium acid to mildly alkaline. The horizon is 4- to 12-inches thick.

Bt horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay. Clay content is 35 to 50 percent. Content of rock fragments ranges from 35 to 50 percent. Reaction is medium acid to mildly alkaline. The combined horizons are 15- to 30-inches thick.

CB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 7 moist and 6 to 8 dry; chroma is 2 to 5 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay loam. Content of rock fragments ranges from 35 to 50 percent. Reaction is slightly acid to moderately alkaline. The horizon is noneffervescent to violently effervescent.

Mollic Cryoboralfs Loamy-Skeletal, Mixed

Representative Pedon

- O—1 inch to 0; undecomposed fir needles and dead grass; abrupt smooth boundary.
- A—0 to 8 inches; dark-brown (10YR 3/3) silt loam, light-gray (10YR 7/2) dry; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky, and nonplastic; few coarse, common fine roots; common very fine

- discontinuous interstitial pores; 10 percent pebbles; strongly acid; abrupt smooth boundary.
- E—8 to 12 inches; pale-brown (10YR 6/3) gravelly silt loam, white (10YR 8/2) dry; moderate medium subangular blocky structure; slightly hard, firm, slightly sticky, and nonplastic; common fine and few coarse roots; common very fine discontinuous vesicular pores; 20 percent pebbles; medium acid; clear smooth boundary.
- Bt1—12 to 17 inches; brown (10YR 5/3) very gravelly silt loam, very pale-brown (10YR 7/3) dry; moderate coarse subangular blocky structure; hard, firm, slightly sticky, and slightly plastic; common fine roots; common very fine discontinuous vertical tubular pores; few faint clay films line pores; 40 percent pebbles; slightly acid; clear wavy boundary.
- Bt2—17 to 32 inches; brown (10YR 5/3) very gravelly silt loam, very pale-brown (10YR 7/3) dry; moderate coarse subangular and angular blocky structure; very hard, very firm, sticky, and slightly plastic; few very fine roots; common fine discontinuous vertical tubular pores; common distinct clay films on faces of peds and line pores; 50 percent pebbles; neutral; gradual wavy boundary.
- CB—32 to 60 inches; pale-brown (10YR 6/3) extremely gravelly silt loam, very pale-brown (10YR 8/3) dry; massive, slightly hard, firm, slightly sticky, and nonplastic; few very fine roots; common very fine discontinuous vesicular pores; 75 percent pebbles; mildly alkaline; slightly effervescent.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 35, T. 15 N., R. 9 W., detailed soil map unit 49. The profile described is on a mountain slope. The slope gradient is 35 percent and has a southeasterly aspect. Parent material is derived from argillite. Elevation is 5,200 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/snowberry.

Range in Characteristics

Parent material is derived from limestone, basaltic, or metasedimentary rocks. Bedrock is at a depth of 20 to 60 inches or more.

O horizon:

The horizon is 1/2-inch to 3-inches thick.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 or 3 moist and 4 to 7 dry; chroma is 1 to 3 moist or dry. Texture is loam or silt loam. Content of

rock fragments ranges from 5 to 35 percent. Reaction is strongly acid to slightly alkaline. The horizon is 6- to 9-inches thick.

E horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 7 moist and 6 to 8 dry; chroma is 1 to 3 moist or dry. Texture is silt loam or loam. Content of rock fragments ranges from 15 to 50 percent. Reaction is strongly acid to slightly alkaline. The horizon is 4- to 15-inches thick.

Bt horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Texture is loam, silt loam, clay loam, or silty clay loam. Clay content is 22 to 35 percent. Content of rock fragments ranges from 35 to 60 percent. Reaction is medium acid to slightly alkaline. The horizon is 12- to 30-inches thick.

CB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 7 moist and 6 to 8 dry; chroma is 1 to 3 moist or dry. Texture is loam, silt loam, clay loam, or silty clay loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is slightly acid to moderately alkaline. The horizon is noneffervescent to strongly effervescent.

Typic Cryoboralfs

Typic Cryoboralfs are Boralfs with light-colored surface layers. They represent the central concept or typical member of the Cryoboralfs great group.

Typic Cryoboralfs Clayey-Skeletal, Mixed

Representative Pedon

- A—0 to 4 inches; brown (7.5YR 4/2) cobbly silt loam, pinkish-gray (7.5YR 6/2) dry; weak coarse platy structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; many fine roots; common fine discontinuous random interstitial pores; 20 percent cobbles; medium acid; clear smooth boundary.
- Bt1—4 to 16 inches; dark yellowish-brown (10YR 4/4) very cobbly silty clay loam, pale-brown (10YR 6/3) dry; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky, and slightly plastic; many fine roots; common fine discontinuous random interstitial pores; 35

percent cobbles; medium acid; clear wavy boundary.

Bt2—16 to 27 inches; brown (7.5YR 4/4) very cobbly silty clay loam, pinkish-gray (7.5YR 6/2) dry; moderate medium subangular blocky structure; hard, firm, sticky, and plastic; few fine discontinuous random interstitial pores; many distinct clay films on faces of peds; 40 percent cobbles; medium acid; clear wavy boundary.

CB—27 to 60 inches; brown (7.5YR 5/2) very cobbly silty clay loam, pinkish-gray (7.5YR 7/2) dry; massive; hard, firm, sticky, and plastic; 40 percent cobbles; medium acid.

Location and Setting

Lewis and Clark County, Montana, NE 1/4, Sec. 1, T. 12 N., R. 1 W., detailed soil map unit 14B. The profile described is in a colluvial basin at a drainage head. The slope gradient is 20 percent and has a southeasterly aspect. Parent material is colluvium derived from quartzite. Elevation is 6,400 feet. Vegetation consists of upper, mixed forest. Habitat type is subalpine fir/twinflower.

Range in Characteristics

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 to 3 dry or moist.

Texture is loam or silt loam. Content of rock fragments ranges from 15 to 35 percent.

Reaction is strongly acid to slightly acid. The horizon is 3- to 10-inches thick.

Bt horizons:

Hue is 7.5YR, 10Y, or 2.5Y; value is 3 to 5 moist and 4 to 6 dry; chroma is 2 to 6 moist or dry.

Texture is clay loam, silty clay loam, silty clay, or clay. Clay content is 35 to 50 percent.

Content of rock fragments ranges from 35 to 50 percent. Reaction is strongly acid to slightly acid. The combined horizons are 20- to 40-inches thick.

CB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 3 to 5 moist and 4 to 7 dry; chroma is 2 to 6 moist or dry.

Texture is silty clay loam, clay loam, silty clay, or clay. Content of rock fragments ranges from 35 to 80 percent. Reaction is medium acid to neutral.

Typic Cryoboralfs Fine-Loamy, Mixed

Representative Pedon

A1—0 to 7 inches; brown (10YR 4/3) coarse sand, pale-brown (10YR 6/3) dry; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky, and nonplastic; common very fine, common fine, and few medium roots; many very fine continuous interstitial pores; 10 percent pebbles; medium acid; abrupt wavy boundary.

A2—7 to 23 inches; brown (10YR 4/3) gravelly coarse sandy loam, pale-brown (10YR 6/3) dry; weak medium subangular blocky structure; hard, friable, nonsticky, and nonplastic; few fine and medium roots; common fine continuous interstitial pores; 25 percent pebbles; medium acid; diffuse wavy boundary.

Bt—23 to 57 inches; dark yellowish-brown (10YR 4/4) gravelly sandy clay loam, light yellowish-brown (10YR 6/4) dry; strong very coarse angular blocky structure; very hard, friable, slightly sticky, and slightly plastic; few very fine roots; common fine discontinuous interstitial pores; many distinct clay films on faces of peds and in pores; 25 percent pebbles; slightly acid; abrupt smooth boundary.

CB—57 to 60 inches; dark yellowish-brown (10YR 4/4) very gravelly sandy loam, very pale-brown (10YR 7/3) dry; massive; hard, friable, slightly sticky, and slightly plastic; common medium discontinuous interstitial pores; 40 percent pebbles; medium acid.

Location and Setting

Lewis and Clark County, Montana, SW 1/4, Sec. 6, T. 8 N., R. 2 W., detailed soil map unit 36. The profile described is on rolling uplands. The slope gradient is 15 percent and has a westerly aspect. Parent material is derived from granite. Elevation is 5,440 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/snowberry.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more.

A horizons:

Hue is 7.5YR or 10YR; value is 3 to 6 moist and 6 to 7 dry; chroma is 3 to 6 moist or dry. Texture is sand to loam. Content of rock fragments

ranges from 10 to 35 percent. Reaction is strongly acid to neutral. The combined horizons are 6- to 24-inches thick.

Bt horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Texture is loam or sandy clay loam. Clay content is 20 to 30 percent. Content of rock fragments ranges from 10 to 35 percent. Reaction is strongly acid to neutral. The horizon is 10- to 40-inches thick.

CB horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 6 moist or dry. Texture is sand to loam. Content of rock fragments ranges from 10 to 50 percent. Reaction is strongly acid to neutral.

Typic Cryoboralfs Loamy-Skeletal, Mixed

Representative Pedon

- O—1 inch to 0; dead roots and Douglas-fir bark and needles; abrupt smooth boundary.
- A—0 to 9 inches; yellowish-brown (10YR 5/4) cobbly loam, pale-brown (10YR 6/3) dry; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky, and slightly plastic; many very fine and common fine roots; common very fine continuous interstitial pores; 30 percent cobbles; medium acid; clear wavy boundary.
- Bt—9 to 16 inches; brown (10YR 4/3) very cobbly loam, yellowish-brown (10YR 5/4) dry; moderate medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky, and slightly plastic; common very fine roots, most roots on faces of peds; common fine continuous vertical tubular pores; common faint clay films on faces of peds and lining pores; 50 percent cobbles; neutral; abrupt wavy boundary.
- CB—16 to 25 inches; dark yellowish-brown (10YR 4/4) extremely cobbly coarse sandy loam, light yellowish-brown (2.5Y 6/4) dry; very weak fine granular structure; slightly hard, very friable, nonsticky, and nonplastic; few very fine roots; many medium continuous interstitial pores; 80 percent cobbles; slightly acid; clear wavy boundary.
- R—25 inches; fractured basalt.

Location and Setting

Broadwater County, Montana, NW 1/4, Sec. 31, T. 7 N., R. 2 W., detailed soil map unit 47. The profile described is on a mountain with a 30 percent slope. Parent material is derived from basalt. Elevation is 5,800 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/pinegrass.

Range in Characteristics

Parent material is derived from metasedimentary or basaltic rocks or from glacial till. Some pedons have a surface layer that has been influenced by volcanic ash. These surface layers are 2- to 7-inches thick. Bedrock is at a depth of 20 to 60 inches or more.

O horizon:

The horizon is 1/2-inch to 3-inches thick.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 4 moist or dry. Texture is sandy loam, loam, silty loam, silty clay loam, or clay loam. Content of rock fragments ranges from 0 to 35 percent. Reaction is medium acid to slightly alkaline. The horizon is 4- to 12-inches thick.

Bt horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Texture is loam, silt loam, clay loam, or silty clay loam. Clay content is 22 to 35 percent. Content of rock fragments ranges from 35 to 60 percent. Reaction is medium acid to slightly alkaline. The horizon is 6- to 24-inches thick.

CB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 85 percent. Reaction is medium acid to moderately alkaline. The horizon is noneffervescent to violently effervescent. When formed in compact glacial till, the horizon is dense and brittle and has bulk density of 1.5 to 1.8 grams per cubic centimeter.

Eutroboralfs

Eutroboralfs are cool base saturated Boralfs. They are in drier, low elevation forested environments.

