SOIL SURVEY AND INTERPRETATIONS
of the
WAPITI MAP AREA, ALBERTA

by

A. G. Twardy and I. G. W. Corns

Soils Deparment

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A.G. Twardy
Pedology Consultants
9120 - 37 Avenue,
Edmonton, Alberta
T6E 5L4

I.G. Corns
Northern Forest Research Centre
5320 - 122 Street,
Edmonton, Alberta
T6H 3S5

Copies of this report are
available from:

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Alberta Research Council
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Edmonton, Alberta, T6G 2C2

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Editing: A. Campbell
Drafting of color maps: C. Parent
Drafting in Report: Z. Widtman
Manuscript Production: K.P. O'Leary, M. Maduro, D. Palting

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SUMMARY

A soil survey of the Wapiti map area (NTS 83L) was initiated in 1972 as part of the continuing program of the Alberta Institute of Pedology to map and describe the soil resources of Alberta. Prior to this, both a reconnaissance soil survey of the northernmost three townships (Odynsky et al. 1956, 1961) and an exploratory soil survey of the map area excluding the mountainous regions (Lindsay et al. 1964) had been conducted. The purpose of this report and accompanying soil maps is to provide data on the kind, characteristics, location, and areal distribution of soils in the Wapiti map area, and to indicate the suitability of these soils for various specified uses.

This was a reconnaissance soil survey in which traverses were made at 1- to 2- mile intervals with soil inspections made approximately every half mile along traverse lines. Aerial photographs and topographic maps (1:50,000) were used to establish soil and topographic boundaries.

Four soils maps supplement this report. These maps, published at a scale of 1:126,720 (1 inch equals 2 miles), show the main topographic features and the location and extent of the individual soil areas. Township and range numbers are shown along the margins. Soil areas are identified on the maps by symbols and colors. A key to color and symbol designations appears in the descriptive legend at the bottom of the maps.

The first sections of the report outline historical, natural resource, and economic highlights of the area. This is followed by a discussion of the environmental aspects of the region, and an evaluation of some trends in soil formation pertinent to the area.

The report then outlines in considerable detail the system and methods that were employed in soil mapping. Soils are described on the basis of soil groups. Soil groups are assembled according to kinds of parent material. The discussion of each soil group includes a description of the physiography, drainage, topography, vegetation, and landform of the area in which the group is found. Each soil unit within a soil group is described, and its properties and distribution are related to other units.

The final portion of the report outlines soil survey interpretations relating to forest vegetation, agriculture, engineering, and erosion hazards. The Soil Capability for Agriculture system is used to group the soils for agricultural interpretations. Engineering interpretations are provided for specific uses. The performance of the various soil groups and phases used in various ways is evaluated: as sites for single family dwellings (with and without basements) and sewage disposal; as throughways for roads and underground pipelines; and as sources of subgrade material, and sand and gravel. The soil groups are also compared to each other and rated according to their potential susceptibility to water erosion.

Four appendices follow the report. The first gives the detailed descriptions of the soils and pertinent analytical data, and also includes a discussion of the actual analyses and the analytical methods used in the laboratory. The second is a discussion of the forest vegetation classification. The third appendix presents the guidelines for evaluating the soils for specific uses, and the fourth includes a glossary of commonly used soil, vegetation, and geological terms as well as an outline of the Canadian System of Soil Classification, 1976 edition.

ACKNOWLEDGMENTS

The soil survey of the Wapiti map area was conducted by the Soils Department, Alberta Research Council, as part of a joint project also involving Agriculture Canada and the University of Alberta. These three organizations form the Alberta Institute of Pedology.

Funds for the field work and for compilation of the soils map were supplied by the Alberta Research Council. The Research Branch, Agriculture Canada, together with the Soils Department, Alberta Research Council, supplied funds for the laboratory work. The University provided office and laboratory accommodation. The Alberta Research Council funded the publication of the report.

Aerial photographs and field maps were obtained from the Technical Division, Alberta Energy and Natural Resources. More recent aerial photographs of a portion of the area were obtained from Proctor and Gamble Cellulose Ltd. of Grande Prairie.

The final soils map was drafted by C. Parent with aid of F.L. Copeland of Drafting Services, Alberta Research Council.

Technical laboratory assistance for this study was provided by A. Schwarzer, W.C. McKean, and J. Beres. Z. Widtman assisted in the compilation and drafting of the maps. L. Kipling, T. Macyk, W. Samoil, W. Taylor, A. Stirrit, C. Veauvy, and Z. Widtman helped in the field mapping. R. Brodie, C. Clayton, G. Gunther, and D. Milner assisted with the forest plot sampling. D. Paton, P. Dubé, and E. Fong assisted with tree growth measurements and computation tasks. Appreciation is expressed to J.D. Lindsay, A. Wynnyk, and W. Pettapiece for reviewing the manuscript. A.R. Campbell assisted in the compilation and proofreading of this report.

LEGEND

11 Blackfoot and Calgary sheets
12 Rosebud and Banff sheets
13 Vermilion and Wainwright sheets
14 Peace Hills sheet
15 Rycroft and Watino sheets
16 Red Deer sheet
17 High Prairie and McLennan sheets
18 Grande Prairie and Sturgeon Lake sheets
19 Rocky Mountain House sheet
20 Beaverlodge and Blueberry Mountain sheets
21 Edmonton sheet
22 St. Mary and Milk River project
23 Cherry Point and Hines Creek area
24 Buck Lake and Wabamun Lake area
25 Grimshaw and Notikewin area
26 Hotchkiss and Keg River area
27 Whitecourt and Barrhead area
28 Chip Lake area
29 Tawatinaw map sheet 83 I
30 Mount Watt and Fort Vermilion area
31 Hinton-Edson area 83 F
31a North Saskatchewan River Valley
33 Waterton Lakes National Park
34 Sand River sheet
36 Oyen sheet
38 Elk Island National Park
39 **Wapiti Map area**
58-1 Preliminary
59-1 Preliminary
60-1 Preliminary
61-1 Preliminary
62-1 Preliminary
63-1 Preliminary
64-1 Preliminary
64-2 Preliminary

Note:
Reports published prior to 1942 are out of print but may be obtained on loan from the Alberta Soil Survey. These include: MacLeod sheet, Medicine Hat sheet, Sounding Creek sheet, Peace River, High Prairie, Sturgeon Lake area, Rainy Hills sheet, Sullivan Lake sheet, Lethbridge and Pincher Creek sheets, Milk River sheet, Blackfoot and Calgary sheets, Rosebud and Banff sheets and Vermilion and Wainwright sheets.

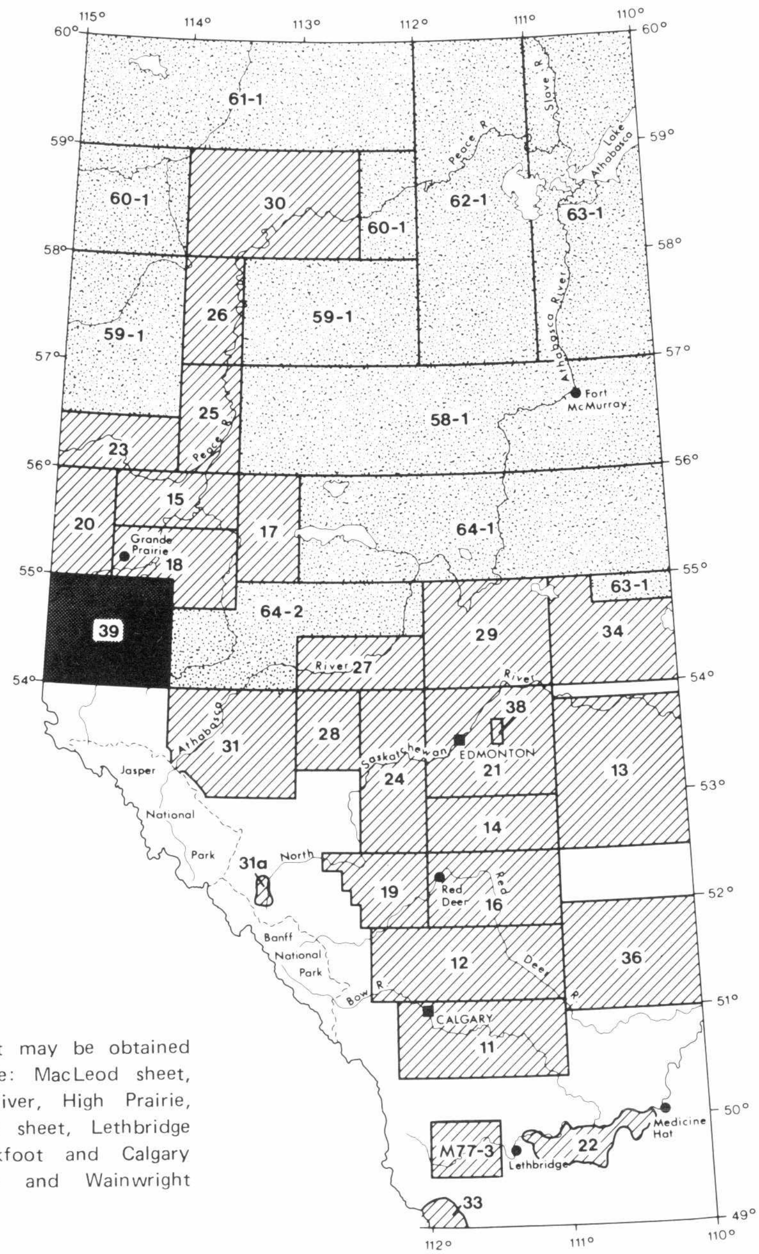


FIGURE 1. Sketch map of Alberta showing locations of surveyed areas for which reports have been published since 1941

GENERAL DESCRIPTION OF THE AREA

LOCATION, EXTENT, AND POPULATION

The Wapiti map area (National Topographic Series Map 83L) covers about 1,436,960 ha (3,550,660 acres) in west central Alberta. The area is about 111 km (69 miles) long (north to south) by 127 km (79.5 miles) wide (east to west) and encompasses part or all of Tps 58 to 69, Rs 1 to 14 inclusive, W 6th Mer. (Fig. 1). The Alberta - British Columbia border forms the western boundary. The city of Grande Prairie, Alberta is located about 16 km (10 miles) north of the center of the northern boundary, while the town of Grande Cache is located on the Smoky River about 14 km (9 miles) south of the southern boundary. This area lies between 54 and 55 degrees north latitude and 118 and 120 degrees west longitude, and spreads over four different physiographic areas (mountains, foothills, elevated plateaus, and lowlands). With the exceptions of a small farming community in the northern portion and a small amount of alpine terrain and wetlands, the area is entirely forested.

Settlement is restricted to a small farming district in portions of Tp 69, Rs 6 to 8 and 10 to 12 inclusive, and a small native settlement of Shuttler Flats on Nose Creek. No major population centers exist in the map area, and total population probably does not exceed 200. The location of the study area is shown in figure 1.

HISTORICAL DEVELOPMENT AND ECONOMY

In 1819, the Hudson's Bay Company established St. Mary's House at the mouth of the Smoky River, near the present town of Peace River. At that time, St. Mary's House was the most westerly post on the Peace River. In 1820, Ignace Giasson entered the Wapiti map area, the first white man on record to do so. He and Tête Jaune, his Iroquois guide, left St. Mary's House and took charge of a voyage up the Smoky River to make friends with the Indians, and to incorporate new fur trapping territories for the Hudson's Bay Company. On March 29, 1820, Giasson arrived at the site of the present town of Grande Cache, where he spoke of leaving a great number of furs in cache (MacGregor, 1974).

At the turn of the century, settlements were established in the Grande Prairie area north of the Wapiti map area. Most of the first traders, missionaries, and settlers came from the east by way of the Grouard and Athabasca trails. In 1911, after the railroad between Edson and Edmonton was completed, an overland trail was surveyed and constructed from Edson to Sturgeon Lake and west to the vicinity of Grande Prairie. The first large influx of settlers came into the Grande Prairie area by way of this trail.

Plate 1. An open pit coal mine near Sheep Creek.