Mollic Entroboralfs

Mollic Entroboralfs are Entroboralfs with dark-colored surface layers. They are often found under forests with understories dominated by bunchgrasses or near a boundary with mountain grassland or shrubland. Their presence can mean that forest and grassland boundaries have shifted and the soil developed under both kinds of vegetation. Competition from grasses and moisture stress often limit forest regeneration on these soils.

Mollic Entroboralfs Fine-Loamy, Mixed

Representative Pedon

- A—0 to 6 inches; dark-brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to moderate medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; common fine, few medium roots; 5 percent pebbles; slightly acid; clear smooth boundary.
- Bt1—6 to 12 inches; dark yellowish-brown (10YR 3/4) sandy clay loam, yellowish-brown (10YR 5/4) dry; weak coarse angular blocky structure parting to moderate medium and fine angular blocky; hard, slightly firm, slightly sticky, and slightly plastic; common medium and coarse roots; common distinct clay films on faces of peds; 5 percent pebbles; slightly acid; clear wavy boundary.
- Bt2—12 to 36 inches; dark yellowish-brown (10YR 4/4) sandy clay loam, light yellowish-brown (10YR 6/4) dry; moderate, coarse, medium, and fine angular blocky structure; hard, firm, sticky, and plastic; common medium and coarse roots; many distinct clay films; 5 percent pebbles; slightly acid; gradual and smooth boundary.
- Bt3—36 to 60 inches; brown (10YR 5/3) sandy loam, very pale-brown (10YR 7/3) dry; weak coarse and medium angular blocky structure; slightly hard, friable, nonsticky, and nonplastic; few coarse roots; few, faint clay films on vertical ped faces; 5 percent pebbles; slightly acid.

Location and Setting

Jefferson County, Montana, SW 1/4, Sec. 25, T. 8 N., R. 3 W., detailed soil map unit 26. The profile described is on rolling uplands. The slope gradient is 30 percent and has a southerly aspect. Parent material is derived from granite. Elevation is 5,000 feet. Vegetation consists of lower, mixed forest. Habitat type is Douglas-fir/snowberry.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more. Bedrock is weakly or moderately weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation. There are class 1 to 3 surface granitic boulders in areas.

A horizon:

Hue is 7.5YR or 10YR; value is 2 or 3 moist and 5 or 6 dry; chroma is 1 to 3 moist or dry. Texture is loamy sand, sandy loam, loam, or sandy clay loam. Content of rock fragments ranges from 0 to 20 percent. Reaction is medium acid to neutral. The horizon is 6- to 9-inches thick.

Bt horizons:

Hue is 7.5YR or 10YR; value is 3 to 5 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Texture is sandy loam, loam, or sandy clay loam. Clay content is 10 to 30 percent. Content of rock fragments ranges from 0 to 35 percent. Reaction is medium acid to neutral. The combined horizons are 24- to 60-inches thick.

Typic Entroboralfs

Typic Entroboralfs are freely drained Entroboralfs with light-colored surface layers. They represent the central concept or typical member of the Entroboralfs great group.

Typic Entroboralfs Fine, Mixed

Representative Pedon

- A—0 to 3 inches; brown (10YR 4/3) silty clay loam, pale-brown (10YR 6/3) dry; weak medium subangular blocky structure parting to strong fine granular; soft, friable, slightly sticky, and slightly plastic; common fine and medium roots; common fine discontinuous random interstitial pores; 5 percent angular pebbles; neutral; clear smooth boundary.
- Bt1—3 to 9 inches; dark yellowish-brown (10YR 4/4) silty clay loam, pale-brown (10YR 6/3) dry; moderate medium subangular blocky structure parting to strong medium granular; hard, firm, sticky, and plastic; common fine and medium roots; common fine discontinuous random interstitial pores; 10 percent angular pebbles; neutral; clear wavy boundary.
- Bt2—9 to 26 inches; dark yellowish-brown (10YR 4/4) gravelly silty clay, very pale-brown (10YR 7/4)

dry; moderate fine and medium angular blocky structure; hard, firm, sticky, and plastic; few fine roots; few fine discontinuous random interstitial pores; common distinct clay films on faces of peds; 25 percent angular pebbles; neutral; clear wavy boundary.

Bk—26 to 60 inches; yellowish-brown (10YR 5/4) gravelly silty clay loam, very pale-brown (10YR 7/4) dry; moderate medium angular blocky structure; slightly hard, firm, sticky, and plastic; lime disseminated throughout; violently effervescent; moderately alkaline; 20 percent angular pebbles.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 4, T. 13 N., R. 10 W., detailed soil map unit 15C. The profile described is on a landslide. The slope gradient is 7 percent and has a northwesterly aspect. Parent material is landslide deposits derived from basalts, tuffs, and breccias. Elevation is 4,550 feet. Vegetation consists of lower, mixed forest. Habitat type is Douglas-fir/snowberry.

Range in Characteristics

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 to 3 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay. Content of rock fragments ranges from 0 to 20 percent. Reaction is slightly acid to mildly alkaline. The horizon is 2- to 6-inches thick.

Bt horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay. Clay content is 35 to 60 percent. Content of rock fragments ranges from 0 to 35 percent. Reaction is slightly acid to mildly alkaline. The combined horizons are 15- to 32-inches thick.

Bk horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 7 moist and 6 to 8 dry; chroma is 2 to 4 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay. Content of rock fragments ranges from 0 to 35 percent. Reaction is moderately to strongly alkaline.

Typic Eutroboralfs Loamy-Skeletal, Mixed

Representative Pedon

A—0 to 4 inches; dark grayish-brown (10YR 4/2) very gravelly loam, light brownish-gray (10YR 6/2) dry; weak fine granular structure; slightly hard, friable, nonsticky, and nonplastic; many fine and medium roots; 40 percent pebbles; slightly acid; clear wavy boundary.

Bt—4 to 20 inches; yellowish-brown (10YR 5/4) very gravelly clay loam, very pale-brown (10YR 7/4) dry; weak medium angular blocky structure parting to moderate medium granular; slightly hard, slightly firm, slightly sticky, and slightly plastic; common fine and medium roots; common distinct clay films on faces of peds and in pores; 55 percent pebbles; neutral, clear, wavy boundary.

CB—20 to 55 inches; brown (10YR 5/3) extremely gravelly loam, very pale-brown (10YR 7/3) dry; weak granular structure; slightly hard, friable, slightly sticky, and slightly plastic; few medium roots; slightly effervescent; 50 percent angular cobbles, 30 percent angular pebbles; moderately alkaline; abrupt irregular boundary.

R—55 inches; hard, fractured argillite.

Location and Setting

Lewis and Clark County, Montana, SE 1/4, Sec. 9, T. 13 N., R. 7 W., detailed soil map unit 380. The profile described is on a mountain. The slope gradient is 50 percent and has a southerly aspect. Parent material is derived from argillite. Elevation is 6,200 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/elk sedge.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 to 3 dry or moist. Texture is loam or silt loam. Content of rock fragments ranges from 10 to 60 percent. Reaction is slightly acid to slightly alkaline. The horizon is 3- to 10-inches thick.

Bt horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry.

Texture is clay loam or silty clay loam. Content of rock fragments ranges from 40 to 60 percent. Reaction is slightly acid to slightly alkaline. The horizon is 12- to 24-inches thick.

CB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 7 moist and 6 to 8 dry; chroma is 1 to 3 moist or dry. Texture is loam or silt loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is neutral to moderately alkaline.

Borolls

Borolls are cool and cold soils with dark-colored surface layers. They are most common under mountain grasslands and shrublands but are occasionally under forests when soils form in material derived from limestone or forest understories are dominated by grasses. Borolls are used to name one map unit in this survey. Soil properties are variable at lower levels of classification in this map unit.

Borolls

Representative Pedon

- A1—0 to 6 inches; very dark-gray (10YR 3/1) gravelly silt loam, gray (10YR 5/1) dry; moderate medium and fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; common fine and medium roots; 20 percent pebbles; slightly acid; clear smooth boundary.
- A2—6 to 12 inches; dark-brown (10YR 3/3) extremely gravelly sandy loam, light brownish-gray (10YR 6/2); weak coarse and medium subangular blocky structure parting to moderate medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; common fine and medium roots; 90 percent pebbles; slightly acid; abrupt smooth boundary.
- A3—12 to 16 inches; black (10YR 2/1) gravelly silt loam, dark-gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; 20 percent pebbles; slightly acid; clear wavy boundary.
- C1—16 to 26 inches; dark-brown (7.5YR 3/2) gravelly silt loam, light brown (7.5YR 6/4) dry; moderate coarse prismatic structure parting to moderate and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; few fine roots; 30 percent pebbles; neutral; clear smooth boundary.

- C2—26 to 33 inches; dark-brown (10YR 3/4) extremely gravelly sandy loam, light yellowish-brown (10YR 6/4) dry; weak medium subangular blocky structure parting to moderate and fine granular; slightly sticky and slightly plastic; 80 percent pebbles; neutral; clear smooth boundary.
- C3—33 to 43 inches; dark-brown (10YR 3/3) gravelly silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure parting to moderate medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; 20 percent pebbles; neutral; clear wavy boundary.
- C4—43 to 60 inches; brown (10YR 5/3) extremely gravelly sandy loam, very pale-brown (10YR 7/3) dry; weak medium subangular structure; slightly hard, very friable, slightly sticky, and slightly plastic; 80 percent pebbles; neutral.

Location and Setting

Lewis and Clark County, Montana, SW 1/4, Sec. 14, T. 16 N., R. 7 W., detailed soil map unit 100. The profile described is on a nearly level low stream terrace. Parent material is alluvium. Elevation is 5,300 feet. Vegetation consists of mountain grassland. Habitat type is big sagebrush/Idaho fescue.

Range in Characteristics

Some profiles have a seasonal water table between 30 and 60 inches from April through July. The soil is subject to the hazard of occasional flooding of short duration. Profiles are texturally stratified with sand to clay textures and rock fragment content of 0 to 80 percent.

A horizons:

Hue is 2.5YR to 2.5Y; value is 2 to 4 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. The combined horizons are 10- to 40-inches thick.

C horizons:

Hue is 2.5YR to 2.5Y; value is 3 to 6 moist and 6 or 7 dry; chroma is 3 to 5 moist or dry.

Argiborolls

Argiborolls are cool Borolls with subsoil clay accumulations. These soils form in alluvium or material derived from metasedimentary rocks. They are under mountain grassland or shrubland and open-grown forests with understories dominated by bunchgrasses.

Lithic Argiborolls

Lithic Argiborolls are Argiborolls 7- to 20-inches deep over hard bedrock. They are on rolling uplands

at elevations ranging from 4,500 to 5,000 feet. These soils are under dry grasslands.

Lithic Argiborolls Loamy-Skeletal, Mixed

Representative Pedon

A1—0 to 4 inches; very dark grayish-brown (10YR 3/2) silt loam, grayish-brown (2.5Y 5/2) dry; weak very fine granular structure; soft, very friable, nonsticky, and nonplastic; many very fine roots; common fine continuous random interstitial pores; 5 percent pebbles; neutral; abrupt smooth boundary.

A2—4 to 7 inches; very dark grayish-brown (10YR 3/2) sandy clay loam, grayish-brown (2.5Y 5/2) dry; strong medium platy structure; slightly hard, firm, nonsticky, and nonplastic; common very fine roots; few fine discontinuous vertical interstitial pores; 5 percent stone; mildly alkaline; abrupt smooth boundary.

Bt—7 to 19 inches; dark yellowish-brown (10YR 3/4) very stony sandy clay loam, brown (10YR 4/3) dry; strong coarse subangular blocky structure; very hard, firm, sticky, and slightly plastic; few fine continuous random interstitial pores; few distinct clay films on faces of peds and lining pores; 40 percent stone; moderately alkaline; abrupt wavy boundary.