Most of the agricultural development to the north has taken place since completion of the railroad to High Prairie in 1914 and to Grande Prairie in 1918.

Agricultural settlements within the map area were established much later in portions of Tp 69 in Rs 6 to 8 and 10 to 12 inclusive, where approximately 30 sections of land in a marginal climatic region are used for coarse-grain production as well as pasture. Most of the mapped area is unsuitable for agricultural development because of the rough terrain, and generally unsuitable climate.

Until the early 1960's the main activities within the Wapiti map area were trapping, some coal mining, and lumbering. Settlement was very limited. Lumbering operations which produced sawn timber, railway ties, and fence posts were located throughout the region but they were generally small-scale ventures. The Wapiti area became more accessible after seismograph crews were active in the area in the 1960's, and sportsmen frequently visited to hunt and fish. Grande Prairie benefitted substantially from such outdoor activities.

Alberta's coal industry was rejuvenated in the late 1960's when demands for thermal electric power increased and extra fine coking coal began to be exported to Japan. The Grande Cache mines were brought into production, which improved access to some of the southwestern portions of the map area (Plate 1). To transport the vast quantities of coal from Grande Cache, the Alberta Resources Railway

Plate 2. An area of strip cutting near Sherman Meadows.

was constructed during the latter part of the sixties. Originally, a spur line was to be built from the Canadian National Railways line near Entrance to Grande Cache to give access to the large field of rich coking coal. Eventually, however, the line was extended to Grande Prairie to connect with the Northern Alberta Railway. The Alberta Resources Railway route follows much the same route taken by Ignace Giasson and Tête Jaune about 150 years earlier.

In 1972, spring flood waters in Sheep Creek and the Smoky River ripped away thousands of cubic metres of fill and several kilometres of rail on the northern portion of the new railroad. Trains could not operate between Grande Prairie and Grande Cache until 1975.

On December 19, 1970, Proctor and Gamble Cellulose Ltd. announced that it would construct a pulp mill 13 km south of the city of Grande Prairie. Most of the trees for the mill were to be harvested in the Wapiti map area. Construction of the mill began the following year, and on August 13, 1973, the first trainload of pulp was shipped from the mill. Business and commerce expanded rapidly and Grande Prairie, which originated as a small city within a farming community, became an active center. Grande Prairie's population is about 20,400.

The establishment of the pulp mill was a major economic impetus for the area. It directly employs between 650 and 750 persons with an annual payroll of about 7 million dollars. Over 300 people are employed directly at the mill and the remainder are in the woodlands operation. In addition, both North Canadian Forestry Industries of Grande Prairie and North Western Pulp and Power Company of Hinton harvest trees within the map area (Plate 2). Recently, substantial reserves of natural gas have been discovered near Elmworth to the southwest of Grande Prairie.

The recently-built forestry roads have opened to the public vast areas which abound in wildlife and have much recreational potential. Kakwa Falls (Plate 3), Two Lakes, Musreau Lake, and other recreational areas are now easily accessible by motor vehicle. Hunting and fishing are very popular sports. The big game found in the area include deer, moose, bear (black and grizzly), caribou, elk, mountain goat, and mountain sheep. The common fur-bearing animals are fox, beaver, muskrat, weasel, and squirrel. Fish are found in most of the streams as well as in Two Lakes and Nose Lake.

THE ENVIRONMENT

PHYSIOGRAPHY

The Wapiti map area spans the transition zone between the Interior Plains and the Western Cordillera. Elevation is only about 525 m (1,750 feet) in the northeast where the Smoky River leaves the map area, but increases gradually to about 2,455 m (8,050 feet) in the southwestern portion of the area. This change in elevation takes place over a distance of approximately 144 km (90 miles).

A number of physiographic subdivisions are recognized in the area. Bostock (1970) assigns the area partly to the Interior Plains region and partly to the Rocky Mountain Area of the Cordilleran region. Further, he subdivides the Interior Plains into the Alberta Plateau and the Peace

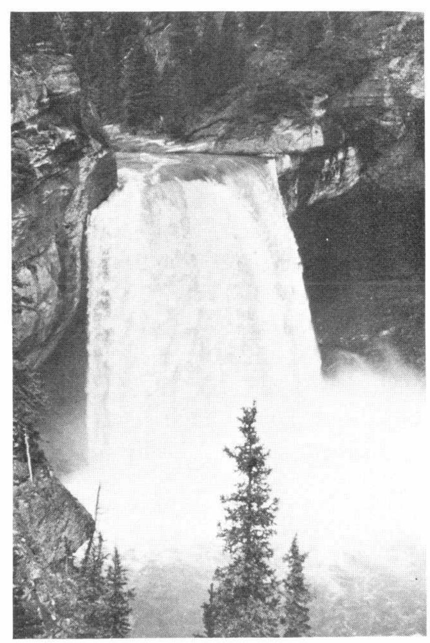
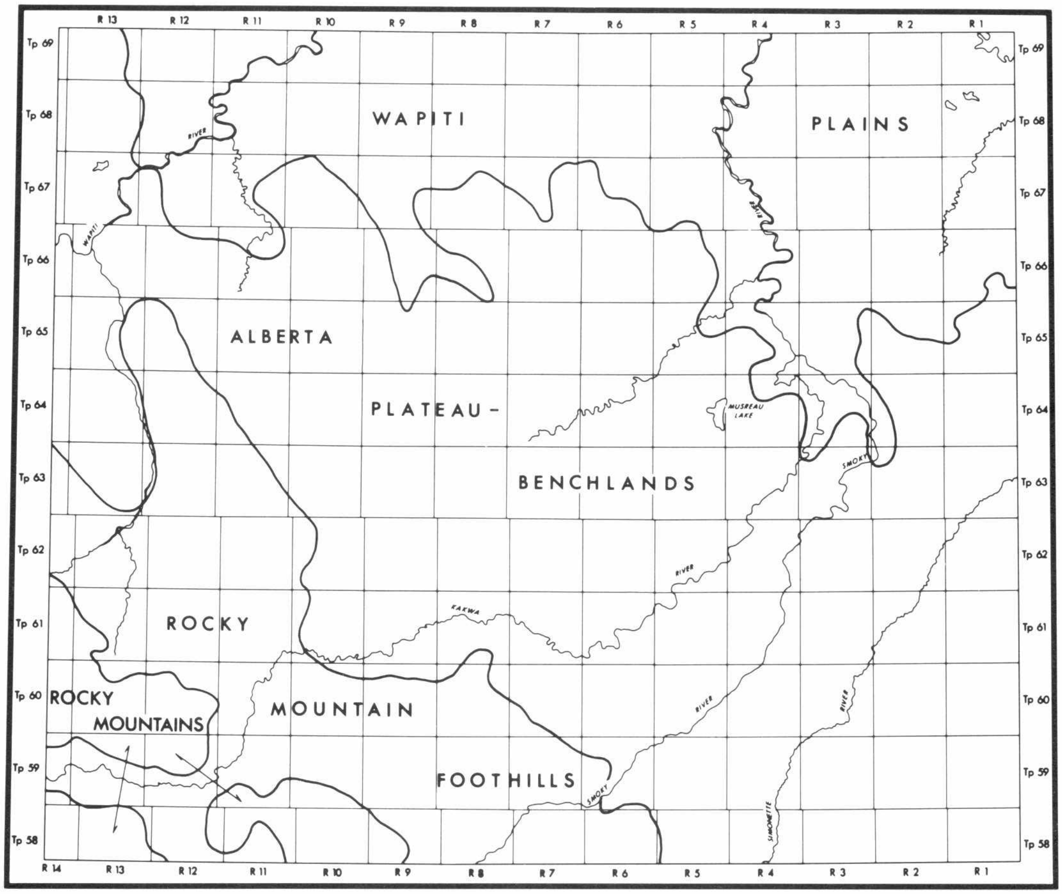


Plate 3. Kakwa falls on the Kakwa River in the southwestern portion of the map area.



REGIONS	DIVISIONS
Interior Plains	Wapiti Plains Alberta Plateau-Benchlands
Western Cordillera	Rocky Mountain Foothills Rocky Mountains

FIGURE 2. Physiographic regions and divisions

River Lowlands and the Rocky Mountain Area into the Southern Rocky Mountains and the Rocky Mountain Foothills. The Atlas of Alberta (Alberta, Government and University, 1969) assigns the area to the Wapiti Plains and the Western Alberta Plains of the Interior Plains region, and to the Rocky Mountains and Rocky Mountain Foothills of the Western Cordillera region.

There is general agreement between the two authors at broad levels of classification, but there are important differences in terminology and areal projection at lower levels of subdivision. For this reason, an independent approach was taken in this report, and the area was subdivided as shown in figure 2. This subdivision is based on land form, regional climatic conditions, general elevations, local relief, and soil profile morphology.

Interior Plains Region

The Interior Plains is the largest physiographic region in the map area. It lies east and northeast of the tightly folded Foothills belt, and occupies the region that is underlain by very gently tilted or flat-lying Cretaceous and Tertiary strata (Douglas *et al*, 1970).

Wapiti Plains Division

This division is the continuation of the Wapiti Plains as defined in the Atlas of Alberta (Alberta, Government and University, 1969) and is somewhat equivalent to the Peace River Lowlands as defined by Holland (1964). Comprising land underlain by a bedrock surface of low relief, the area is in general a lowland compared to the

Plate 4. A relatively level upland plateau area and a steeply sloping escarpment in the Alberta Plateau-Benchlands physiographic division. Soils of the Simonette group occur on the plateau area and soils of the Deep Valley group are found on the escarpment.

rest of the map area. The bedrock crops out in a few locations, but mostly it is buried by glacial and postglacial deposits of considerable but variable thickness. Generally, the landscape is one of gently undulating to undulating glaciolacustrine and glaciofluvial deposits, gently undulating to gently rolling ground moraine, and gently rolling to rolling eolian material. Maximum elevation in this division is about 855 m (2,800 feet) which corresponds approximately to the upper limit of the glaciolacustrine and lacustrotill (lacustrotill is a type of glaciolacustrine deposit) deposits in the northern portion of the map area.

Orthic Gray Luvisols and Solonetzic Gray Luvisols predominate in this area. At the higher elevations in the area, relatively intense eluviation tends to bleach the upper portion of the Ae horizon producing a double Ae horizon sequence. At the boundary between the Wapiti Plains and the Alberta Plateau Benchlands, eluviation is severe and incipient Bf_j or Bm horizons may be present at the contact between the upper and lower Ae horizons; such soils are called Brunisolic Gray Luvisols.

Alberta Plateau-Benchlands Division

The upland lying between the Wapiti Plains to the north and the Rocky Mountain Foothills to the southwest constitutes this division. Bedrock is very gently dipping Cretaceous and Tertiary strata. The most common features are smooth upland areas dissected by wide valleys. A typical example of such an area is the flat upland in the southeastern portion of the map area which is formed primarily of preglacial Tertiary gravel deposits. Much of the remaining terrain consists of long, sloping, dissected benchlands (Plate 4) extending from the Foothills to the Plains. In general, the division is covered by Pleistocene sediment which is usually less than 1 m thick. Soft bedrock commonly crops out. Average elevation ranges from about 855 m (2,800 feet) to about 1465 m (4,800 feet), but highlands may rise to about 1525 m (5,000 feet). The area is approximately equivalent to benchlands and tablelands as defined by Roed (1968) and to the Alberta Plateau as described by Bostock (1970).

At lower elevations, on medium textured materials, Orthic Gray Luvisols exhibiting a double Ae horizon sequence predominate. With increasing elevation both the incidence and the degree of expression of the Brunisolic profile increase, so that at higher elevations Podzolic and Brunisolic Gray Luvisols are predominant, even though Orthic Gray Luvisols with a double Ae horizon sequence can be found.