R—19 inches; fractured quartzite.

Location and Setting

Broadwater County, Montana, SW 1/4, Sec. 27, T. 6 N., R. 1 W., detailed soil map unit 29C. The profile described is on rolling uplands with a 10 percent slope. Parent material is derived from quartzite interbedded with thin layers of argillite. Elevation is 5,000 feet. Vegetation consists of dry grassland. Habitat type is bluebunch wheatgrass/Sandberg bluegrass.

Range in Characteristics

Bedrock is at a depth of 10 to 20 inches.

A horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 2 or 3 moist or dry. Texture is loam, silt loam, clay loam, or sandy clay loam. Content of rock fragments ranges from 0 to 35 percent. Reaction is neutral to mildly alkaline. The combined horizons are 4- to 7-inches thick.

Bt horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 3 to 5 moist and 4 to 6 dry; chroma is 3 to 5 moist or dry.

Texture is sandy clay loam or clay loam. Clay content is 20 to 35 percent. Content of rock fragments ranges from 35 to 60 percent. Reaction is neutral to moderately alkaline.

Typic Argiborolls

Typic Argiborolls are Argiborolls 20 to 60 inches or more deep over hard bedrock. They represent the central concept or typical member of the Argiborolls great group.

Typic Argiborolls Loamy-Skeletal, Mixed

Representative Pedon

A—0 to 11 inches; black (10YR 2/1) silt loam, dark-gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, and nonplastic; common very fine and fine roots; few very fine discontinuous interstitial pores; 5 percent pebbles; medium acid; abrupt wavy boundary.

Bt1—11 to 19 inches; brown (10YR 4/3) very gravelly clay loam, brown (10YR 5/3) dry; strong medium angular blocky structure; hard, firm, sticky, and plastic; common very fine and fine roots; few fine discontinuous interstitial pores; common faint clay films on faces of peds and lining pores; 40 percent pebbles; slightly acid; clear wavy boundary.

Bt2—19 to 32 inches; dark yellowish-brown (10YR 4/4) very gravelly clay loam, brown (10YR 5/3) dry; moderate coarse angular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; few very fine roots; common fine discontinuous random tubular pores; few faint clay films line pores; 45 percent pebbles; neutral; gradual wavy boundary.

Bk—32 to 60 inches; brown (10YR 5/3) very gravelly clay loam, pale-brown (10YR 6/3) dry; massive; slightly hard, firm, slightly sticky, and slightly plastic; few very fine discontinuous interstitial pores; 50 percent pebbles; finely divided lime disseminated throughout; slightly effervescent; mildly alkaline.

Location and Setting

Broadwater County, Montana, NW 1/4, Sec. 4, T. 6 N., R. 1 W., detailed soil map unit 110. The profile

described is on an alluvial fan with a 10 percent slope. Parent material is alluvium. Elevation is 5,360 feet. Vegetation consists of grass. Habitat type is rough fescue/Idaho fescue.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is loam or silt loam. Content of rock fragments ranges from 0 to 35 percent. Reaction is medium acid to mildly alkaline. The horizon is 7- to 14-inches thick.

Bt horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Texture is clay loam or silty clay loam. Clay content is 28 to 35 percent. Content of rock fragments ranges from 35 to 80 percent. Reaction is slightly acid to mildly alkaline. The combined horizons are 12- to 30-inches thick.

Bk horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 5 moist or dry. Texture is loam, silt loam, clay loam, or silty clay loam. Content of rock fragments ranges from 35 to 60 percent. The horizon is slightly to violently effervescent.

Calciborolls

Calciborolls are Borolls that are calcareous and have strong lime accumulations in lower soil layers. They are formed in weathered limestone under forests with understories dominated by grass.

Typic Calciborolls

Typic Calciborolls are Calciborolls that are 20 to 60 inches or more deep over hard bedrock. They represent the central concept or typical member of the Calciborolls great group.

Typic Calciborolls Loamy-Skeletal, Carbonatic

Representative Pedon

A—0 to 9 inches; dark-brown (10YR 3/3) gravelly silt loam, grayish-brown (10YR 5/2) dry; weak medium subangular blocky structure parting to weak medium granular; loose, very friable, nonsticky, and nonplastic; few very fine roots; few

discontinuous random interstitial pores; strongly effervescent; 15 percent angular limestone pebbles; moderately alkaline; clear wavy boundary.

Bw—9 to 12 inches; brown (10YR 5/3) very gravelly silt loam, light brownish-gray (10YR 6/2) dry; weak medium subangular blocky structure; soft, very friable, nonsticky, and nonplastic; few very fine roots; few discontinuous random interstitial pores; violently effervescent; 45 percent angular limestone pebbles; moderately alkaline; clear wavy boundary.

Bk—12 to 38 inches; brown (10YR 5/3) extremely gravelly silt loam, light brownish-gray (10YR 6/2) dry; very weak fine granular structure; soft, friable, slightly sticky, and slightly plastic; few discontinuous random interstitial pores; finely divided lime disseminated throughout and lime pendants on the underside of pebbles; violently effervescent; 80 percent angular limestone pebbles; moderately alkaline; abrupt, wavy boundary.

R—35 inches; fractured limestone.

Location and Setting

Lewis and Clark County, Montana, SE 1/4, Sec. 13, T. 12 N., R. 3 E., detailed soil map unit 31. The profile described is on a mountain. The slope gradient is 45 percent and has a northerly aspect. Parent material is derived from limestone. Elevation is 5,300 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/pinegrass, bluebunch wheatgrass phase.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more. Texture is loam or silt loam throughout the profile.

A horizon:

Hue is 7.5YR or 10YR; value is 2 or 3 moist and 3 to 5 dry; chroma is 2 or 3 moist or dry. There are 15 to 35 percent limestone pebbles. The horizon is 7- to 12-inches thick.

Bw horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 5 moist or dry. There are 35 to 60 percent limestone pebbles. The horizon is 3- to 20-inches thick.

Bk horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 6 to 8 dry; chroma is 2 or 3 moist or dry. There are 35 to 80 percent limestone pebbles.

Cryoborolls

Cryoborolls are the cold Borolls. These soils are mainly at elevations ranging from 5,000 to 7,500 feet. Dominant slopes are 10 to 40 percent. Cryoborolls are under mountain grassland or shrubland and on forests with understories dominated by grasses.

Argic Cryoborolls

Argic Cryoborolls are Cryoborolls with subsoil clay accumulations.

Argic Cryoborolls Clayey-Skeletal, Mixed

Representative Pedon

- A—0 to 3 inches; very dark-gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; strong fine and medium granular structure; soft, very friable, slightly sticky, and slightly plastic; many fine and common medium roots; common medium continuous random tubular pores; 5 percent pebbles; slightly acid; clear smooth boundary.
- Bt1—3 to 14 inches; dark-brown (7.5YR 3/2) very gravelly silty clay loam, brown (7.5YR 5/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky, and slightly plastic; common fine roots; common fine continuous random tubular pores; few faint clay films on faces of peds and lining pores; 35 percent pebbles; medium acid; gradual wavy boundary.
- Bt2—14 to 36 inches; yellowish-red (5YR 4/6) very gravelly silty clay, light reddish-brown (5YR 6/4) dry; strong fine and medium angular blocky structure; slightly hard, friable, slightly sticky, and plastic; few faint clay films on faces of peds; 40 percent pebbles; medium acid; clear wavy boundary.
- BC—36 to 48 inches; strong brown (7.5YR 4/6) very gravelly silty clay loam, pink (7.5YR 7/4) dry; moderate fine angular blocky structure; slightly hard, very friable, slightly sticky, and plastic; 35 percent pebbles; medium acid; clear wavy boundary.
- C—48 to 60 inches; strong brown (7.5YR 4/6) very gravelly silty clay loam, pink (7.5YR 7/4) dry; massive; slightly hard, friable, slightly sticky, and plastic; 35 percent pebbles; medium acid.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 9, T. 13 N., R. 1 W., detailed soil map unit 150. The

profile described is on a landslide. The slope gradient is 20 percent and has a northerly aspect. Parent material is landslide deposits derived from quartzite and limestone. Elevation is 6,500 feet. Vegetation consists of grassland. Habitat type is rough fescue/Idaho fescue.

Range in Characteristics

Reaction is medium acid to mildly alkaline.

A horizon:

Hue is 2.5YR to 2.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is silt loam, loam, clay loam, silty clay loam, silty clay, or clay. Content of rock fragments ranges from 0 to 35 percent. The horizon is 3- to 12-inches thick.

Bt horizons:

Hue is 2.5YR to 2.5Y; value is 3 to 5 moist and 4 to 6 dry; chroma is 2 to 4 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay. Clay content is 35 to 50 percent. Content of rock fragments ranges from 35 to 50 percent. The combined horizons are 12- to 36-inches thick.

BC and C horizons:

Hue is 2.5YR to 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 6 moist or dry. Texture is silty clay loam, clay loam, silty clay, or clay. Content of rock fragments ranges from 35 to 50 percent.

Argic Cryoborolls Fine-Loamy, Mixed

Representative Pedon

- A—0 to 10 inches; very dark grayish-brown (10YR 3/2) gravelly sandy loam, grayish-brown (10YR 5/2) dry; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky, and slightly plastic; common very fine and fine roots; many fine continuous interstitial pores; 25 percent pebbles; slightly acid; clear wavy boundary.
- Bt1—10 to 20 inches; brown (10YR 4/3) gravelly sandy clay loam, pale-brown (10YR 6/3) moderate coarse subangular blocky structure parting to strong fine and medium granular; hard, firm, sticky, and plastic; common fine roots; common medium continuous interstitial pores; many distinct clay films on faces of peds; 30 percent pebbles; slightly acid; clear wavy boundary.

Bt2—20 to 33 inches; dark yellowish-brown (10YR 4/4) gravelly sandy clay loam, light brownish-gray (10YR 6/2) dry; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky, and slightly plastic; common medium continuous interstitial pores; 30 percent pebbles; slightly acid; clear wavy boundary.

BC—33 to 45 inches; yellowish-brown (10YR 5/6) gravelly sandy clay loam, brownish-yellow (10YR 6/6) dry; massive; soft, very friable, nonsticky, and nonplastic; common coarse continuous interstitial pores; 20 percent pebbles; slightly acid; abrupt wavy boundary.

R—45 inches; derived from granite.

Location and Setting

Lewis and Clark County, Montana, SW 1/4, Sec. 32, T. 9 N., R. 4 W., detailed soil map unit 36A. The profile described is on rolling uplands. The slope gradient is 25 percent and has a southerly aspect. Parent material is derived from granite. Elevation is 5,300 feet. Vegetation consists of mountain grassland. Habitat type is rough fescue/bluebunch wheatgrass.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more. Bedrock is weakly or moderately weathered. Moderately weathered bedrock decomposes to coarse sand and gravel when exposed by excavation. Reaction is medium acid to neutral throughout the profile.

A horizon:

Hue is 7.5YR or 10YR; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is loam or sandy loam. Content of rock fragments ranges from 15 to 35 percent. The horizon is 10- to 15-inches thick.

Bt horizons:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Texture is loam or sandy clay loam. Clay content is 15 to 25 percent. Content of rock fragments ranges from 15 to 35 percent. The combined horizons are 8- to 30-inches thick.

BC horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Texture is sand, loamy sand, or sandy loam. Content of rock fragments ranges from 15 to 50 percent.

Argic Cryoborolls Loamy-Skeletal, Mixed

Representative Pedon

A—0 to 10 inches; dark-brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak coarse subangular blocky structure; soft, friable, nonsticky, and nonplastic; common very fine roots; few very fine discontinuous vertical interstitial pores; 7 percent pebbles; neutral; abrupt smooth boundary.