Western Cordillera Region

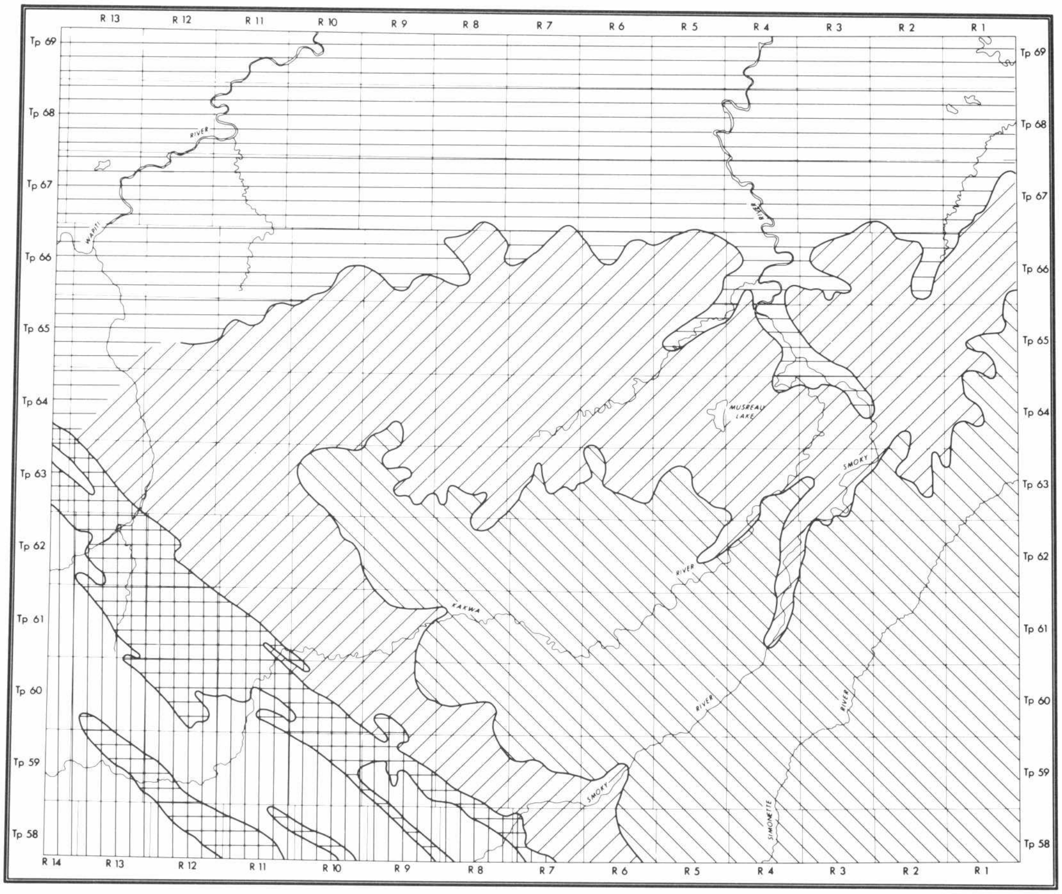
This region occupies the southwestern portion of the map area. Bedrock is composed primarily of intensely folded and faulted sedimentary strata. Elevations are considerably higher than those in the Interior Plains.

Rocky Mountain Foothills Division

This division occupies a general northwest-trending zone between the Rocky Mountains and the Interior Plains. Structurally, the division is a series of distinct, predominantly "razor-back," approximately parallel ridges which are aligned in a northwestern to southeastern direction (Plate 5). Local relief is commonly less than 35 m (100 feet) but may be as much as a few hundred metres.

Bedrock consists of highly folded strata of Cretaceous and Tertiary age. This is covered by thin till deposits to

Plate 5. Steeply sloping terrain in the Rocky Mountain Foothills physiographic division.



LEGEND

- Paskapoo Formation - Paleocene and Upper Cretaceous
- Scollard Member of Paskapoo Formation - Paleocene and Upper Cretaceous
- Wapiti Formation - Upper Cretaceous
- Brazeau Formation - Paleocene and Upper Cretaceous
- Alberta Group - Upper Cretaceous
- Mesozoic - Lower Cretaceous, Jurassic and Triassic

Source: Geological map of Alberta: Research Council of Alberta

FIGURE 3. Bedrock geology of the Wapiti map area

which, in many cases, considerable colluvial material has been added. Elevations within the Rocky Mountain Foothills range from 1,065 m (3,500 feet) to 1,830 m (6,000 feet), but generally are between 1,525 m (5,000 feet) and 1,585 m (5,200 feet). The area is highly dissected, resulting in strongly rolling to hilly topography.

Morphologically the soils in the Foothills are similar to those prevalent at the upper elevational levels of the Alberta Plateau-Benchlands. Orthic Gray Luvisols with a double Ae horizon sequence as well as Brunisolic and Podzolic Gray Luvisols are present on the gentler slopes. Eluviated Dystric and Eluviated Eutric Brunisols are generally confined to the steeper slopes and the coarser-textured deposits.

Rocky Mountains Division

The Rocky Mountains division, located in the extreme southwestern portion of the map area, includes part of the Hart Ranges of the Southern Rocky Mountains which rise gradually and form a long saddle of relatively subdued mountains with summits below 2,745 m (9,000 feet) (Bostock, 1970). The bedrock in this portion in the map area is composed exclusively of sedimentary Mesozoic strata that have been intensely folded. Sculptured glacial features such as cirques, aretes, horns, and U-shaped valleys are prominent. Elevations range from about 1,525 m (5,000 feet) to 2,455 m (8,050 feet), and local relief can be very high.

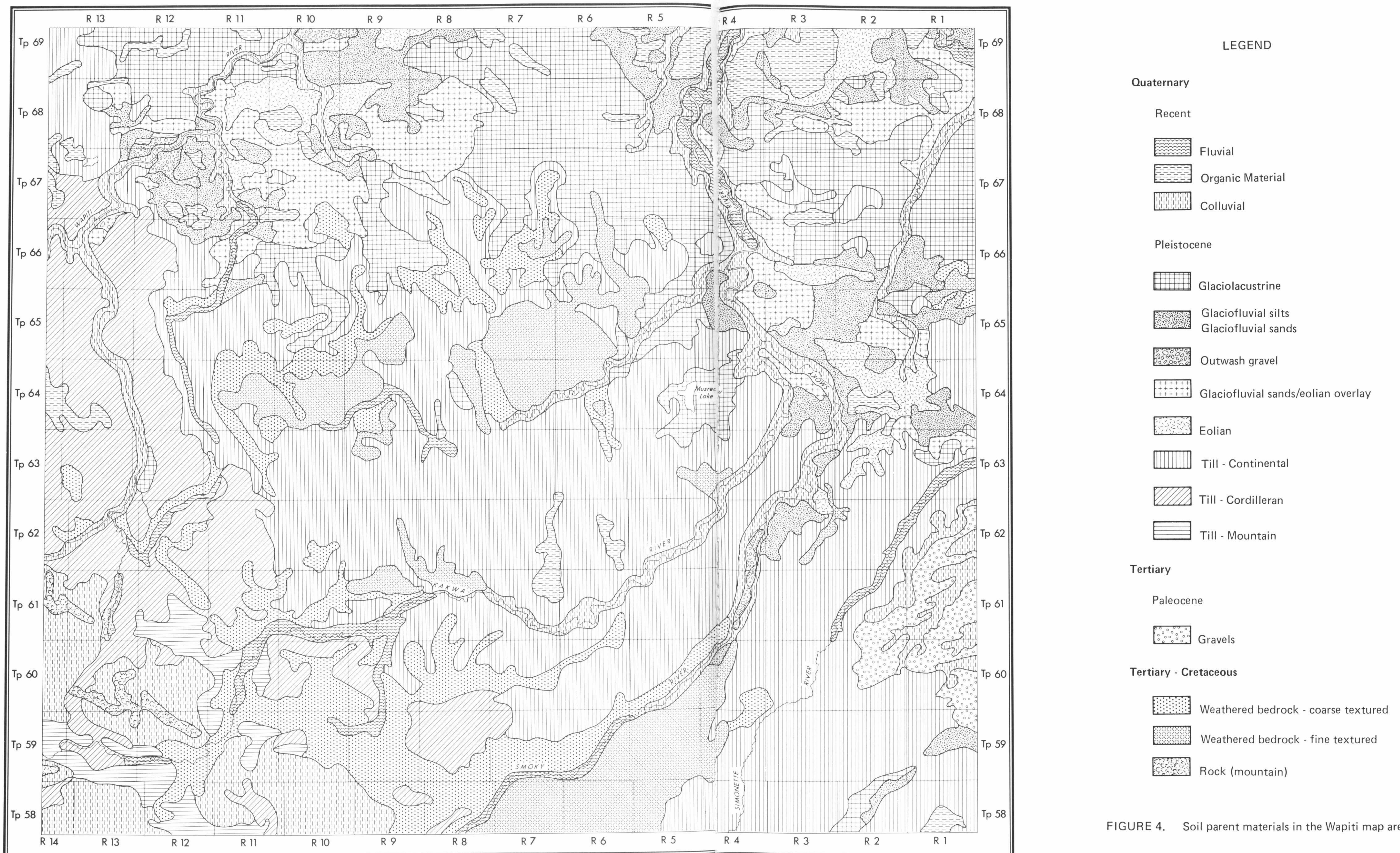


FIGURE 4. Soil parent materials in the Wapiti map area

Eluviated Dystric and Eluviated Eutric Brunisols developed primarily on colluvial material predominate on the very steep, treed portions of this division. Above tree line periglacial features such as stone rings, stone stripes, and solifluction lobes are common. The tree line is at an elevation of 1,830 m (6,000 feet) in the map area.

GEOLOGY AND SOIL PARENT MATERIALS

Bedrock Geology

In the map area, physiographic boundaries closely approximate boundaries of bedrock units (Fig. 3). The Wapiti Plains division of the Interior Plains is underlain by rocks belonging to the Late Cretaceous Wapiti Formation. This nonmarine formation is composed of gray, feldspathic, clayey sandstones and gray bentonitic mudstone and bentonite (Green, 1972). The Alberta Plateau-Benchlands division is underlain by the Paskapoo Formation of Paleocene to Late Cretaceous age. The Paskapoo Formation as described by Roed (1968) consists of weakly consolidated beds of sandstone and siltstone, with interbedded strata of shale, coal, and chert conglomerate. Upland plateau areas are often capped by thin beds of cobbly gravel composed mainly of metaquartzite cobbles. The Scollard Member of the Paskapoo Formation has also been recognized in the map area (Fig. 3). This unit is similar to the rest of the Paskapoo Formation except that it contains bentonitic mudstone and thick coal beds (Green, 1972).

Bedrock in the Western Cordillera region is composed of a thick sequence of clastic rocks belonging to the Alberta and Blairmore Groups of Cretaceous, Jurassic, and Triassic age. Due to the ubiquitous folding and faulting, local elongated exposures of Cardium, Blackstone, and Wapiabi Formations (Alberta Group formations) as well as the Brazeau Formation and the Blairmore Group are found throughout the area (Green, 1972).

Surficial Deposits

Most soils in the Wapiti area have developed on glacial and postglacial deposits. During glacial times, much of the area was covered by a Continental ice sheet which advanced from the central region of the Keewatin district (Gravenor and Bayrock, 1955). Cordilleran ice, moving from the west and northwest, glaciated the southwestern and western portions of the area. These two ice sheets met along a zone roughly paralleling Nose Creek (Alberta Research Council, unpublished information). In addition, a number of local valley glaciers (informally called Mountain glaciers in this report) formed in the mountains shortly after the Cordilleran ice advance.

Bayrock (1962) found that the tills of east-central Alberta contain 80 percent local bedrock. On this basis, material deposited by the Continental ice is derived primarily from the Wapiti and Paskapoo Formations, while material deposited by Cordilleran ice consists chiefly of fragments of the bedrock units forming the mountains and foothills. However, some mixing of till took place along the zone of contact between the two ice sheets. Granitic erratics of Precambrian Shield origin identify Continental till, while quartzite erratics are common in Cordilleran till.

Material accumulated by the glaciers was deposited on the subglacial land-surface. In postglacial times, some of this material was moved, sorted, and re-deposited. The preglacial, glacial, and postglacial deposits recognized in the map area and their areal extent are shown in figure 4.