Bt1—10 to 17 inches; dark-brown (10YR 4/3) very cobbly loam, brown (10YR 5/3) dry; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky, and nonplastic; common very fine roots; few fine discontinuous vertical tubular pores; very few faint clay films on faces of peds; 40 percent cobbles; neutral; clear wavy boundary.

Bt2—17 to 26 inches; dark yellowish-brown (10YR 4/6) very cobbly loam, yellowish-brown (10YR 5/4) dry; weak very coarse subangular blocky; slightly hard, friable, nonsticky, and nonplastic; common fine discontinuous vertical tubular pores; 45 percent cobbles; neutral; clear wavy boundary.

CB—26 to 40 inches; yellowish-brown (10YR 5/4) very cobbly loam, light yellowish-brown (10YR 6/4) dry; massive; slightly hard, friable, nonsticky, and slightly plastic; many medium continuous random interstitial pores; 55 percent cobbles; neutral.

R—40 inches; fractured sandstone.

Location and Setting

Broadwater County, Montana, SW 1/4, Sec. 29, T. 6 N., R. 1 W., detailed soil map unit 39A. The profile described is on a mountain. The slope gradient is 35 percent and has an easterly aspect. Parent material is derived from sandstone. Elevation is 6,400 feet. Vegetation consists of shrubland. Habitat type is big sagebrush/Idaho fescue.

Range in Characteristics

Parent material is derived from basaltic or metasedimentary rocks or from colluvial deposits. Bedrock is at a depth of 20 to 60 inches or more.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is sandy loam to clay loam. Content of rock fragments ranges from 0 to 35 percent. Reaction is slightly acid to mildly alkaline. The horizon is 10- to 15-inches thick.

Bt horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Texture is loam, clay loam, or sandy clay loam. Clay content is 20 to 30 percent. Content of rock fragments ranges from 35 to 60 percent. Reaction is moderately acid to neutral. The combined horizons are 10- to 24-inches thick.

CB horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 5 moist or dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is slightly acid to moderately alkaline. The horizon is effervescent in areas.

Calcic Cryoborolls

Calcic Cryoborolls are Cryoborolls that are calcareous and have strong subsoil lime accumulations. They are formed in material derived from limestone.

Calcic Cryoborolls Loamy-Skeletal, Carbonatic**Representative Pedon**

- O—1 inch to 0; undecomposed twigs, needles, and dead grass; abrupt smooth boundary.
- A—0 to 11 inches; dark-brown (10YR 3/3) very gravelly silt loam, brown (10YR 5/3) dry; moderate fine granular structure; soft, friable, nonsticky, and nonplastic; many very fine and common fine roots; many medium continuous interstitial pores; 55 percent angular limestone pebbles; neutral; clear wavy boundary.
- Bk1—11 to 23 inches; dark yellowish-brown (10YR 3/4) very gravelly silt loam, grayish-brown (10YR 5/2) dry; weak medium granular structure; soft, very friable, slightly sticky, and nonplastic; common very fine and fine roots; many medium continuous interstitial pores; violently effervescent; 50 percent angular limestone pebbles; moderately alkaline; abrupt smooth boundary.
- Bk2—23 to 38 inches; light yellowish-brown (10YR 6/4) extremely gravelly loam, light-gray (10YR 7/2) with thin bands of white (10YR 8/1), dry; moderate fine angular blocky structure; hard,

firm, slightly sticky, and nonplastic; few very fine roots; few very fine discontinuous interstitial pores; lime pendants on the undersides of pebbles and finely disseminated lime throughout; violently effervescent; 70 percent angular limestone pebbles; moderately alkaline; clear wavy boundary.

R—38 inches; fractured limestone.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 31, T. 12 N., R. 2 E., detailed soil map unit 32. The profile described is on a dip slope. The slope gradient is 35 percent and has a northerly aspect. Parent material is derived from limestone. Elevation is 6,880 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/pinegrass.

Range in Characteristics

Bedrock is at a depth of 20 to 40 inches. Texture is silt loam or loam throughout the profile.

O horizon:

The horizon is 1/2-inch to 2-inches thick.

A horizon:

Hue is 7.5YR or 10YR; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. There are 15 to 60 percent limestone pebbles. Reaction is neutral to moderately alkaline. The horizon is effervescent in some pedons. The horizon is 7- to 12-inches thick.

Bk horizons:

Hue is 7.5YR or 10YR; value is 4 to 7 moist and 5 to 8 dry; chroma is 1 to 4 moist or dry. There are 35 to 80 percent limestone pebbles. The horizon is moderately to violently effervescent. The horizon is 8- to 33-inches thick.

Lithic Cryoborolls

Lithic Cryoborolls are Cryoborolls 4- to 20-inches deep over hard bedrock.

Lithic Cryoborolls Loamy-Skeletal, Mixed**Representative Pedon**

- O—1 inch to 0; semi-decomposed grass roots.
- A—0 to 5 inches; very dark-brown (10YR 2/2) loam, dark-brown (10YR 4/3) dry; weak medium

subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky, and slightly plastic; many very fine and few fine roots; common fine continuous vertical tubular pores; 5 percent cobbles; neutral; clear smooth boundary.

Bw—5 to 11 inches; dark-brown (10YR 3/3) very cobbly loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to moderate fine granular structure; soft, very friable, slightly sticky, and slightly plastic; many very fine and few fine roots; common fine continuous vertical tubular pores; 40 percent cobbles; neutral; abrupt wavy boundary.

CB—11 to 15 inches; dark yellowish-brown (10YR 3/4) extremely cobbly loam, yellowish-brown (10YR 5/6) dry; massive; slightly hard, friable, nonsticky, and nonplastic; common very fine roots; 75 percent cobbles; neutral; diffuse wavy boundary.

R—15 inches; fractured basalt.

Location and Setting

Jefferson County, Montana, NW 1/4, Sec. 12, T. 7 N., R. 5 W., detailed soil map unit 77A. The profile described is on a mountain ridge. The slope gradient is 16 percent and has a northerly aspect. Parent material is derived from basalt. Elevation is 7,450 feet. Vegetation consists of mountain grassland. Habitat type is rough fescue/Idaho fescue.

Range in Characteristics

Parent material is derived from basaltic or metasedimentary rocks. Bedrock is at a depth of 10 to 20 inches. Texture is loam or sandy loam. Reaction is slightly acid to mildly alkaline.

A horizon:

Hue is 10YR or 2.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 dry or moist. Content of rock fragments ranges from 0 to 35 percent. The horizon is 4- to 12-inches thick.

Bw horizon:

Hue is 10YR or 2.5Y; value is 3 to 6 moist and 4 to 7 dry; chroma is 3 to 5 moist or dry. Content of rock fragments ranges from 35 to 80 percent. The horizon is 0- to 15-inches thick. The horizon is not present in some pedons, and the A horizon overlies bedrock.

CB horizon:

Hue is 10YR or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Content of rock fragments ranges from 35 to 80 percent. The horizon is not present in some pedons, and the Bw horizon overlies bedrock.

Haploborolls

Haploborolls are cool Borolls that do not have subsoil clay accumulations. They are under mountain grassland and shrubland. These soils are at elevations ranging from 4,500 to 6,000 feet.

Typic Haploborolls

Typic Haploborolls are the Haploborolls that are 20- to 60-inches deep over hard bedrock. They represent the central concept or typical member of the Haploborolls great group.

Typic Haploborolls Loamy-Skeletal, Mixed

Representative Pedon

A—0 to 11 inches; very dark-gray (10YR 3/1) gravelly loam, grayish-brown (10YR 5/2) dry; weak fine and medium granular structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; common fine discontinuous interstitial pores; slightly effervescent; 20 percent angular pebbles; moderately alkaline; clear smooth boundary.

Bw—11 to 27 inches; very dark grayish-brown (10YR 3/2) very cobbly loam, light brownish-gray (10YR 6/2) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; common fine discontinuous interstitial pores; strongly effervescent; 55 percent cobbles; moderately alkaline; abrupt wavy boundary.

R—27 inches; fractured argillite.

Location and Setting

Broadwater County, Montana, NE 1/4, Sec. 27, T. 6 N., R. 4 E., detailed soil map unit 390. The profile described is on a mountain slope. The slope gradient is 40 percent and has a westerly aspect. Parent material is derived from weakly calcareous argillite. Elevation is 5,800 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/Idaho fescue.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 to 4 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 5 to 35 percent. Reaction is neutral to moderately alkaline. In some pedons this horizon is not

effervescent. The horizon is 7- to 15-inches thick.

Bw horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 3 to 5 moist and 5 to 7 dry; chroma is 2 to 4 moist or dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 75 percent. Reaction is slightly acid to moderately alkaline. In some pedons this horizon is not effervescent.

Typic Haploborolls Sandy, Mixed

Representative Pedon

- 0—1 inch to 0; undecomposed pine needles; abrupt smooth boundary.
- A—0 to 14 inches; very dark grayish-brown (10YR 3/2) sandy loam, dark grayish-brown (10YR 4/2) dry; weak medium granular structure; soft, very friable, nonsticky, and nonplastic; few fine and common medium roots; common continuous interstitial pores; 5 percent pebbles; neutral; clear wavy boundary.
- Bw1—14 to 32 inches; brown (10YR 4/3) loamy coarse sand, yellowish-brown (10YR 5/4) dry; single grain; soft, very friable, nonsticky, and nonplastic; common medium and many coarse roots; common continuous interstitial pores; 5 percent pebbles; neutral; abrupt wavy boundary.
- Bw2—32 to 50 inches; brown (10YR 4/3) loamy coarse sand, yellowish-brown (10YR 5/6) dry; single grain; loose, nonsticky, and nonplastic; common coarse roots; common continuous interstitial pores; 5 percent pebbles; neutral; diffuse wavy boundary.
- Cr—50 inches; weathered granite.

Location and Setting

Lewis and Clark County, Montana, SE 1/4, Sec. 23 T., 8 N., R. 3 W., detailed soil map unit 260. The profile described is on rolling uplands. The slope gradient is 20 percent and has a southerly aspect. Parent material is derived from granite. Elevation is 4,650 feet. Vegetation consists of lower, mixed forest. Habitat type is Douglas-fir/Idaho fescue.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches. Bedrock is weakly or moderately weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation. The soil

contains 0 to 25 percent fine rounded pebbles. Reaction is slightly acid to neutral.

O horizon:

The horizon is 1/2-inch to 2-inches thick.

A horizon:

Hue is 7.5YR or 10YR; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Texture is loam or sandy loam. The horizon is 10- to 20-inches thick.

Bw horizons:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Texture is loamy sand or sand.

Ochrepts

Ochrepts are soils with light-colored or thin dark-colored surface layers that do not have subsoil clay accumulations. They are extensive soils and are on most landforms; they form in most of the parent materials in the survey area. Ochrepts are most common on steep or very steep slopes. They are considered young soils with minimum evidence of alteration of parent materials and redistribution of minerals within the soil profile.

Cryochrepts

Cryochrepts are the cold Ochrepts. These soils are mainly at elevations ranging from 5,000 to 8,500 feet. Cryochrepts tend to be under upper, mixed or subalpine forests.

Andic Cryochrepts

Andic Cryochrepts are the Cryochrepts with loess surface layers that have been influenced by volcanic ash. These surface layers are 7- to 10-inches thick. Bulk density of the loess surface layer is 0.8 to 1 gram per cubic centimeter. They tend to be on high elevation ridges and upper mountain slopes in the western part of the survey area. Elevation ranges from 6,000 to 8,500 feet. The loess surface layer is usually the best rooting environment in the soil. This layer can be damaged by equipment used in forest management.

Andic Cryochrepts Loamy-Skeletal, Mixed

Representative Pedon

Bs—0 to 8 inches; dark yellowish-brown (10YR 4/4) loam, yellowish-brown (10YR 5/4) dry; weak fine

subangular blocky structure; soft, very friable, nonsticky, and nonplastic; common fine, few very fine roots; many very fine continuous interstitial pores; 5 percent angular pebbles; strongly acid; clear wavy boundary.

2A—8 to 16 inches; brown (10YR 5/3) very cobbly coarse sandy loam, light-gray (10YR 7/1) dry; few fine very pale-brown (10YR 7/4) mottles; very weak fine granular structure; soft, very friable, nonsticky, and nonplastic; common fine and very fine roots; common very fine continuous interstitial pores; 35 percent cobbles; strongly acid; gradual wavy boundary.

2Bw1—16 to 24 inches; brown (10YR 5/3) very cobbly coarse sandy loam, light-gray (10YR 7/1) dry; moderate medium subangular blocky structure; soft, very friable, slightly sticky, and nonplastic; common very fine roots; common very fine continuous interstitial pores; 40 percent cobbles; extremely acid; gradual wavy boundary.

2Bw2—24 to 37 inches; brown (10YR 5/3) very cobbly coarse sandy loam, light-gray (10YR 7/1) dry; single grain; loose, nonsticky, and nonplastic; common fine continuous interstitial pores; 35 percent cobbles; extremely acid; abrupt wavy boundary.

R—37 inches; fractured rhyolite.

Location and Setting

Lewis and Clark County, Montana, NE 1/4, Sec. 25 T. 14 N., R. 7 W., detailed soil map unit 58. The profile described is on a mountain ridge. The slope gradient is 25 percent and has a southeasterly aspect. Parent material is loess that has been influenced by volcanic ash, which overlies material derived from rhyolite. Elevation is 6,600 feet. Vegetation consists of lower subalpine forest. Habitat type is subalpine fir/beargrass.

Range in Characteristics

Parent material is derived from rhyolitic or metasedimentary rocks or is glacial till. Bedrock is at a depth of 20 to 60 inches or more.

Bs horizon:

Hue is 7.5YR or 10YR; value is 4 to 5 moist and 5 to 6 dry; chroma is 3 or 4 moist or dry. Texture is silt loam or loam. Content of rock fragments ranges from 0 to 15 percent. Reaction is strongly acid to neutral. The horizon is 7- to 10-inches thick.

2A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 6 moist and 6 to 8 dry; chroma is 1 to 3 moist or dry.

Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 60 percent. Reaction is strongly acid to neutral. The horizon is 4- to 10-inches thick.

2Bw horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 5 to 6 moist and 6 to 7 dry; chroma is 1 to 5 moist or dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is extremely acid to mildly alkaline. The combined horizons are 10- to 40-inches thick.

Dystric Cryochrepts

Dystric Cryochrepts are the Cryochrepts with moderately to extremely acid subsoils and substrata. Base saturation in the subsoil or upper substrata is 20 to 60 percent. They form in coarse-textured material derived from rhyolitic rocks.

Dystric Cryochrepts Sandy-Skeletal, Mixed

Representative Pedon

O—2 inches to 0; litter; weakly decomposed needles and twigs.

A—0 to 6 inches; brown (7.5YR 5/2) very gravelly sandy loam, pinkish-gray (7.5YR 7/2) dry; weak very fine granular structure; soft, very friable, nonsticky, and nonplastic; common very fine roots; many fine continuous interstitial pores; 40 percent pebbles; neutral; clear wavy boundary.

Bw—6 to 14 inches; brown (7.5YR 5/2) very gravelly sandy loam, pinkish-white (7.5YR 8/2) dry; weak medium subangular blocky structure; soft, very friable, nonsticky, and nonplastic; many very fine and common medium roots; many medium continuous interstitial pores; 50 percent pebbles; medium acid; clear wavy boundary.

CB—14 to 38 inches; brown (7.5YR 5/2) extremely cobbly coarse loamy sand, pinkish-white (7.5YR 8/2) dry; single grain; loose, nonsticky, and nonplastic many medium continuous interstitial pores; 80 percent cobbles; medium acid.

R—38 inches; fractured rhyolite.

Location and Setting

Lewis and Clark County, Montana, NE 1/4, Sec. 35, T. 14 N., R. 7 W., detailed soil map unit 48. The profile described is on a mountain slope. The slope gradient is 45 percent and has a southeasterly

aspect. Parent material is derived from rhyolite. Elevation is 6,500 feet. Vegetation consists of lower subalpine forest. Habitat type is subalpine fir/beargrass.

Range in Characteristics

Bedrock is at a depth of 20 to 40 inches.

O horizon:

The horizon is 1/2-inch to 3-inches thick.

A horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 to 3 moist or dry. Texture is loam or sandy loam. Content of rock fragments ranges from 15 to 50 percent. Reaction is medium acid to neutral. The horizon is 4- to 10-inches thick.

Bw horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 4 moist or dry. Content of rock fragments ranges from 35 to 80 percent. Reaction is extremely to medium acid. The horizon is 10- to 20-inches thick.

CB horizon:

Hue is 7.5YR or 10Y; value is 4 to 6 moist and 5 to 8 dry; chroma is 2 to 4 moist or dry. Content of rock fragments ranges from 35 to 80 percent. Reaction is extremely to medium acid.

Lithic Cryochrepts

Lithic Cryochrepts are the Cryochrepts 4- to 20-inches deep over hard bedrock. These soils tend to be on dip slopes and mountain ridges. They are most often formed in material derived from limestone or basaltic rocks.

Lithic Cryochrepts Loamy-Skeletal, Carbonatic

Representative Pedon

- A—0 to 5 inches; very dark grayish-brown (10YR 3/2) very gravelly silty clay loam, light brownish-gray (10YR 6/2) dry; weak medium subangular blocky structure parting to moderate medium and fine granular; soft, friable, slightly sticky, and slightly plastic; common fine and medium roots; 50 percent limestone pebbles; slightly effervescent; slightly alkaline; clear smooth boundary.
- Bk—5 to 18 inches; dark yellowish-brown (10YR 4/4) very gravelly silty clay loam, light-gray (10YR 7/2) dry; weak medium subangular blocky structure parting to moderate medium granular; soft,

friable, slightly sticky, and slightly plastic; few fine and common medium roots; finely divided lime disseminated throughout and lime pendants on the undersides of pebbles; violently effervescent; 55 percent limestone pebbles; moderately alkaline; abrupt and wavy boundary.

R—18 inches; fractured limestone.

Location and Setting

Lewis and Clark County, Montana, SW 1/4, Sec. 2, T. 12 N., R. 1 W., detailed soil map unit 51. The profile described is on a mountain ridge. The slope gradient is 10 percent. Parent material is derived from limestone. Elevation is 7,400 feet. Vegetation consists of upper subalpine forest. Habitat type is whitebark pine-subalpine fir.

Range in Characteristics

Bedrock is at a depth of 4 to 20 inches.

A horizon:

Hue is 7.5YR or 10YR; value is 2 to 4 moist and 6 to 7 dry; chroma is 2 or 3 moist or dry. Texture is loam, silt loam, or silty clay loam. There are 15 to 60 percent limestone pebbles. The horizon is slightly to strongly effervescent. The horizon is 2- to 5-inches thick.

Bk horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 6 to 8 dry; chroma is 2 to 4 moist or dry. Texture is loam, silt loam, or silty clay loam. There are 35 to 80 percent limestone pebbles.

Lithic Cryochrepts Loamy-Skeletal, Mixed

Representative Pedon

- A—0 to 6 inches; dark-brown (10YR 4/3) very gravelly loam, pale-brown (10YR 6/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; many fine and few coarse roots; common fine continuous random interstitial pores; 50 percent angular pebbles; neutral; clear wavy boundary.
- Bw—6 to 17 inches; dark yellowish-brown (10YR 4/4) very gravelly loam, pale-brown (10YR 6/3) dry; weak medium subangular blocky structure parting to weak medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; common fine and few coarse roots; common fine continuous random interstitial pores; 55 percent angular pebbles; neutral; abrupt wavy boundary.
- R—17 inches; fractured argillite.

Location and Setting

Lewis and Clark County, Montana, SW 1/4, Sec. 20, T. 16 N., R. 7 W., detailed soil map unit 94A. The profile described is on a structural breakland. The slope gradient is 65 percent and has a southerly aspect. Parent material is derived from argillite. Elevation is 7,500 feet. Vegetation consists of upper, mixed forest. Habitat type is limber pine/Idaho fescue.

Range in Characteristics

Parent material is derived from granitic, basaltic, or metasedimentary rocks. Bedrock is at a depth of 4 to 20 inches. Texture is sandy loam, loam, or silt loam.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 to 3 moist or dry. Content of rock fragments ranges from 15 to 60 percent. Reaction is medium acid to neutral. The horizon is 4- to 10-inches thick.

Bw horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry. Content of rock fragments ranges from 35 to 80 percent. Reaction is medium acid to mildly alkaline.

Typic Cryochrepts

Typic Cryochrepts are the Cryochrepts that are 20 to 60 inches or more deep over bedrock. Loess surface layers that have been influenced by volcanic ash are 2- to 7-inches thick if present. Base saturation is 60 to 100 percent in the subsoil and substrata. They represent the central concept or typical member of the Cryochrepts great group.

Typic Cryochrepts Loamy-Skeletal, Carbonatic

Representative Pedon

A—0 to 4 inches; very dark grayish-brown (10YR 3/2) extremely gravelly silt loam, light brownish-gray (10YR 6/2) dry; moderate medium granular structure; slightly hard, friable, slightly sticky, and slightly plastic; many very fine and fine roots; 70 percent angular limestone pebbles; neutral; clear, smooth boundary.

Bw—4 to 17 inches; brown (10YR 5/3) very gravelly silty clay loam, pale-brown (10YR 6/3) dry; weak medium angular blocky structure parting to moderate medium granular; slightly hard, slightly firm, slightly sticky, and slightly plastic; common medium and coarse roots; strongly effervescent;

40 percent angular limestone pebbles; mildly alkaline; abrupt and wavy boundary.

Bk—17 to 37 inches; pale-brown (10YR 6/3) very gravelly silt loam, very pale-brown (10YR 7/3) dry; weak medium angular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky, and nonplastic; few coarse roots; lime pendants on the underside of pebbles and finely divided lime disseminated throughout; violently effervescent; 40 percent angular limestone pebbles; moderately alkaline; abrupt wavy boundary.

R—37 inches; fractured limestone.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 2, T. 15 N., R. 6 W., detailed soil map unit 32B. The profile described is on a dip slope. The slope gradient is 55 percent and has a southerly aspect. Parent material is derived from limestone. Elevation is 6,000 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/common juniper.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more.

A horizon:

Hue is 7.5YR or 10YR; value is 3 to 5 moist and 5 to 7 dry; chroma is 2 to 3 moist or dry. Texture is loam or silt loam. There are 10 to 75 percent limestone pebbles. Reaction is neutral to moderately alkaline, and the horizon is effervescent in areas. The horizon is 2- to 8-inches thick.

Bw horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 4 moist or dry. Texture is loam, silt loam, or silty clay loam. There are 35 to 80 percent limestone pebbles. Reaction is mildly to moderately alkaline. The horizon is 10- to 25-inches thick.

Bk horizon:

Hue is 7.5YR or 10YR; value is 5 to 7 moist and 6 to 8 dry; chroma is 2 or 3 moist or dry. Texture is loam, silt loam, or silty clay loam. There are 35 to 80 percent limestone pebbles. The horizon is 8- to 27-inches thick.