Till is a heterogeneous material, deposited directly from glacial ice. In this area till forms 40 percent of the surficial deposits and underlies most other glacial deposits. The dominant landform associated with till is ground moraine with relatively low local relief. Although this landform is very common throughout the Foothills and Interior Plains, the till deposits are relatively thin so underlying bedrock landforms are covered but usually not masked. Small pockets of hummocky dead-ice moraine, end moraine, and lateral moraine are also found in the area.

Within the Wapiti map area, Soil Survey has recognized two variants of Continental till, two variants of Cordilleran till, and two of Mountain till. The tills generally reflect both the characteristics of the underlying geological formations and the source areas of the glacial ice which deposited the materials.

The main glaciolacustrine and glaciolacustrotill basins are found in the Wapiti Plains in the northern portion of the map area. The stone-free, fine to very fine textured lacustrine sediments are confined to elevations below 745 m (2,450 feet). The lacustrotill deposits consist of fine textured stratified materials containing some stones.

Two variants of lacustrotill were recognized in the map area. The more areally extensive variant is found in the Wapiti Plains at elevations below 855 m (2,800 feet). The other is found in both the Alberta Plateau-Benchlands and the Foothills adjacent to major and semi-major drainage channels in deposits extending from the drainage channel to the nearest significant rise of land. This material was probably deposited in ice-marginal lakes that developed as the glacial ice retreated from the uplands to the lower-lying preglacial valleys.

Topography associated with glaciolacustrine materials varies from gently undulating to gently rolling. These materials usually mask but do not obliterate the underlying topography. Lacustrine and lacustrotill deposits constitute 12 percent of the surficial deposits of the map area.

Rock outcrops (non-soil) as well as soils developed on the various bedrock materials constitute 15 percent of the map area. The rock outcrops are confined to the mountainous regions near and above tree line, in areas of rough topography. Soils developed on soft bedrock materials are found mainly in the Alberta Plateau-Benchlands and Foothills divisions. The bedrock materials were differentiated on the basis of texture – namely, those which are moderately coarse to medium textured and those which are moderately fine to fine textured. The textural variations did not correlate with any of the bedrock formations. However, it is thought that in the Alberta Plateau-Benchlands the coarser textured material is derived primarily from the sandstone beds of the Paskapoo Formation, and the finer textured material primarily from a shaly member of the Paskapoo Formation. Soils in the Foothills are developed on sandstones of the Brazeau, Cardium, Wapiabi, and Blackstone Formations as well as on the Paskapoo Formation. Soft bedrock materials are usually found on the more steeply sloping landscapes and high hills and plateaus.

Colluvial deposits constitute about 10 percent of the surficial deposits of the map area. These materials occupy the steeply sloping river banks and the eroded escarpments of Tertiary uplands in the Interior Plains and are the dominant deposits of the mountainous region.

Glaciofluvial materials are sediments deposited by glacial streams on land (Thwaites, 1963). In the map area these deposits include gravels and cobbly gravels, sands, silts, and some overlay sand materials. About 10 percent of the deposits in the Wapiti area are glaciofluvial. In the main, they are found in the northern portion of the map area and along some of the major and semi-major drainage channels. These deposits may be present as thin beds (less than 50 cm thick) overlying other deposits. Topography is normally undulating to gently rolling.

Preglacial gravels outcrop on various upland plateaus. These gravels are composed predominantly of rounded metaquartzite cobbles and pebbles, with lesser amounts of feldspathic and quartzose sandstones. This material is common in the region to the east of the Simonette and Nose towers. Topography associated with this deposit is usually relatively flat to undulating. In certain areas these deposits are crushed and used as road-building materials. Preglacial gravels occupy only 1 percent of the map area.

Eolian deposits are found east of the Wapiti and Smoky Rivers in the northern portion of the map area. These deposits are coarse textured and take the form of U-shaped and longitudinal dunes, or of thin beds overlying other deposits. The dunes are now stabilized by forest vegetation and Brunisolic soils while the inter-dune areas are characteristically occupied by Organic soils. Eolian deposits constitute approximately 2 percent of the area's surficial deposits.

Organic deposits are significant throughout the Interior Plains region. They are characterized by an accumulation of peat exceeding a compact thickness of 50 cm. Two types of organic materials have been recognized in the area. One is peat developed from sedge (fen), while the other is peat developed primarily from moss (bog). Organic deposits make up approximately 7 percent of the area.

The postglacial fluvial deposits along the floodplains of streams and rivers constitute approximately 2 percent of the area. The most extensive deposits are found along the Smoky, Kakwa, and Simonette Rivers.

VEGETATION

The Wapiti map area is located within the Boreal and Subalpine Forest regions as defined by Rowe (1959). Most of the area lies within the Mixedwood (B. 18a), Lower Foothills (B. 19a), and Upper Foothills (B. 19c) sections of the Boreal Forest region. A small area in the southwest lies inside the East Slope Rockies (SA. 1) of the Subalpine Forest region. A similar area of alpine vegetation occurs in the southwest above timber line. Figure 5 shows an interpretation of Rowe's forest regions in the study area.

Observations made during the course of the soil survey generally agree with the work of Rowe (1959), except in the portion of the map area covered by the Wapiti Plains. In this area, aspen poplar (*Populus tremuloides*) dominates the forest vegetation further south than indicated by Rowe, so this area should be considered as part of the Mixedwood section (B. 18a), and not as part of the Lower Foothills section (B. 19a). This alteration of Rowe's boundaries is adopted here.

The vegetation of the Wapiti map area is discussed according to the previously divided physiographic subdivisions (Fig. 2). It should be remembered that this is a general discussion. A more detailed treatment of component vegetation types is discussed in the context of the Soil Group descriptions.

Wapiti Plains Division

Well drained uplands, particularly at elevations below 855 m (2,800 feet), are covered by an almost continuous

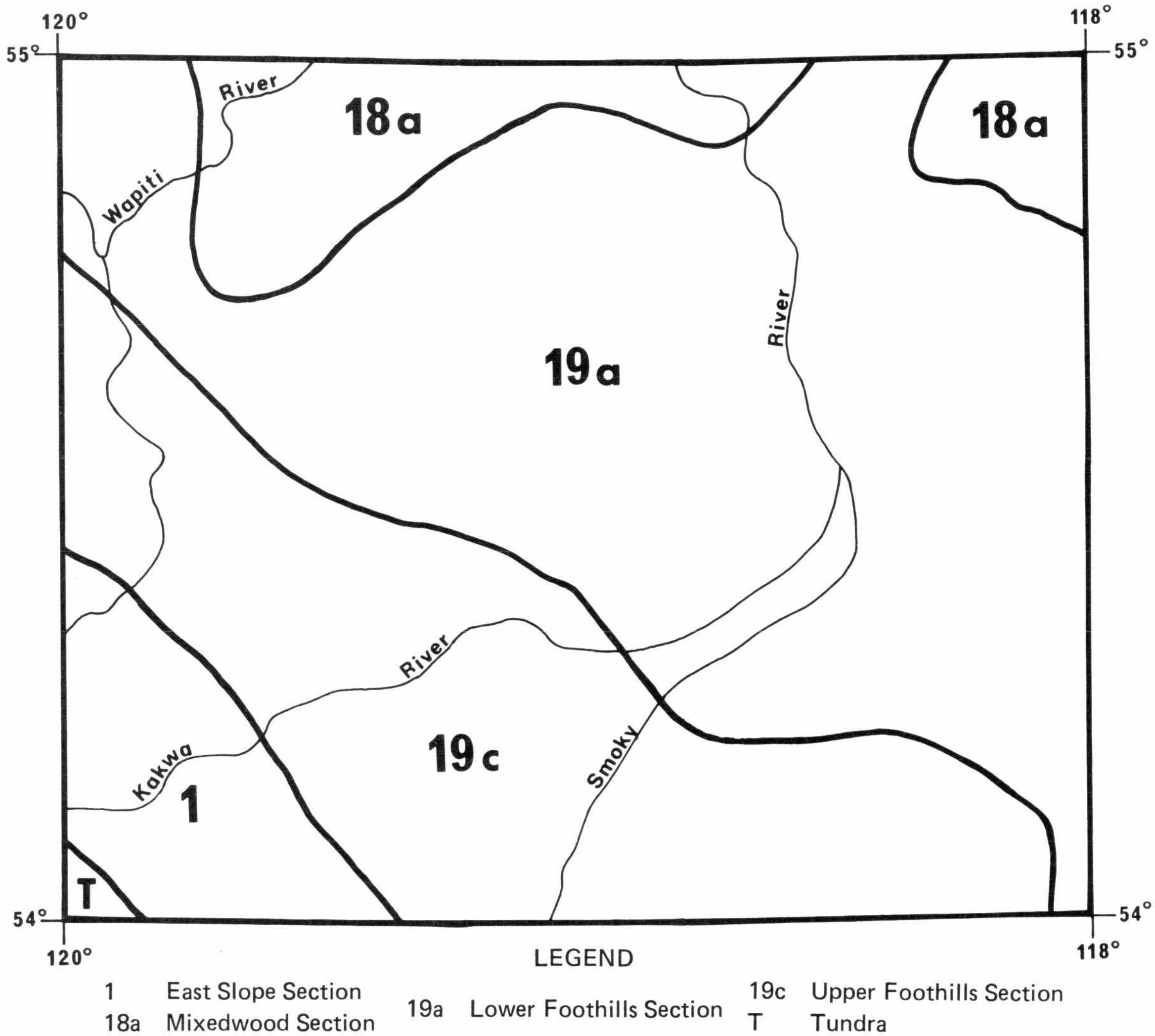


FIGURE 5. Forest regions in the vicinity of the Wapiti map area (after Rowe, 1959)

canopy of aspen poplar. Associated with this is a developing understory or a codominant story of white spruce (*Picea glauca*) and occasionally lodgepole pine (*Pinus contorta* var. *latifolia*). White spruce is prevalent in some of the older stands that have escaped destruction by fire. Lodgepole pine is abundant in some of the drier areas where very coarse textured soils are common. Undergrowth consists of shrubs, the most common being low-bush cranberry (*Viburnum edule*), bracted honeysuckle (*Lonicera involucrata*), wild raspberry (*Rubus strigosus*), and wild rose (*Rosa acicularis*), and low shrubs - Labrador tea (*Ledum groenlandicum*), blueberry (*Vaccinium myrtilloides*), bog cranberry (*Vaccinium vitis-idaea*), bearberry (*Arctostaphylos uva-ursi*), and twinflower (*Linnaea borealis*). Some of the more common forbs of the Wapiti Plains are bunchberry (*Cornus canadensis*), vetch (*Vicia americana*), Bishop's cap (*Mitella nuda*), and pea vine (*Lathyrus* spp.). Grasses and feathermosses are common.

Towards the periphery of the area, vegetation changes due to a gradual rise in elevation. The incidence of aspen poplar decreases while that of lodgepole pine and white spruce increases. Undergrowth may be similar to that found at lower elevations.

Imperfectly drained local areas are commonly covered by combinations of balsam poplar (*Populus balsamifera*), paper birch (*Betula papyrifera*), white spruce, and black spruce (*Picea mariana*). Undergrowth in such areas is dominated by Labrador tea and feathermosses. In some poorly drained depressional areas, peat areas covered by black spruce and tamarack (*Larix laricina*) have developed. These organic deposits are commonly 50 cm to 100 cm deep, but are occasionally more than 4 m deep. Undergrowth tends to be feathermoss and sphagnum moss. Other poorly drained areas consist predominantly of willow with sedge (*Carex* spp.) undergrowth.

Alberta Plateau - Benchlands Division

This broad general division is characterized by isolated elevated plateaus separated from each other and from the Foothills by long, gently sloping benchlands. Elevation ranges from 855 m (2,800 feet) to about 1,465 m (4,800 feet) above mean sea level. The most common tree species on well drained upland sites is lodgepole pine with some local stands of aspen and balsam poplar. These species have assumed a dominant position over most of the landscape in the wake of fire (Moss, 1955; Rowe, 1959). In certain older stands, white spruce and black spruce are common and subalpine fir (*Abies lasiocarpa*) may be abundant at higher elevations.

The composition of the shrub layer varies with the density of the tree cover, but commonly observed species include buffalo berry (*Shepherdia canadensis*), willow, wild raspberry, wild rose, alder, and Labrador tea. Bearberry, bog cranberry, blueberry, twin flower, Indian paintbrush (*Castilleja* spp.), bunchberry, wild strawberry (*Fragaria virginiana*), vetch, and fireweed (*Epilobium angustifolium*) are common in the herb layer. Feathermosses and plumemosses, in association with various lichens, constitute the moss layer. Grasses are common only in aspen-dominated areas and in more open coniferous sites.

Poorly drained, depressional, and adjacent marginal areas as well as some of the seepage sites consist predominantly of black spruce. Common associates are white spruce, tamarack, lodgepole pine, and swamp birch (*Betula pumila* var. *glandulifera*). Undergrowth is commonly an association between feathermosses and Labrador tea with minor amounts of sphagnum moss.

Rocky Mountain Foothills Division

This area lies between the Alberta Plateau - Benchlands and the Rocky Mountains, and rises in elevation to about 1,830 m (6,000 feet). The landscape consists of a series of parallel, razor-back ridges which, except for a few of the very highest ridges, are forested to the summits with conifers.

Lodgepole pine is the dominant tree species on well-drained upland sites, but white spruce, Engelmann spruce (*Picea engelmanii*), and black spruce are also well represented. Subalpine fir is common but somewhat less prevalent; while aspen, balsam poplar, and paper birch are relatively scarce. Undergrowth is complex, but common understory species are: Labrador tea, willow, alder, bog cranberry, tall bilberry, bearberry, bunchberry, twinflower, and feathermosses, and lichens.

Plate 6. Upper subalpine vegetation and landscape.

The vegetation in poorly drained areas is commonly black spruce and dwarf birch with an undergrowth of Labrador tea and feathermosses.

Rocky Mountains Division

The Rocky Mountains cover the elevational range between 1,680 m (5,500 feet) to 2,455 m (8,050 feet) in the survey area. Topography is highly sculptured and consists of steep slopes and deep valleys. Climate is highly variable and winds of high velocity are common. Tree line lies at an elevation of about 1,830 m (6,000 feet) in this general area.

At lower elevations, the forest is similar to that described for the Foothills. As elevation increases, there is a gradual change to the Subalpine Forest which Rowe (1959) describes as being the mountain counterpart of the Boreal Forest. The most common tree species is the Engelmann spruce which grows in association with Subalpine fir and lodgepole pine (Plate 6). Representatives of the poplar species are rare, and black spruce is also of limited importance. At higher elevations, near tree line, stunted Subalpine fir and Engelmann spruce are common. The dominant undergrowth vegetation consists of red and yellow heathers and white mountain heather. Open meadows dominated by herbs and willows are also common features of upper Subalpine vegetation.

The area above tree line is characterized by a collection of dwarf shrubs, herbs, and cushion plants; growth, however, is generally sparse, and unvegetated ground is common. Some characteristic species of the alpine tundra recognized in the map area include white dryad (*Dryas octopetala*), sedge (*Carex nardina*), white mountain heather (*Cassiope tetragona*), kobresia (*Kobresia myosuroides*), and moss campion (*Silene acaulis*).

TABLE 1
Mean Temperature and Precipitation Data for Stations Near the Area

	Beaverlodge		Grande Prairie		Muskeg Ranger Station	South Wapiti
	Mean Temperature (°C)	Total Precipitation (mm)	Mean Temperature (°C)	Total Precipitation (mm)	Mean Temperature (°C)	Mean Temperature (°C)
December	-11.3	27	-13.2	30	-12.1	-12.5
January	-14.9	32	-17.3	34	-16.0	-15.4
February	-10.3	29	-12.4	28	- 9.9	-10.4
Winter	*-12.2*	*88*	*-14.3*	*92*	*-12.7*	*-12.8*
March	- 5.8	23	- 7.4	21	- 7.1	- 5.7
April	2.6	22	2.4	22	- 0.4	2.7
May	9.5	41	20.0	38	6.3	8.8
Spring	*2.1*	*86*	*1.7*	*81*	*- 0.4*	*1.9*
June	13.3	62	13.7	64	9.4	12.4
July	15.6	65	16.0	60	12.3	14.6
August	14.3	57	14.8	53	10.9	13.2
Summer	*14.4*	*184*	*14.8*	*177*	*10.8*	*13.4*
September	9.8	39	10.2	34	6.7	8.9
October	4.5	26	4.2	26	2.1	3.7
November	- 5.2	56	- 6.3	31	- 6.9	- 5.4
Fall	*3.0*	*121*	*2.7*	*91*	*0.6*	*2.4*
Annual	*1.8*	*479*	*1.2*	*441*	*- 0.4*	*1.2*

TABLE 2
Days with no Frost at Stations within or near Map Area,
for the Months of May to August inclusive

	Bald Mountain	Beaverlodge	Grande Prairie	Nose Mountain	Simonette
Years of records	6	56	29	12	6
Elevation (metres)	939	762	667	1574	1274
Frost free days	116	116	117	87	89

CLIMATE

The general physiography of the Wapiti map area suggests some climatic zonation or variation. Unfortunately, climatic data within the area are limited and generally incomplete. The nearest full-time weather stations are located at Grande Prairie and Beaverlodge to the north of the map area. Incomplete records are available for the South Wapiti Ranger Station in the northern portion and at the Muskeg Ranger Station to the southeast of the map area. Some data are available from forestry lookout towers, generally for the months of April to October. The tower sites include Bald Mountain in the north, Nose Mountain in the west, and Simonette in the southeastern portion of the map area.

The climatic data shown in Tables 1 and 2 were compiled by Environment Canada.

In general, the Wapiti map area experiences a continental climate with long cold winters and moderately mild summers modified to some extent by the proximity of the Rocky Mountains. The mean air temperature in January is about -17.3^{o}C at Grande Prairie, -16.0^{o}C at the Muskeg Ranger Station, and -15.4^{o}C at the South Wapiti Ranger Station. Mean monthly air temperatures are below freezing for the months of November to March inclusive. July is the warmest month with a mean air temperature ranging from 16.0^{o}C at Grande Prairie to 12.3^{o}C at the Muskeg Ranger Station.

Bowser (1967) describes the northern one-third of the map area as a region where the amount of precipitation is usually adequate but where it is not considered practical to grow wheat because of the frequency of damaging frosts (agroclimatic area 3H). The remainder of the map area is described by Bowser (1967) as a region where the amount of precipitation has usually been adequate but where the average frost-free period has been so short (generally less than 60 days) that it is not practical to grow cereal crops (agroclimatic area 5H).

The frost-free periods recorded at the Bald Mountain, Nose Mountain, and Simonette fire towers (Table 2) appear relatively long. This can be explained by the fact that all fire towers and associated climatological stations are located on heights of land. Consequently cold air drains away downslope at night resulting in higher temperatures, which are not representative of the entire area.

Total precipitation at Grande Prairie is about 441 mm. Of this amount 21 percent falls during the winter months of December to February, 18 percent in the spring from March to May, 40 percent in the summer months of June to August, and 21 percent in the fall. Practical experience has shown that there is some risk involved in growing grain crops in this region because of precipitation during harvest time as well as the frost hazard noted previously.

In summary, it may be stated that climate is quite variable in this area. It reflects the combined effects of changes in elevation, differences in local relief, and the effects of the mountains.

DRAINAGE

The map area is drained by the Smoky, Wapiti, Narraway, Torrens, Cutbank, Kakwa, Simonette, Latornell, and Little Smoky Rivers which ultimately flow into the Smoky River to form part of the Peace River drainage system. The Kakwa, Narraway, Smoky, Torrens, and Wapiti Rivers have their sources in the mountains of British Columbia. These rivers are fed by melting glacial ice and snow throughout the year and have permanent flow. The creeks and smaller rivers such as Big Mountain, Pinto, and Nose Creeks, and the Cutbank, Simonette, Latornell, and Little Smoky Rivers originate essentially in organic soil basins. Their discharge varies greatly throughout the season but they are rarely, if ever, dry. During the spring melt, some of the water goes directly into the soil, some runs off via the streams, and a considerable amount is stored in organic soil depressions. Being generally land-locked or with only high-water outlets, these basins act as storage areas for large amounts of water; consequently runoff contributes to streams over a fairly long period.

The drainage of the area is generally to the north and northeast. Drainage patterns vary from trellis to subparallel to dendritic. The patterns strongly reflect the effects of bedrock contortion and faulting, with minor modification by glacial activity.

Musreau Lake and Two Lakes are the only lakes of significant size in the area. Musreau Lake is freshened by a number of small streams which originate from the Organic soil areas to the south and west. The water sources for the two small lakes called Two Lakes are seepage from the surrounding hills and underground springs (Plate 7). A small stream flows out of the southern lake into Stetson Creek.

Plate 7. An area of groundwater discharge in which Smoky soils are found. Note the lack of tree cover.

METHODS OF SURVEY

The object of a soil survey is to map and classify the soils in a defined geographical area. During mapping the soils are examined at points in the landscape and these point observations are extrapolated by airphoto interpretation to characterize landscape units. Since soil is a continuum and adjacent soils seldom have sharp boundaries, soils within landscape units are defined as having a certain range of properties. These soil units are delineated on the basis of parent geologic material and landform, soil profile, and soil moisture conditions. The soil, land, and vegetation attributes observed during mapping are the fundamental facts on which sound interpretations are based.

FIELD PROCEDURES AND ACCESS

Field work in the Wapiti map area began in the spring of 1972. Field mapping was done on National Topographic Series maps at a scale of 1:50,000 with the aid of 1949, 1968, and 1972 aerial photographs (1:40,000) and a map of the surficial geology (Alberta Research Council unpublished map, 1972). Towards the end of the field survey the field sheets were reduced and compiled, and then field checked. The final result is the accompanying soils map published at a scale of 1:126,720 (2 miles to 1 inch).

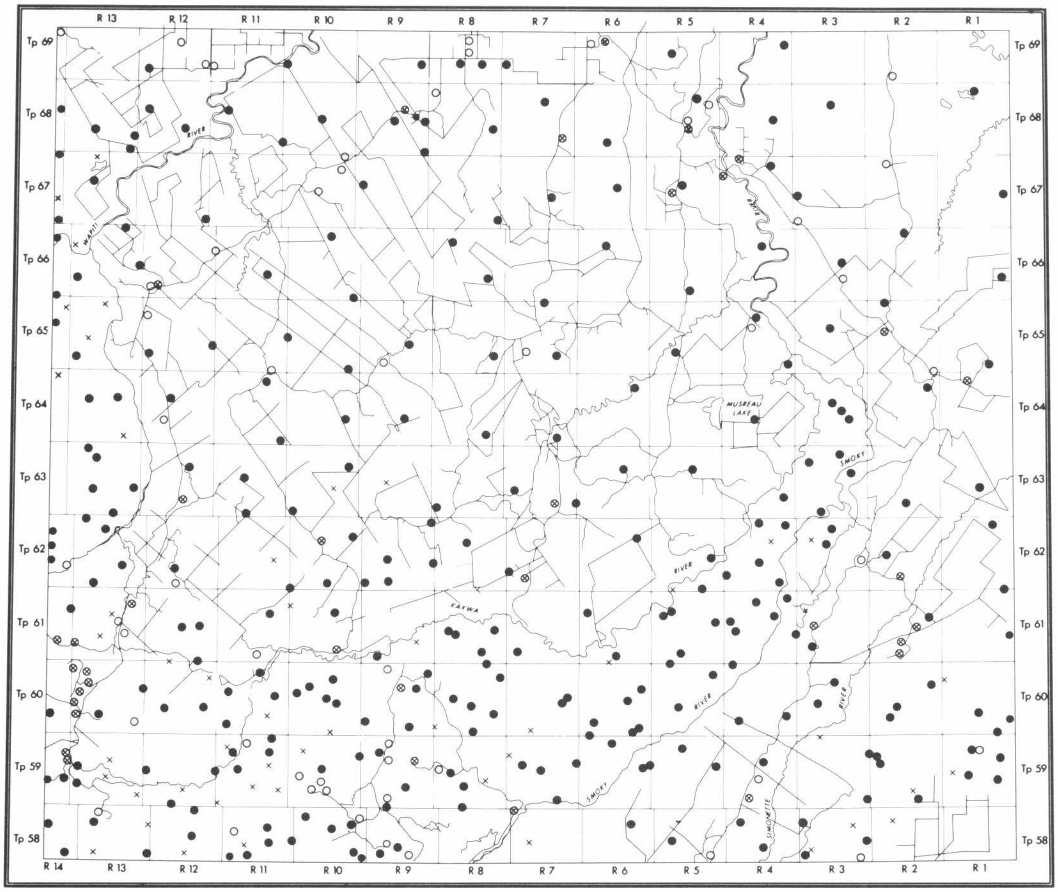
The major portion of the Wapiti area is under long-term lease to Proctor and Gamble Cellulose Ltd. and Canadian Forestry Industries Ltd. (CANFOR), both located in Grande Prairie. The terrain is rough and difficult to traverse and, apart from the cultivated portion in the extreme northcentral and northwestern portions of the area, access is limited (see accompanying access map, figure 6).