Typic Cryochrepts Loamy-Skeletal, Mixed

Representative Pedon

A—0 to 4 inches; dark-brown (10YR 4/3) very cobbly loam, pale-brown (10YR 6/3) dry; weak medium

and fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; common medium and coarse roots; common fine continuous random interstitial pores; 40 percent cobbles; slightly acid; clear wavy boundary.

Bw1—4 to 10 inches; yellowish-brown (10YR 5/4) very cobbly loam, very pale-brown (10YR 7/4) dry; weak medium subangular blocky structure parting to weak medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; common fine continuous random interstitial pores; 60 percent cobbles; slightly acid; clear wavy boundary.

Bw2—10 to 20 inches; yellowish-brown (10YR 5/6) extremely cobbly loam, very pale-brown (10YR 7/4) dry; weak fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; few fine continuous random interstitial pores; 80 percent cobbles; neutral; clear wavy boundary.

Bw3—20 to 40 inches; yellowish-brown (10YR 5/6) extremely cobbly loam, very pale-brown (10YR 7/4) dry; massive; slightly hard, friable, slightly sticky, and slightly plastic; 80 percent cobbles; neutral; abrupt wavy boundary.

R—40 inches; fractured basalt.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 5, T. 15 N., R. 6 W., detailed soil map unit 44. The profile described is on a mountain slope. The slope gradient is 50 percent and has a northwesterly aspect. Parent material is derived from basalt. Elevation is 5,890 feet. Vegetation consists of upper, mixed forest. Habitat type is subalpine fir/beargrass, blue huckleberry phase.

Range in Characteristics

Parent material is derived from granitic, basaltic, or metasedimentary rocks or from glacial till. Bedrock is at a depth of 20 to 60 inches or more. Some pedons have a surface mantle of loess that has been influenced by volcanic ash. These surface mantles are 2- to 7-inches thick.

A horizon:

Hue is 7.5YR, 10YR, or 2.5Y; value is 2 to 6 moist and 4 to 7 dry; chroma is 1 to 3 moist or dry.

Texture is sandy loam to clay loam. Content of rock fragments ranges from 0 to 50 percent.

Reaction is strongly acid to mildly alkaline. The horizon is 2- to 10-inches thick.

Bw horizons:

Hue is 7.5YR, 10YR, or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 5 moist or dry.

Texture is loamy sand, sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is strongly acid to moderately alkaline. These horizons can be effervescent in areas. The combined horizons are 6- to 30-inches thick.

Ustochrepts

Ustochrepts are the Ochrepts of subhumid climates. They are moist in spring and early summer and dry for less than 45 consecutive days in late summer and early fall. These soils are at lower elevations and are on slopes with southerly aspects. Ustochrepts are at elevations ranging from 3,500 to 7,000 feet. Vegetation consists of lower, mixed forest; upper, mixed forest; and dry grassland. Forest understory vegetation is dominated by bunchgrasses.

Lithic Ustochrepts

Lithic Ustochrepts are the Ustochrepts with hard bedrock at 4 to 20 inches. They form in material derived from limestone or metasedimentary rocks.

Lithic Ustochrepts Loamy-Skeletal, Carbonatic, Frigid

Representative Pedon

A—0 to 2 inches; very dark-gray (10YR 3/1) gravelly loam; gray (10YR 6/1) dry; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky, and slightly plastic; many fine and common medium roots; 20 percent limestone pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

Bk—2 to 19 inches; brown (10YR 5/3) very gravelly loam, very pale-brown (10YR 7/3) dry; weak medium and fine subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky, and slightly plastic; common fine roots; lime pendants on the undersides of pebbles and finely divided lime disseminated throughout; 40 percent limestone pebbles; violently effervescent; moderately alkaline; abrupt and wavy boundary.

R—19 inches; fractured limestone.

Location and Setting

Lewis and Clark County, Montana, NW 1/4, Sec. 8, T. 12 N., R. 2 W., detailed soil map unit 22. The profile described is on a dip slope. The slope gradient is 20 percent and has a southerly aspect. Parent material is derived from limestone. Elevation is 4,200 feet.

Vegetation consists of lower, mixed forest. Habitat type is ponderosa pine/Idaho fescue.

Range in Characteristics

Bedrock is at a depth of 4 to 20 inches.

A horizon:

Hue is 7.5YR or 10YR; value is 3 to 5 moist and 6 to 7 dry; chroma is 1 to 3 moist or dry. Texture is loam or silt loam. There are 15 to 60 percent limestone pebbles. Reaction is mildly to moderately alkaline. The horizon is 2- to 6-inches thick.

Bk horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 6 to 8 dry; chroma is 2 to 4 moist or dry. Texture is loam or silt loam. There are 35 to 80 percent limestone pebbles.

Lithic Ustochrepts Loamy-Skeletal, Mixed, Frigid

Representative Pedon

A—0 to 7 inches; dark-brown (10YR 3/3) extremely gravelly loam, light-gray (10YR 7/2) dry; weak medium and fine granular structure; soft, very friable, slightly sticky, and slightly plastic; 80 percent angular pebbles; neutral; clear wavy boundary.

Bw—7 to 18 inches; brown (10YR 4/3) extremely gravelly loam, light-gray (10YR 7/2) dry; weak medium and fine granular structure; soft, very friable, slightly sticky, and slightly plastic; 80 percent angular pebbles; neutral; abrupt wavy boundary.

R—18 inches; fractured quartzite.

Location and Setting

Broadwater County, Montana, SE 1/4, Sec. 28, T. 6 N., R. 4 E., detailed soil map unit 39B. The profile described is on a mountain slope. The slope gradient is 60 percent and has a southerly aspect. Parent material is derived from quartzite. Elevation is 5,700 feet. Vegetation consists of mountain shrubland. Habitat type is big sagebrush/Idaho fescue.

Range in Characteristics

Bedrock is at a depth of 4 to 20 inches.

A horizon:

Hue is 2.5YR to 2.5Y; value is 3 to 6 moist and 5 to 7 dry; chroma is 2 or 3 moist or dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 15 to 80 percent.

Reaction is medium acid to moderately alkaline. The horizon is effervescent in some pedons. The horizon is 4- to 10-inches thick.

Bw horizon:

Hue is 2.5YR to 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 5 moist or dry. Texture is sandy loam, loam, or clay loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is medium acid to moderately alkaline. The horizon is effervescent in some pedons.

Typic Ustochrepts

Typic Ustochrepts are the Ustochrepts with hard bedrock at 20 to over 60 inches. They tend to have calcareous subsoils and substrata. They represent the central concept or typical member of the Ustochrepts great group.

Typic Ustochrepts Loamy-Skeletal, Carbonatic, Frigid

Representative Pedon

O—1 inch to 0; slightly decomposed grass and fir needles.

A—0 to 6 inches; dark-brown (10YR 3/3) very gravelly loam, light brownish-gray (10YR 6/2) dry; weak medium subangular blocky structure; soft, very friable, nonsticky, and nonplastic; many fine, many medium, and few coarse roots; many very fine continuous interstitial pores; strongly effervescent; 35 percent angular limestone pebbles; moderately alkaline; clear wavy boundary.

Bk1—6 to 26 inches; brown (10YR 5/3) extremely gravelly loam, white (10YR 8/2) dry; moderate medium subangular structure; soft, very friable, slightly sticky, and nonplastic; many fine, common medium, and few coarse roots; many very fine continuous interstitial pores; violently effervescent; 75 percent angular limestone pebbles; moderately alkaline; diffuse wavy boundary.

Bk2—23 to 35 inches; brown (10YR 5/3) extremely gravelly silt loam, white (10YR 8/2) dry; very weak fine granular structure; soft, very friable, slightly sticky, and slightly plastic; few very fine roots on rock faces; common very fine continuous interstitial pores; finely divided lime disseminated throughout and lime pendants on the underside of pebbles; violently effervescent; 85 percent angular limestone pebbles; moderately alkaline.

R—35 inches; fractured limestone.

Location and Setting

Lewis and Clark County, Montana, SW 1/4, Sec. 31, T. 11 N., R. 1 E., detailed soil map unit 210. The profile described is on a mountain slope. The slope gradient is 55 percent and has a southerly aspect. Parent material is derived from limestone. Elevation is 4,500 feet. Vegetation consists of lower, mixed forest. Habitat is Douglas-fir/bluebunch wheatgrass.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more.

O horizon:

The horizon is 1/2-inch to 2-inches thick.

A horizon:

Hue is 7.5YR or 10YR; value is 3 to 5 moist and 5 to 7 dry; chroma is 2 or 3 moist or dry. Texture is loam or silt loam. There are 15 to 60 percent limestone pebbles. Reaction is mildly to moderately alkaline. The horizon is 4- to 10-inches thick.

Bk horizons:

Hue is 7.5YR or 10YR; value is 4 to 6 moist and 6 to 8 dry; chroma is 2 or 3 moist or dry. Texture is loam or silt loam. There are 35 to 85 percent limestone pebbles.

Typic Ustochrepts Loamy-Skeletal, Mixed, Frigid

Representative Pedon

A—0 to 8 inches; dark reddish-brown (5YR 3/4) very channery sandy loam, pale-red (2.5YR 6/2) dry; weak medium subangular blocky structure parting to weak very fine granular; soft, very friable, nonsticky, and nonplastic; common very fine and fine roots; many very fine continuous interstitial pores; 50 percent fragments; mildly alkaline; clear wavy boundary.

Bw1—8 to 26 inches; dark reddish-brown (2.5YR 3/4) very channery sandy loam, pinkish-gray (5YR 7/2) dry; weak medium subangular blocky structure; soft very friable, slightly sticky, and nonplastic; few fine roots; many very fine, continuous interstitial pores; 40 percent fragments; slightly effervescent; moderately alkaline; clear wavy boundary.

Bw2—26 to 47 inches; dark reddish-brown (2.5YR 3/4) extremely channery sandy loam, pinkish-gray (5YR 7/2) dry; very weak fine granular structure; soft, very friable, nonsticky, and

nonplastic; common fine continuous interstitial pores; 85 percent fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

R—47 inches; fractured argillite.

Location and Setting

Lewis and Clark County, Montana, NE 1/4, Sec. 30, T. 11 N., R. 1 E., detailed soil map unit 39. The profile described is on a mountain. The slope gradient is 45 percent and has a southerly aspect. Parent material is derived from argillite. Elevation is 4,400 feet. Vegetation consists of upper, mixed forest. Habitat type is Douglas-fir/Idaho fescue.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more.

A horizon:

Hue is 2.5YR or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 1 to 5 moist or dry. Texture is sandy loam to clay loam. Content of rock fragments ranges from 15 to 60 percent. Reaction is slightly acid to moderately alkaline. The horizon is 4- to 12-inches thick.

Bw horizons:

Hue is 2.5YR or 2.5Y; value is 3 to 6 moist and 5 to 7 dry; chroma is 2 to 5 moist or dry. Texture is sandy loam to clay loam. Content of rock fragments ranges from 35 to 80 percent. Reaction is slightly acid to moderately alkaline. The horizon can be effervescent or noneffervescent.

Typic Ustochrepts Sandy, Mixed, Frigid

Representative Pedon

A—0 to 2 inches; dark-brown (10YR 3/3) gravelly sandy loam, brown (10YR 5/3) dry; very weak medium subangular blocky structure parting to weak medium and fine granular; soft, very friable, nonsticky, and nonplastic; many fine and common medium roots; 15 percent subangular fine pebbles; slightly acid; clear wavy boundary.

Bw1—2 to 16 inches; dark yellowish-brown (10YR 4/4) gravelly sandy loam, light yellowish-brown (10YR 6/4) dry; weak medium subangular blocky structure parting to weak medium and fine granular; slightly hard, very friable, nonsticky, and nonplastic; common medium and coarse roots; 25 percent subangular fine pebbles; slightly acid; clear wavy boundary.

Bw2—16 to 30 inches; olive-brown (2.5Y 4/4) gravelly loamy sand, light yellowish-brown (2.5Y 6/4) dry; single grain; soft, loose, nonsticky, and nonplastic; few medium roots; 30 percent subangular fine pebbles; slightly acid; abrupt wavy boundary.

Cr—30 to 60 inches; soft, moderately weathered granite.

Location and Setting

Lewis and Clark County, Montana, SE 1/4, Sec. 6, T. 8 N., R. 2 W., detailed soil map unit 26. The profile described is on rolling uplands. The slope gradient is 20 percent and has a southerly aspect. Parent material is derived from granite. Vegetation consists of lower, mixed forest. Habitat type is Douglas-fir/pinegrass, kinnikinnick phase.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more. Bedrock is weakly or moderately weathered. Moderately weathered bedrock decomposes to coarse sand and fine gravel when exposed by excavation. There are class 1 to 3 surface granite boulders.

A horizon:

Hue is 7.5YR or 10YR; value is 2 to 4 moist and 4 to 6 dry; chroma is 1 to 3 moist or dry. Texture is loam, sandy loam, or loamy sand. Content of rock fragments ranges from 0 to 20 percent. Reaction is medium acid to neutral. The horizon is 1- to 4-inches thick.

Bw1 horizon:

Hue is 2.5Y to 7.5YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Content of rock fragments ranges from 10 to 35 percent. Reaction is strongly acid to neutral. The horizon is 10- to 19-inches thick.

Bw2 horizon:

Hue is 2.5Y to 7.5YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Content of rock fragments ranges from 10 to 35 percent. Reaction is strongly acid to neutral. The horizon is 9- to 37-inches thick.

Cr horizon:

This horizon is not present in all pedons. An R horizon of hard weakly weathered granitic rock underlies some pedons. In others, the Bw2 extends to 60 inches or more.

Orthents

Orthents are very weakly developed soils that have little evidence of soil development except in the surface layer. They are very minor soils in the survey area and are formed in extremely bouldery sand weathered from granitic rocks.

Cryorthents

Cryorthents are the cold Orthents. They are at elevations ranging from 5,100 to 7,000 feet.

Typic Cryorthents

Typic Cryorthents represent the central concept or typical member of the Cryorthents great group.

Typic Cryorthents Sandy-Skeletal, Mixed

Representative Pedon

Soil colors are for moist soil unless otherwise indicated.

A—0 to 5 inches; very dark grayish-brown (10YR 3/2) extremely bouldery sand, light brownish-gray (10YR 6/2) dry; single grain; loose, nonsticky, and nonplastic; few fine and medium roots; 70 percent boulders; strongly acid; clear smooth boundary.

C—5 to 60 inches; yellowish-brown (10YR 5/4) extremely bouldery sand, very pale-brown (10YR 7/4) dry; single grain; loose, nonsticky, and nonplastic; few medium and coarse roots; 70 percent boulders; strongly acid.

Location and Setting

Lewis and Clark County, Montana, NE 1/4, Sec. 7, T. 10 N., R. 5 W., detailed soil map unit 46. The profile described is on a stabilized rock glacier on a mountain ridge. Slope gradient is 10 percent. Parent material is extremely bouldery material derived from granite. Elevation is 5,900 feet. Vegetation consists of an open-grown stand of lodgepole pine growing in soil material between boulders. Community type is scree.

Range in Characteristics

Bedrock is at a depth of 20 to 60 inches or more. There are class 5 or 6 surface granitic boulders.

Umbrepts

Umbrepts have low base saturation and thick dark-colored surface layers. They do not have subsoil clay accumulations.

Cryumbrepts

Cryumbrepts are the cold Umbrepts. They are at elevations ranging from 8,000 to 9,500 feet on mountain ridges. These soils are under alpine meadows and form in material derived from granitic, metasedimentary, and basaltic rocks.

Typic Cryumbrepts

Typic Cryumbrepts are the freely drained Cryumbrepts with a cambic horizon. These soils represent the central concept or typical member of the Cryumbrepts great group. They are the only Cryumbrepts in the survey area and are of very minor extent.

Typic Cryumbrepts Loamy-Skeletal, Mixed

Representative Pedon

A—0 to 10 inches; dark-brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak medium subangular blocky structure parting to weak medium and fine granular; soft, very friable, nonsticky, and nonplastic; many very fine and fine roots; many fine discontinuous interstitial pores; 15 percent pebbles; medium acid; clear wavy boundary.

Bw1—10 to 19 inches; dark yellowish-brown (10YR 4/4) very gravelly sandy loam, light yellowish-brown (10YR 6/4) dry; weak medium subangular blocky structure parting to weak medium and fine granular; soft, very friable, nonsticky, and nonplastic; common very fine and fine roots;

many fine discontinuous interstitial pores; 35 percent pebbles; medium acid; clear wavy boundary.

Bw2—19 to 30 inches; dark yellowish-brown (10YR 4/6) very gravelly sandy loam, light yellowish-brown (10YR 6/4) dry; weak medium subangular blocky structure parting to weak medium and fine granular; soft, very friable, nonsticky, and nonplastic; common very fine roots; many fine discontinuous interstitial pores; 40 percent pebbles; medium acid; abrupt wavy boundary.

R—30 inches; granite.

Location and Setting

Broadwater County, Montana, SE 1/4, Sec. 22, T. 8 N., R. 4 E., detailed soil map unit 69. The profile described is on a mountain ridge. The slope gradient is 18 percent and has a southerly aspect. Parent material is derived from granite. Elevation is 8,650 feet. Vegetation consists of alpine meadow. Habitat type is Idaho fescue/tufted hairgrass.

Range in Characteristics

Parent material is derived from granitic, basaltic, or metasedimentary rocks. Bedrock is at a depth of 20 to 40 inches. Texture is sandy loam, loam, or clay loam.

A horizon:

Hue is 7.5YR, 10YR, or 7.5Y; value is 2 or 3 moist and 3 to 5 dry; chroma is 1 to 3 moist or dry. Content of rock fragments ranges from 15 to 35 percent. Reaction is strongly to medium acid. The horizon is 10- to 15-inches thick.

Bw horizons:

Hue is 7.5YR, 10YR, or 7.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 3 to 6 moist or dry. Content of rock fragments ranges from 35 to 80 percent. Reaction is extremely to medium acid.

Soil Formation

There are five principal factors of soil formation: parent material, topography, biological activity, climate, and time. The soil-forming factors are interdependent, each modifying the effects of the others.

Soil is the result of the combined effects of these five factors, and soil differences are due principally to the relative importance or strength of the various factors. In mountainous areas such as the Helena National Forest Area, changes in one or more soil-forming factors occur within relatively short distances. The many microclimates that result from change in elevation, air drainage, topography, slope gradient, and aspect strongly influence soil formation. Complexity of parent material, topography, and time further increase the number of different kinds of soil in the area.

There are some obvious relationships between soil properties and parent material within the survey area. Soils formed in materials weathered from granitic or rhyolitic rocks tend to be moderately coarse or coarse textured. These soils commonly have low fertility and

are droughty. Soils formed in materials weathered from limestone, basaltic or metasedimentary rocks are moderately coarse to moderately fine textured, have higher fertility, and hold more moisture.

The survey area has had many climatic fluctuations in the last million years. The climate has, at times, been drier or wetter and warmer or cooler than at present. During the driest periods, only a few areas appear to have been forested. These are probably the moistest, most densely forested sites today. Tree line in the last 15,000 years has varied from 6,500 to possibly 9,000 feet.

Forest and grassland boundaries have been fluctuating for thousands of years. Soil properties change more slowly than vegetation. Therefore, many soils have properties inherited from a former vegetative cover. For example, some soils in the survey area have surface layers that appear to have formed under both grassland and forest vegetation. Forests growing on these soils are often difficult to regenerate.

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Glossary

- 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.
- Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.
- Alpine.** Characteristic of high mountains, especially ones modified by intense glacial erosion. Implies high elevation and cold climate.
- Andesite.** A volcanic rock composed essentially of andesine and one or more mafic constituents such as ash pyroxene, hornblende, or biotite.
- Animal-unit-month.** The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month. Abbreviated AUM.
- Argillic horizon.** A diagnostic illuvial subsurface horizon characterized by an accumulation of silicate clays.
- Basalt.** An extrusive igneous rock composed primarily of calcic plagioclase and pyroxene, with or without olivine.
- 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.
- Basin.** A depressed area with no or limited outlet.
- Bedrock.** The solid material that underlies the soil and other unconsolidated material or that is exposed at the surface.
- Boulders.** Rock fragments larger than 2 feet in diameter.
- Bulk density.** The mass of dry soil per unit volume, expressed in grams per cubic centimeter.
- Cable logging.** A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable logging 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, felled trees generally are reeled in while one end is lifted or the entire log is suspended.
- Cambic horizon.** A horizon that has been altered or changed by soil forming processes, usually occurring below a diagnostic surface horizon.
- Canyon.** A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.
- Channel.** The bed of single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium.
- Channery.** Soils containing thin, flat rock fragments up to 6 inches along the longer axis. A single piece is a fragment.
- Cirque.** Semicircular, concave, bowl-like areas that have steep faces primarily resulting from glacial ice and snow abrasion.
- Clay.** The mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonymous with clay skin.
- Climax vegetation.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.
- Coarse fragments.** Mineral or rock particles larger than 2 millimeters in diameter.
- Coarse-textured soil.** Sand or loamy sand.
- Cobble.** Rock 3 to 10 inches in diameter.
- Colluvium.** Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.
- Compaction.** The packing together of soil particles by forces exerted at the soil surface, resulting in increased solid density.
- Complex slope.** Irregular or variable slope.
- Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small an 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.

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 at various soil moisture contents are:

Wet soil—Nonsticky, slightly sticky, sticky, very sticky, nonplastic, slightly plastic, plastic, very plastic.

Moist soil—Loose, very friable, friable, firm, very firm, extremely firm.

Dry soil—Loose, soft, slightly hard, hard, very hard, extremely hard.

Cryic. Soil temperature regime in which the mean annual soil temperature at 20 inches depth is higher than 0° C but lower than 8° C and the mean summer soil temperature is lower than 8° C if an O horizon is present.

Cutbanks, road. The steep slope above a road from which material has been excavated during construction.

Delineation. A single enclosed area within a drawn boundary line on a map. A single occurrence of a map unit.

Dendritic. A drainage pattern characterized by a treelike branching drainage system in which the tributaries join the main stream from all directions and at almost any angle.

Deposition. The laying down of potential rock-forming materials; sedimentation.

Deranged. A poorly integrated drainage system resulting from a relatively young landform having a flat or undulating topographic surface. These forms occur on young moraines and landslides in the survey area.

Displacement. Repositioning or removal of the surface soil layers by mechanical action.

Drainage pattern. The spatial relationships of drainage channels, including geographic orientation and angles of intersection. It is influenced by topographic relief, bedrock, and soil properties.

Draw. A small stream valley, generally more open and with broader bottomland than a ravine or a gulch.

Droughty. An area or soil that characteristically has either a prolonged or a chronic lack of available water.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion hazard. An interpretation of the risk of erosion associated with a specified management practice.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fan, alluvial. A low, outspread, gently sloping mass of loose rock material shaped like an open fan or a segment of a cone, deposited by a stream.

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.

Fill, road. A structure, often composed largely of borrowed soil and rock materials, which forms the foundation upon which a road surface is constructed.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It is commonly on the downhill side of a road.

Fine-textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially. It is usually a landform built of sediment deposited during overflow and lateral migration of the stream.

Flow. A mass movement of unconsolidated material that exhibits a continuity of motion and a plastic or semifluid behavior resembling a viscous fluid. The mass of material moved by a flow.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants covering the ground in a forest.