A variety of mechanized transport was used to survey the area. All passable roads were traversed by four-wheel drive truck. Forest trails and seismograph cutlines were traversed by a locally manufactured Cramer A.W.D. (Plate 8), without which adequate coverage of the area would have been impossible. Remote areas, or those considered to be beyond the working distance of the Cramer A.W.D., were surveyed by helicopter. Some of these areas were later ground checked using Cramer A.W.D.

The soil survey of the Wapiti area was a reconnaissance survey carried out by making traverses approximately 1 mile apart. In local areas of poor access the traverse separation distance was increased to as much as 2 miles. Soil inspections were made approximately every ½ mile along a line of traverse, but in areas of complex soil pattern the density of inspection sites was increased considerably. At each inspection site the arrangement, thickness, color, texture, consistency, and structure of the soil profile horizons were recorded. These parameters as well as soil reaction, topography, drainage, and stoniness were considered when the mapping units were established. Representative samples of the various soil groups in the map area were collected for laboratory study.

It is important to appreciate the changes in map accuracy in relation to ease and availability of access. The most accurate and dependable portions of the map depict areas where access was adequate. The parts of the map compiled by extrapolation decrease in accuracy in proportion to the distance between traverse lines. Least accurate are the parts of the map which show areas surveyed by helicopter. An estimate of the relative degree of reliability of any portion of the map can be obtained by referring to the accompanying access map.

Plate 8. The Cramer A.W.D. vehicle used in steep mountainous terrain. Most of the area was traversed with this machine.



LEGEND

- • Helicopter observation site
- × Helicopter observation site and parent material sampled for engineering analyses
- ○ Soil profile sampled for routine analyses
- ⊗ Soil profile sampled for routine analyses and parent material sampled for engineering analyses
- —— Routes traversed for the purpose of soil inspection

FIGURE 6. Soil sampling sites, traverse routes and helicopter observation points used in the soil survey of the Wapiti map area

Forest Sampling Methodology

Plot areas were chosen from forest cover maps and aerial photographs to encompass a wide variety of vegetation, soil, and landform types, within uniform, even-aged, and normally-stocked stands ranging from 45 to over 200 years old. Within each of the 137 (0.405 ha) plots sampled, a soil profile was exposed and described in a position representative of the plot area. The diameters at breast height and heights of all trees were tallied by species and when the tree tally was completed, five to seven healthy dominant and co-dominant trees were selected and felled and sections removed at 0.3 m, 1.5 m, and 1.8 or 3.7 m intervals thereafter for stem analysis. Computations used to determine the resulting height-diameter and height-age curves are derived from procedures outlined for stem analysis by Avery (1967). The following statistics were taken from the individual tree stem analysis data for each species sampled in each plot: 1) site index (at 70 years); 2) total volume per tree; 3) periodic volume increment (70 to 80 years); 4) maximum periodic volume increment; and 5) age of maximum periodic volume increment. Mean annual total volume increment (MAI) was computed for each plot by dividing the total gross volume by the average age of the dominant trees sampled.

Percent cover estimates of understory vegetation were made in 12 randomly placed 1 x 1 m quadrats for mosses, lichens,

TABLE 3
Forest Vegetation Types with Mean Annual Increment, Site Index (mean and standard error) and Principal Soil Groups

Type Number	Vegetation Type	Mean Annual Increment (m^3/ha/yr)	Site Index Height at 70 years (m)	Species*	Principal Soil Groups
2	Balsam poplar/Prickly rose/Veiny meadow rue	5.0 ± 0	21.3 ± 0	bP	Iosegun
3	White spruce/Dewberry/Wild lily-of-the-valley	4.7 ± 1.1	16.7 ± 2.5	wS	Donnelly Smoky
1	Aspen/Low-bush cranberry/Dewberry	4.3 ± 0.7	20.5 ± 2.9	A	Lodge Donnelly
8	Lodgepole pine/Low-bush cranberry/Dewberry	4.2 ± 1.2	19.8 ± 2.3	P	Edson Torrens Copton
9	Lodgepole pine/White meadowsweet/Bunchberry	4.0 ± 0.6	17.0 ± 0.5	P	Mayberne Edson Robb Lodge
10	Lodgepole pine/Green alder/Bunchberry	3.7 ± 1.0	18.2 ± 2.6	P	Edson Marlboro Torrens
4	White spruce/Horsetail/Feathermoss	3.7 ± 1.2	12.2 ± 3.8	wS	Snipe Smoky Gunderson
5	White spruce/Feathermoss	3.6 ± 1.1	13.8 ± 3.8	wS	Jarvis Robb
11	Lodgepole pine/Labrador tea/Feathermoss	3.1 ± 1.1	16.3 ± 5.6	P	Edson Snipe Torrens Copton Heart
12	Lodgepole pine/Black spruce/Labrador tea/Tall bilberry	3.1 ± 0.9	14.4 ± 2.8	P	Edson Mayberne Copton Sheep
13	Lodgepole pine/False azalea/Five-leaved bramble	2.7 ± 0.9	13.9 ± 3.2	P	Putzy Robb Mayberne
15	Engelmann spruce/Subalpine fir/False azalea	2.5 ± 0	5.5 ± 0	eS	Robb Copton
6	Black spruce/Labrador tea/Horsetail	2.1 ± 0.7	8.2 ± 2.8	bS	Kenzie Smoky
14	Lodgepole pine/Blueberry/Lichen	1.3 ± 0.4	11.9 ± 2.2	P	Blackmud Jarvis
7	Black spruce/Labrador tea/Cloudberry	0.4 ± 0.1	4.3 ± 0.9	bS	Kenzie

* Species code

A: aspen
bP: balsam poplar
bS: black spruce
eS: Engelmann spruce
P: lodgepole pine
wS: white spruce

herbs, and dwarf shrub species (up to 0.5 m tall). Shrub cover (over 0.5 m tall) estimates were made by species within 5 x 5 m quadrats centered around the 1 x 1 m quadrats. Species occurring in the plot but not in the quadrats were also recorded. Tree regeneration was tallied by species and height class within the 5 x 5 m quadrats for individuals less than 1.5 m tall. Tables of tree growth and vegetation data as well as various treatments of the data can be found in Corns (1978).

In addition to the 137 forested plots sampled in detail, an additional 132 abbreviated forested plots were sampled at the same sites that soil profile descriptions were made during the late summer of 1973 and 1974 in areas accessible only by helicopter. In these plots, plant cover estimates were made in an area approximately 20 m^2, and MAI estimations were made using the plotless sampling method reported by Kowall (1971).

Fifteen vegetation types were synthesized from the 137 detailed plots and a description of each is presented in Appendix B of this report. Additional types were observed in the alpine and subalpine zones; records are in the form of abbreviated plots and descriptive field notes. Site index estimates are not available from the helicopter survey data, though MAI was determined. In the soil group descriptions following, the predominant vegetation types are given. Table 3 gives the approximate forest productivity for the vegetation types.

PROBLEMS ASSOCIATED WITH MAPPING

In an area as diverse and complex as the Wapiti map area specific problems exist which influence the accuracy of the soils information presented. Some of these problems are overcome by subdividing the map area into physiographic units. The area was further divided into soil groups, using physiography and parent material as a guide, then each group was defined according to location, elevation, land forms, climate, and soils. A discussion of this is found in the section describing the physiography of the region.

The concept of soil groups was the basis of the mapping. Under this system a collection of individual soil series developed on similar parent material is grouped into a single category. This allows the mapper to represent soil distribution patterns as they are found in the field.

When soils and associated landscapes in a region as diverse as the Wapiti area are mapped, topography is a major consideration. The topographic classification outlined by the Canadian Soil Survey Committee (1974) was used and is as follows:

Class		Slope (%)
b:	gently undulating	0 to 2
c:	undulating	2 to 5
d:	gently rolling	5 to 9
e:	moderately rolling	9 to 15
f:	strongly rolling	15 to 30
g:	hilly	30 to 60
h:	very hilly	over 60

Applying this classification to the Wapiti Plains is straight forward since that region has a relatively simple topography. Elsewhere in the area topography is complex, and must often be indicated as a combination of classes representing a considerable range in slope.

The degree of detail available for differentiating map units is governed by the scale of mapping. The accompanying soil maps were prepared at a scale of 1 inch to 2 miles (1:126,120) which imposes a limit on the size of area that can be depicted.

EXPLANATORY NOTES ON THE SOILS MAP AND LEGEND

This section attempts to explain fully the various categories and terms employed in the legend that accompanies the soils map. Soil terminology not explained in this section is defined in Appendix D.

Soil Group - A soil group is a group of closely interrelated soil series developed on similar parent materials under somewhat similar climates.

In this survey the major soil groups are distinguished according to lithologic differences in soil parent materials. Names used are taken from Dumanski *et al.* (1972) or Odynsky *et al.* (1956, 1961) where applicable, or from local geographic features. The broad soil groups are subdivided into soil units which are found in predictable geographic association, yet have differing profile morphologies and drainage regimes. Soil groups are strictly a mapping convenience used to bring together various collections of soils in order to focus on certain pertinent aspects of the landscape.

Soil Unit - Soil units are areal subdivisions of soil groups such that within a given soil unit the component soil types are found in specified proportions. The symbols on the map representing these units identify both the group and the proportions of the soils within the unit, and also indicate the relative landscape and consequent drainage conditions.

Dominant Soils and Significant Soils - These terms refer to the relative proportion of various soils as they are found in a natural soil unit. Within a soil unit, dominant soils occupy over 40 percent of the area, while significant soils occupy over 15 percent but less than 40 percent of the area. In most cases only a single soil is indicated as dominant or as significant. Where two are listed, it means that the two soils together make up over 40 percent or over 15 percent of the soil unit. Soils constituting less than 15 percent of a soil unit are not shown.

The relative abundance of Gleysolic soils within the various soil units was used as a guide for standardizing the legend. Generally within a soil group, the first unit denotes areas containing less than 15 percent Gleysols; the second, areas of significant (15 to 40 percent) Gleysols. The reverse holds for Gleysolic groups within which the first unit is predominantly Gleysolic and may contain less than 15 percent better-drained soils, while the second represents Gleysolic soil areas containing significant (15 to 40 percent) amounts of better-drained upland soils.

Soil Series -

> "A soil series is a soil body such that any profile within the body either has a similar number and arrangement of horizons whose color, texture, structure, consistence, thickness, reaction, and composition, or a combination of these, are within a defined range or, in soils without horizons, any profile which has the differentiating properties, except thickness, within specified depth limits." (Canada Soil Survey Committee, 1974.)

In this survey, only soil series established for soils in the Hinton-Edson area (Dumanski *et al.*, 1972), Grande Prairie and Sturgeon Lake areas (Odynsky *et al.*, 1961) were used. No new soil series were established for the map area. The soil series names from some of the previously published soil surveys are inserted in brackets in the soils legend mainly to aid correlation of this map with some of those previously published.

Soil Combinations - Land areas which contain collections of soil units are shown on the soils map as combinations. Such combinations are shown in decreasing order of area occupied, with the first soil unit of the combination always occupying more than one-half of the delineated soil area.

Soil Phase - A soil phase is a subdivision of any taxonomic class based on any soil characteristic or combination of soil characteristics which are considered to be potentially significant to man's use or management of the land apart from the properties used in the taxonomic classification. (Canada Soil Survey Committee, 1974.) Four soil phase notations (stony, thin, gleyed, and peaty) are used in this survey.

a) Stony Phase - used for soils that contain a greater quantity of stones than defined in the description of the material; it is reserved for soils not defined as being exceedingly or excessively stony or cobbly under normal circumstances.

b) Thin Phase - used for soil areas where the depth to bedrock or other strongly nonconforming material is less than 50 cm; it is used exclusively in mineral soils. (A thin phase should not be confused with overlay materials. The latter are soil parent materials such as, for example, a layer of sand less than 50 cm thick which overlies till or lacustrine deposits.)

c) Gleyed Phase - reserved for soils which, because of their position in the landscape, show well-expressed mottling in A horizons but not in B horizons, or are continually saturated but are not strongly mottled; these soils do not exhibit the structure of Gleysolic soils and are considered to be imperfectly drained.

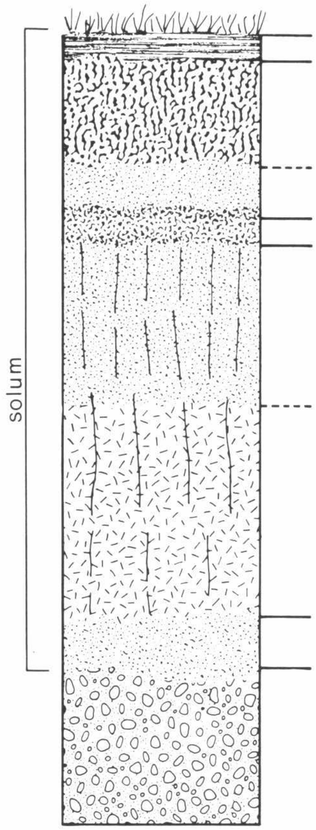
d) Peaty Phase - used in areas where Gleysolic soils have greater than 15 cm but less than 50 cm of surface peat; soils with greater than 50 cm of surface peat are considered to be Organic soils.

Soils Map Notations - Each individual soil area is shown on the soils map enclosed in a boundary line. The soil area within each boundary is identified by a collection of symbols which are always arranged in the following sequence:

$$\frac{\text{Soil Group} \quad \text{Soil Unit/(Soil Phase)}}{\text{Topographic Class(es)}}$$

THE SOILS

Soils possess chemical and physical characteristics which reflect the effects of the environment and thus can be used as a basis for classifying the soils according to the



L,F,H — Organic horizon, which may be subdivided into: L (raw organic matter), F (partially decomposed organic matter), and H (decomposed organic matter).

A — A mineral horizon at or near the surface. It may be a dark colored horizon in which there is an accumulation of humus (Ah), or a light colored horizon from which clay, iron, and humus have been leached (Ae).

AB — Transition horizon.

B — Mineral horizons that (1) may have an enrichment of clay (Bt), iron (Bf), or organic matter (Bh), or (2) may be characterized by a columnar structure and a significant amount of exchangeable sodium (Bn); or (3) may be altered to give a change in color or structure (Bm). Usually lime and salts have been leached out of this horizon. (4) The symbol (j) is used with the above suffixes to denote a failure to meet the specified limits of the suffix.

BC — Transition horizon.

C — Mineral horizon comparatively unaffected by the soil forming process operative in the A and B horizons except for the process of gleying (Cg) and the accumulation of calcium and/or magnesium carbonates (Ck) and soluble salts (Cs).

FIGURE 7. Diagram of a soil profile showing various horizons.

processes involved in soil formation (soil genesis). Such a classification scheme permits the grouping of soils into natural units. The recognition of these units depends on the examination and study of the soil profile.

THE SOIL PROFILE

A soil profile is a vertical section of a soil extending downward through all its horizons (or layers) into the unweathered material. Soil horizons differ from one another in one or more of the following features: color, texture, structure, consistence, reaction, and thickness as well as in chemical and biological composition. Master soil horizons are designated L, F, H, or O for organic horizons, and A, B, or C for mineral horizons. Lower case letter suffixes are used to indicate the type of horizon and Arabic numeral suffixes are used when further division into sub-horizons is required. If the soil is developed from two or more nonconforming parent materials, Roman numeral prefixes are used to indicate the lithological changes. Master horizon designations and lower case suffixes are defined in table 4. A diagrammatic example of the use of these is given in figure 7.

SOIL GENESIS

Soil genesis is the process or processes responsible for the development of soil. Climate, vegetation, relief, and drainage act upon the unconsolidated parent material to produce the soil profile or solum. The type of soil formed in any one place is dependent upon the interactions of these agents and upon the lengths of time they have been active. Since certain of the agents have a regional influence and others are only local, innumerable different types of soils are recognized, each reflecting the combined effects of the particular set of genetic factors responsible for its development.

In forested upland regions, such as those found in the Wapiti area, soil development is the result of delicate interactions among climate, relief, and vegetation, all of which act upon soil parent materials of varying lithologies. Climate exerts its influence at a regional level since it generally controls biological activity in an area. Vegetation acts directly on the soil by influencing microenvironments,

TABLE 4

Definition of Soil Horizon Symbols Pertinent to the Wapiti Area
(after Canada Soil Survey Committee, 1976)

Organic Horizons

Organic horizons are found at the surface of some mineral soils, or at any depth beneath the surface in buried soils, or overlying geologic deposits. Such horizons contain more than 17 percent organic carbon by weight. Two groups are recognized.

(1) O - This is an organic horizon developed mainly from mosses, rushes, and woody material.

(a) Of - The fibric horizon is the least decomposed of all the organic soil materials. It contains large amounts of well-preserved fiber that is readily identifiable as to botanical origin.

(b) Om - The mesic horizon is in an intermediate stage of decomposition, with intermediate amounts of fiber and moderate bulk density and water-holding capacity. The fiber is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of either fibric or humic horizons.

(c) Oh - The humic horizon contains the most highly decomposed organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest water-holding capacity. A humic horizon is very stable and changes very little physically or chemically with time, unless it is drained.

(2) L-F-H - These organic horizons develop primarily from leaves, twigs, woody materials, and a minor component of mosses.

(a) L - This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.

(b) F - This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna, moder*, or it may be a partly decomposed mat permeated by fungal hyphae, mor†.

(c) H - This is an organic horizon characterized by an accumulation of decomposed matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification, chiefly through the action of organisms. This horizon is a zoogenous humus form consisting mainly of spherical or cylindrical droppings of microarthropods. It is frequently intermixed with mineral grains, especially near the junction with a mineral horizon.

Master Mineral Horizons and Layers

Mineral horizons are those that contain less organic matter than is specified for organic horizons.

(1) A - This is a mineral horizon formed at or near the surface in the zone of removal of materials in solution or suspension or in the zone of maximum in situ accumulation of organic matter, or both. Included are:

(a) horizons in which organic matter has accumulated as a result of biological activity (Ah);

(b) horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of these (Ae).

(2) B - This is a mineral horizon characterized by one or more of the following:

(a) an enrichment in silicate clay (Bt);

(b) an enrichment in sesquioxides (Bf);

(c) an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below (Bm and Bg);

(d) a columnar structure and a significant amount of exchangeable sodium (Bn).

(3) C - This is a mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, excepting the process of gleying (Cg) and the accumulation of calcium and/or magnesium carbonates (Ck) and more soluble salts (Cs) (Csa).

(4) R - This is a consolidated bedrock layer that is too hard to break with the hands (3 on Mohs scale) or dig with a spade when moist, and that does not meet the requirements of a C horizon. The boundary between the R layer and any overlying unconsolidated material is called a lithic contact.

*Moder - plant material in a state intermediate between living and decayed

†Mor - a raw type of humus developed under cool, moist conditions

TABLE 4 (continued)

Lowercase Suffixes

(1) b - A buried soil horizon.

(2) ca - A horizon of secondary carbonate enrichment in which the concentration of lime exceeds that in the unenriched parent material.

(3) e - A horizon characterized by the removal of clay, iron, aluminum, or organic matter alone, or in combination. When dry, it is higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae, Ahe).

(4) f - A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5YR or redder, or its hue is 10YR near the upper boundary and becomes yellower with depth. It contains 0.6 percent or more pyrophosphate-extractable Al+Fe in textures finer than sand and 0.4 percent or more in sands. The ratio of pyrophosphate-extractable Al+Fe to clay is more than 0.05 and organic carbon exceeds 0.5 percent. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. These criteria for "f" do not apply to Bgf horizons. A Bf horizon contains 0.5 to 5 percent organic carbon. A Bhf horizon contains more than 5 percent organic carbon.

(5) g - A horizon characterized by gray colors, or prominent mottling, or both, indicating permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less.

(6) h - A horizon enriched with organic matter. When used with A it must show one Munsell unit of value darker than the horizon below, or have 0.5 percent more organic carbon than the parent material (IC). It contains less than 17 percent organic carbon by weight.

(7) j - Used as a modifier of suffixes e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right and adjacent to the suffix it modifies.

(8) k - Denotes the presence of carbonate as indicated by visible effervescence when dilute HCl is added.

(9) m - A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color or structure, or both.

(10) n - A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. When used with B it must also have the following properties: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistency when dry.

(11) s - A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts or salt crystals, by distressed crop growth, or by the presence of salt-tolerant plants. It is commonly used with C and k (Csk).

(12) sa - A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates, in which the concentration of salts exceeds that present in the unenriched parent material. The conductivity of the saturation extract must be at least 4 mmhos/cm and must exceed that of the C horizon by at least one-third. The horizon is 10 cm or more thick.

(13) t - An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g(Btg), with B and n (Bnt), and so on.

(14) Bt - A Bt horizon is one that contains illuvial layer-lattice clays. It forms below an eluvial horizon, but may lie at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than IC. It has the following properties:

(a) If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizon, as follows:

(i) If any part of the eluvial horizon has less than 15 percent total clay in the fine earth fraction, the Bt horizon must contain at least 3 percent more clay.

(ii) If the eluvial horizon has more than 15 percent and less than 40 percent total clay in the fine earth fraction, the ratio of clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more.

(iii) If the eluvial horizon has more than 40 percent total clay in the fine earth fraction, the Bt horizon must contain at least 8 percent more clay than the eluvial horizon.

cycling nutrients, and exuding gases and enzymes during growth. Dead vegetation serves as an energy source for soil microorganisms and is decomposed, transformed, or oxidized. Such material collects on the surface of the soil, or is translocated into the soil, where it forms complexes with soil mineral matter. Topography or relief exerts its influence by controlling or affecting surface runoff, soil erosion, water infiltration, and groundwater flow. Soil parent materials of varying lithologies react to the combined effects of these processes in different ways, to produce soils with varying chemical and physical properties.

SOILS OF THE WAPITI MAP AREA

The soils were classified according to the revised System of Soil Classification for Canada (1974), but this report (prepared at a later time) incorporates the changes in the System agreed upon at the 1975 and 1976 meetings of the Canada Soil Survey Committee (1976). The legend on the soils map shows the classification of the various soils found in the Wapiti map area. The various soil units are classified into their respective Subgroups, Great Groups, and Orders. The following is a brief description of the soil Orders found in this region.

Luvisolic Soils

Soils of the Gray Luvisol Great Group occupy about 58 percent of the map area. Gray Luvisols are well to imperfectly drained soils that have developed under forest vegetation in cool climates. These soils have pronounced eluvial (Ae) horizons and illuvial textural (Bt) horizons in which silicate clay is the main accumulation product. All the Gray Luvisols in the map area have L-F and L-H surface horizons and very thin or absent Ah horizons. The recognition of various horizon characteristics permits the further classification of the soils to the more detailed Subgroup level. Four Subgroups of the Gray Luvisol Great Group are found in this area: Orthic Gray Luvisols, Brunisolic Gray Luvisols, Gleyed Solonetzic Gray Luvisols, and Podzolic Gray Luvisols.