Frigid. A soil temperature regime in which the soil at 20 inches depth has a mean temperature of 0° C to 8° C and mean summer soil temperatures equal to or greater than 8° C.

Frost pocket. Accumulation of cold air in a topographic low or depression leading to unseasonable occurrence of frost.

Glacial. Of or relating to the presence and activities of ice and glaciers, as glacial erosion. Pertaining to distinctive features and materials produced by or derived from glaciers and ice sheets, as glacial lakes. Pertaining to an ice age or region of glaciation.

Glacial till. Unsorted and unstratified glacial drift, generally unconsolidated, deposited directly by a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

Glaciation. The formation, movement, and recession of glaciers or ice sheets. A collective term for the

geologic processes of glacial activity, including erosion and deposition, and the resulting effects of such action on the earth's surface.

- Granite.** A plutonic rock in which quartz constitutes 10 to 50 percent of the felsic components and in which alkali feldspar constitutes 65 to 90 percent of total feldspar.
- Granitic.** A class of igneous rocks in which the constituent crystals are visible to the unaided eye because of crowding, nonglassy in appearance and approximately of the same size.
- Gravel.** Rounded or angular fragments of rock up to 3 inches in diameter. An individual piece is a pebble.
- Grus.** Material consisting of angular, coarse-grained fragments resulting from the granular disintegration of crystalline rocks.
- Habitat type.** All land areas potentially capable of producing similar plant communities at climax. Habitat types are named by the climax tree species in the first part of the name and a dominant undergrowth species in the second part of the name.
- Headwall.** The steep slope at the head of a valley; especially the rock cliff at the back of a cirque.
- Herbage.** The total production of grasses, forbs, and shrubs available to livestock.
- 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.
- 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 upper case letter represents the major horizons. Numbers or lower case 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.
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 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.

R layer. Consolidated rock beneath the soil. The rock commonly underlies a C horizon but can be directly below an A or a B horizon.

- Hummock.** A rounded or conical mound or knoll, hillock, or other small elevation. Also, a slight rise of ground above a level surface.
- Igneous rock.** Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic rock, such as granite, and volcanic rock, such as basalt.
- Inclusion.** Soil or vegetative bodies found within a map unit not extensive enough to be mapped separately or as part of a complex.
- Intrusive.** Denoting igneous rocks derived from molten matter (magmas) which invaded preexisting rocks and cooled below the surface of the earth.
- Landform.** Any physical, recognizable form or feature of the earth's surface having a characteristic shape and produced by natural causes.
- Landscape.** All the natural features, such as fields, hills, forests, and water, that distinguish one part of the earth's surface from another part. Also, the distinct association of landforms, especially as modified by geologic forces, that can be seen in a single view.
- Landslide.** A mass-wasting process, and the landform produced, involving moderately rapid to rapid (greater than one foot per year) downslope transport by means of gravitational stresses of a mass of rock and regolith that may or may not be water saturated.
- Landtype.** Unit of land with similar designated soil, vegetation, geology, topography, climate, and drainage.
- Limestone.** A sedimentary rock consisting chiefly (more than 50%) of calcium carbonate, primarily in the form of calcite.
- Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.
- Livestock forage.** The percent of total herbage that is palatable to domestic livestock.

- Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.
- Loess.** Fine-grained material, dominantly of silt-sized particles, deposited by wind. In this survey area, it is rich in volcanic ash.
- Low strength.** The soil is not strong enough to support the strength of the load.
- Map unit.** The set of areas delineated on a map considered similar to all other members of the set (delineations) with respect to the selected properties used to define the set.
- Mass wasting.** Dislodgment and downslope transport of earth (regolith and rock) material as a unit under direct gravitational stress. The process includes slow displacements, such as creep and solifluction, and rapid movements, such as landslides, rock slides and falls, earthflows, debris flows, and avalanches. Agents of fluid transport (water, ice, air) may play a subordinate role in the process.
- Mean annual increment.** The annual increase per acre in the volume of a stand. Increment is computed by dividing the total volume of a stand by its age. Abbreviated MAI.
- Meander.** One of a series of sinuous loops, with sine-wave form, in the course of a stream channel. Meandering streams commonly have cross sections with low width-to-depth ratios; fine-grained, cohesive bank material; and low gradient.
- Medium-textured soil.** Very fine sandy loam, loam, silt loam, or silt.
- 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.
- Metasedimentary.** A sedimentary rock which shows evidence of having been subjected to metamorphism.
- Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.
- Moderately coarse-textured soil.** Coarse sandy loam, sandy loam, and fine sandy loam.
- Moderately fine-textured soil.** Clay loam, sandy clay loam, and silty clay loam.
- Moraine.** An accumulation of unsorted earth and rock deposited by a glacier.
- 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 describe abundance, size, and contrast.
- Mountain.** A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surfaces. A mountain can occur as a single, isolated mass or in a group forming a chain or range.
- Munsell notation.** A designation of color by degrees of three simple variables: hue, value, and chroma.
- Neutral soil.** A soil having a pH value between 6.6 and 7.3.
- Organic matter.** Plant and animal residue in the soil in various stages of decomposition.
- Outcrop.** That part of a geologic formation or structure that appears at the surface of the earth.
- Parallel.** In the survey area, a local drainage pattern in which drainage pattern tributaries are parallel to one another and join the mainstream at right angles, characteristic of steeply sloping landforms and high energy streams.
- Parent material.** The unconsolidated organic and mineral matter in which soil forms.
- 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, depending on the variability of the soil.
- 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.
- pH value.** The numerical designation of acidity and alkalinity in soil (See Reaction, 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.
- Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. The vertical section of the soil extending through all its horizons and into the parent material.

Puddling. Destruction of natural soil structure by agitation with water.

Quartz monzonite. A granitic rock in which quartz comprises 10 to 50 percent of the light-colored minerals and in which alkali feldspar is 35 to 65 percent of total feldspar.

Quartzite. Relatively hard rocks derived from metamorphosed sandstone.

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.

Raptors. Birds of prey.

Ravel. The movement of individual soil or gravel particles down a slope by gravitational force.

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 degree of acidity or alkalinity is expressed as:

| | |
|------------------------------|-----------------|
| 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. |

Regeneration. The renewal of a tree crop by natural or artificial means.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum. Unconsolidated, weathered, or partly weathered mineral material that only accumulates by disintegration of bedrock in place.

Ridge. A long narrow elevation of the land surface, usually sharp crested with steep sides and forming an extended upland between valleys.

Riparian area. Areas within 100 horizontal feet of live water or areas that support plants or animals requiring free water.

Road cut. The sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fall. Fall of cobble-size and larger rocks from steep cutslopes onto the road surface.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. Barren exposures of hard bedrock that is fractured in places. Some soil material is in cracks and crevices. In this survey area, the rock is mostly hard crystalline, andesite, or basalt. When rock outcrop is on steep slopes it normally includes small areas of loose stones, cobbles, or gravel.

Rock structure. A weathered rock material in which the constituent parts remain in the same position with the same orientation as in the original rock.

Rock weathering. Transformation of rock by physical and chemical processes associated with the environment at the earth's surface.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of an area without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Rutting. Furrows made in road surfaces by the passage of wheeled vehicles over wet and plastic materials.

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.

Schist. A medium- or coarse-grained metamorphic rock with subparallel orientation of the micaceous minerals that dominate its composition.

Scour. The powerful and concentrated clearing and digging action of flowing air, water, or ice.

Sediment. Solid clastic material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, ice or mass-wasting and has come to rest on the earth's surface either above or below sea level.

Sediment delivery. The relative ease with which sediment produced in an efficiency landscape reaches stream channels within the same landscape. This is the qualitative equivalent of the sediment delivery ratio, which is the ratio of the sediment reaching streams to the amount eroded within a drainage area.

Sediment yield. The amount of material eroded from the land surface by runoff and delivered to a stream system.

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.

Seral. A plant species or community that is replaced by another species or community as succession progresses.

Shale. Sedimentary rock formed by the hardening of a clay deposit having the tendency to split into thin layers.

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.

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 and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

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.

Slough. Small landslides involving less than 10 cubic yards of material which detach from road cut slopes and fall in the road ditch and on the running surface.

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 (mm) in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

| | |
|------------------------|---------------------|
| Very coarse sand | 2.0 to 1.0 mm. |
| Coarse sand | 1.0 to 0.5 mm. |
| Medium sand | 0.5 to 0.25 mm. |
| Fine sand | 0.25 to 0.10 mm. |
| Very fine sand | 0.10 to 0.05 mm. |
| Silt | 0.05 to 0.002 mm. |
| Clay | Less than 0.002 mm. |

Solar insolation. Sum total of all long- and short-wave radiation intercepted by a slope.

Solifluction. A mass wasting process occurring in areas of frozen ground, with alternate freezing and thawing of surface materials.

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 these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches in diameter if rounded or 6 to 15 inches in length if flat.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stream order. In a drainage basin network, the smallest unbranched tributaries are designated stream order 1; the confluence of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3; etc. The order of a drainage basin is determined by the highest integer.

Stream reach. The length of a stream channel, uniform with respect to discharge, depth, area, and slope, or a length of stream between two specified points.

Stream terrace. See Terrace, stream.

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), *granular* (rounded), and *structureless* (soils are either single grained or massive).

Subgrade. The upper part of a road fill upon which the road surfacing components are placed.

Subsoil. Technically, the B horizon; roughly, the part of the solum below the surface soil.

Substratum. The part of the soil below the solum; the C horizon.

Surface layer. The uppermost layer in the soil, usually ranging in depth from 4 to 10 inches.

Taxonomic unit. A defined class at any categorical level in the soil classification system. The soil names for map units refer to taxonomic units.

Terrace, stream. A step-like surface, bordering a valley floor or shoreline, that represents the

former position of an alluvial plain, fan, or lake or seashore. The term is usually applied to both the relatively flat summit surface (platform, tread), cut or built by stream or wave action and the steeper descending slope (scarp, riser), graded to a lower base level of erosion.

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.

Till, glacial. See Glacial till.

Topography. The relative position and elevations of the natural or man-made features of an area that describe the configurations of its surface.

Transitory range. Livestock forage available from typically forested lands during the period of seral grass, forb, and shrub growth following timber harvest or fire.

Triassic. First period of the Mesozoic Era, following the Permian Period of the Paleozoic Era and preceding the Jurassic Period of the Mesozoic Era (approximately 181 to 230 million years ago).

Trough wall. Side slopes of elongate, U-shaped valleys produced by glacial activity.

Udic. Soil moisture regime in which the soil moisture control section is not dry in any part for as long as 90 days, or 45 consecutive days in the growing season.

Undifferentiated. A group of two or more soil or vegetative bodies that are not consistently

associated geographically but that are mapped together because some common feature, such as climate or steepness, determines use and management.

Ustic. A soil moisture regime in which the moisture control section is dry for 90 or more days but is not dry more than half the time the soil temperature is above 50° C at 20 inches.

Upland. The elevated land above the low areas along streams or between hills; land above the footslope zone of the hillslope continuance.

Valley. An elongate, relatively large, externally-drained depression of the earth's surface that is primarily developed by stream erosion.

Volcanic. Pertaining to (1) the deep-seated (igneous) processes by which magma and associated gases rise through the crust and are extruded onto the earth's surface and into the atmosphere, and (2) the structure, rocks, and landforms produced.

Volcanic ash. Fine pyroclastic material smaller than 4.0 mm. diameter. In this survey area, the volcanic ash qualifies as fine ash, less than 0.25 mm. diameter, because it is mostly in the silt and very fine sand-size range. See Loess.

Water bar. A ridge made across a road surface to divert water.

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.

Windthrow. The action of uprooting and tipping over trees by the wind.

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