Brunisolic and Podzolic Soils

Brunisolic and Podzolic soils occupy approximately 16 percent of the map area. Of these two Orders the Brunisols have the greater areal distribution.

The Brunisolic Order consists of rapidly to imperfectly drained soils that have developed under forest, mixed forest and grass, or heath and tundra vegetation associations. In the map area Brunisols have organic (L-H) surface horizons, thin organo-mineral (Ah) horizons, and weakly or strongly developed eluvial (Ae) horizons, but they never have textural (Bt) or sesquioxide (Bf) horizons. The only Subgroups of the Brunisolic Order recognized in the map area are Eluviated Dystric Brunisols and Eluviated Eutric Brunisols. These are differentiated according to soil reaction: those soils with pH ($CaCl_2$) greater than 5.5 are classed as Eutric Brunisols while those with pH less than 5.5 are classed as Dystric Brunisols. Lithic versions of these Subgroups are common on some of the tills and colluvial materials in the area.

Podzolic soils are rapidly to imperfectly drained soils that have developed under coniferous and mixed-forest vegetation, mostly in cool and temperate climates. They are characterized by light-colored eluvial horizons and darker-colored illuvial horizons in which the accumulation products are organic matter or sesquioxides or both. Only Humo-Ferric Podzols are found in the Wapiti map area. These soils are characterized by organic (L, F, H) surface horizons and eluviated (Ae) light-colored horizons which overlie Bf horizons.

Regosolic Soils

Regosols include well to imperfectly drained soils that lack discernible horizons or have only organic (L-H) or nonChernozemic organo-mineral (Ah) surface horizons. Only the Orthic and Cumulic Regosol Subgroups are found in the map area. Cumulic Regosols are characterized by buried (Ahb or L-Hb) surface horizons. Orthic Regosols may or may not contain surface organic (L, F, H) horizons or organo-mineral (Ah) horizons. Cumulic Regosols are common on the postglacial fluvial floodplains of the major rivers and streams. Orthic Regosols are confined to areas above tree line, where turbated soils developed on colluvium are common. Regosolic soils occupy only about 4 percent of the map area.

Gleysolic Soils

The Gleysolic Order comprises soils which are poorly drained and have strongly gleyed mineral horizons. They develop under various climatic and vegetative conditions in the presence of a high or a fluctuating water table. These soils may have organic surface horizons up to 50 cm thick and are characterized throughout the profile by dull, grayish colors which may be embellished by prominent yellowish or reddish-colored mottles. In the map area, Gleysolic soils have developed in poorly drained areas in a variety of parent materials whose textures range from clay to sand. Two Great Groups, the Gleysol and the Luvic Gleysol, are represented in the map area. The Gleysol has an Ah horizon less than 10 cm thick and lacks an eluvial horizon. Soils of the Luvic Gleysol Great Group are characterized by an eluvial (Ae) horizon. More detailed classifications, at the Subgroup level, are based on horizon characteristics. Three Subgroups – the Orthic Gleysol, Rego Gleysol, and Orthic Luvic Gleysol – were recognized in the map area. In some soil groups all three Subgroups are represented; these were lumped and classified simply as Gleysolics (see legend). Where the surface peat thickness was greater than 15 cm but less than 50 cm, the soils were designated as peaty phases of the three Gleysolic Subgroups. Gleysolic soils are dominant in approximately 9 percent of the map area, but commonly are associated with better-drained upland soils.

Organic Soils

Organic soils, which contain 17 percent or more organic carbon, have developed in poorly to very poorly drained areas primarily from peat deposits greater than 50 cm in thickness. They are water saturated for most of the year, if not artificially drained. Differentiation at the Great Group level is determined by the degree of decomposition of the organic material. Criteria for Subgroup differentiation are based largely on the nature and source of material within the multilayered deposits. In the map area two types of Organic soils were mapped : peat developed from sedge, and peat developed from moss. Generally, in this area these soils belong to the Mesisol Great Group, which is characterized by an intermediate stage of decomposition. The limited investigation of the Organic Order did not permit further differentiation of these soils. Organic soils occupy 7 percent of the map area.

The remaining 6 percent of the map area consists of miscellaneous land types and open bodies of water.

A key to the soils of the area is presented in Table 5. Soils are grouped according to parent material characteristics and drainage. The class name given after each soil group is the dominant soil type of the soil group.

DESCRIPTIONS OF SOIL GROUPS

The soil groups of the Wapiti map area are grouped according to kinds of parent material. Each description of a soil group within a parent material grouping includes a discussion of the physiography, drainage, topography, vegetation, extent, and landforms in the soil group's immediate environment. The acreage shown for each soil unit is the sum of the acreages of all map units in which the soil types that define the soil unit are dominant. Detailed descriptions of soils common to the various soil groups as well as tables of chemical and physical analyses of representative profiles are presented in Appendix A.

Soils on Morainal Deposits

Soils developed on till deposits occupy about 36 percent of the Wapiti map area. Tills lie at the surface over much of the Alberta Plateau-Benchlands and Rocky Mountain Foothills, but most of the till deposits in the Wapiti Plains are overlain by other, postglacial, deposits. Gray Luvisol, Brunisolic, Gleysolic, and Podzolic soils predominate, and the soil groups recognized include Edson, Marlboro, Mayberne, Putzy, Robb, Smoky, and Sheep. Robb soils, which are found exclusively in the Rocky Mountain Foothills, are considered to have developed on undifferentiated till and colluvial deposits.

Edson Soil Group (EDS)

The Edson soils consist of moderately well drained Gray Luvisols developed on moderately fine to fine textured, weakly to moderately calcareous Continental till (Plate 9). Of all soils mapped, these are the most extensive areally, being the dominant soils in approximately 16 percent of the area. Edson soils are found in both the Wapiti Plains and the Alberta Plateau-Benchlands between 825 m (2,700 feet) and 1,370 m (4,500 feet) above mean sea level. This wide range in elevation produces some variation in profile morphology and parent material characteristics. The till is generally dark grayish brown to olive brown, moderately fine to fine textured, firm in consistency, and slightly to moderately stony. The stones are generally less than 5 cm in diameter and are mainly mountain-derived meta-quartzites, orthoquartzites, sandstones, and limestones, and crystalline rocks from the Precambrian Shield. Deposits at higher elevations tend to exhibit characteristics similar to those of the underlying bedrock and generally have higher silt contents, lower sand contents, and fewer stones than till deposits at lower elevations. Thickness of the till varies

TABLE 5
Key to the Soils of the Wapiti Map Area

I. Soils developed on medium to fine textured Continental till.

Well to moderately well drained
1. Mayberne (Orthic Gray Luvisol)
(Brunisolic Gray Luvisol)

Moderately well drained
1. Edson (Orthic Gray Luvisol)

Poorly drained
1. Smoky (Gleysolics)

II. Soils developed on moderately coarse to medium textured Cordilleran till.

Well to moderately well drained
1. Marlboro (Brunisolic Gray Luvisol)
2. Robb (Brunisolic Gray Luvisol and Lithic soils)

Poorly drained
1. Smoky (Gleysolics)

III. Soils developed on skeletal, moderately coarse to medium textured Mountain till.

Well to rapidly drained
1. Putzy (Eluviated Dystric Brunisol and Orthic Humo-Ferric Podzol)

Poorly drained
1. Smoky (Gleysolics)

IV. Soils developed on medium to moderately fine textured Mountain till overlying reworked shales.

Moderately well drained
1. Sheep (Brunisolic Gray Luvisol)

Poorly drained
1. Smoky (Gleysolics)

V. Soils developed on moderately coarse to moderately fine textured colluvium found on eroded escarpments of Tertiary Uplands.

Moderately well drained
1. Deep Valley (Eluviated Eutric Brunisol)

VI. Soils developed on moderately coarse to moderately fine textured colluvium.

Well drained
1. Caw (Orthic Regosol)
2. Errington (Eluviated Eutric and Eluviated Dystric Brunisols)

Moderately well to poorly drained
1. Nickerson (Orthic Regosol)

VII. Soils developed on moderately fine to very fine textured glaciolacustrine deposits or lacustrotill.

Moderately well drained
1. Tri-Creek (Orthic Gray Luvisol)

Imperfectly to moderately well drained
1. Donnelly (Gleyed Solonetzic Gray Luvisol)
2. Nampa (Gleyed Solonetzic Gray Luvisol)

Poorly drained
1. Snipe (Orthic Luvic Gleysol)

VIII. Soils developed on coarse to medium textured postglacial fluvial deposits.

Well to imperfectly drained
1. Iosegun (Cumulic Regosol)

IX. Soils developed on medium textured glaciofluvial deposits.

Well drained
1. Davis (Orthic Gray Luvisol)

Poorly drained
1. Wanham (Orthic Luvic Gleysol)

TABLE 5 (continued)

X. Soils developed on skeletal, coarse textured outwash gravels.

Rapidly drained
1. Jarvis (Brunisolic Gray Luvisol)

XI. Soils developed on coarse textured glaciofluvial deposits.

Rapidly drained
1. Blackmud (Eluviated Eutric Brunisol)

Well drained
1. Blackmud (Brunisolic Gray Luvisol)

Poorly drained
1. Gunderson (Gleysolics)

XII. Soils developed on coarse textured glaciofluvial or eolian deposits overlying finer textured deposits.

Well drained
1. Lodge (Orthic Gray Luvisol)
(Brunisolic Gray Luvisol)

Poorly drained
1. Gunderson (Gleysolics)

XIII. Soils developed on skeletal, coarse textured Tertiary gravels.

Rapidly drained
1. Judy (Brunisolic Gray Luvisol)

Poorly drained
1. Simonette (Gleysolics)

XIV. Soils developed on coarse textured eolian deposits.

Rapidly drained
1. Heart (Eluviated Eutric Brunisol)

Well drained
1. Heart (Brunisolic Gray Luvisol)

Poorly drained
1. Gunderson (Gleysolics)

XV. Soils developed on moderately coarse to medium textured unconsolidated bedrock and colluvium.

Well drained
1. Copton (Eluviated Dystric and Eluviated Eutric Brunisols)
(Lithic Eluviated Dystric Brunisol)

Poorly drained
1. Smoky (Gleysolics)

XVI. Soils developed on moderately fine to fine textured unconsolidated bedrock and colluvium.

Moderately well drained
1. Torrens (Orthic Gray Luvisol)

Poorly drained
1. Smoky (Gleysolics)

XVII. Soils developed on organic (peat) deposits.

Very poorly drained
1. Eaglesham (Mesisol)
2. Kenzie (Mesisol)

Plate 9. An Orthic Gray Luvisol developed on Edson till.

from several centimetres in upland and steeply sloping areas to many metres in some portions of the low lying areas. Edson soils are distinguished from Mayberne soils (also developed on Continental till) by their lower stone content, finer texture, and somewhat darker color.

Ground moraine is the most common geomorphic expression of the Edson soil group but a distinctive hummocky dead-ice moraine exists in a small area east of Kar Lake in the northeast portion of the map area. In the Wapiti Plains, topography generally varies from undulating to gently rolling, and in this division the till is commonly covered by postglacial deposits. In areas where Edson soils are associated with glaciolacustrine deposits, the topography is undulating. Gently rolling to hilly topography prevails in the Alberta Plateau-Benchlands where the till is generally thinner, rarely underlies other deposits, and commonly is associated with soft sedimentary bedrock deposits.

On the Edson soils group, the characteristic vegetation is the Aspen/Low-bush cranberry/Dewberry type (1) (see Appendix B) at elevations less than 915 m (3,000 feet) and the Lodgepole pine/Low-bush cranberry/Dewberry type (8) and the Lodgepole pine/Green alder/Bunchberry type (10) at elevations of 915 to 1160 m (3,000 to 3,800 feet) in the northern portions of the map area. At elevations above 1,160 m the Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) predominates. Productivity estimates (MAI and site index) of the various forest types are included in Table 3. Detailed descriptions of the forest types can be found in Appendix B.

The soils are characterized by strongly developed Gray Luvisol features (L-H, Ae, Bt horizon sequence). The Bt horizon is very strongly to strongly acid and has a firm to very firm consistency. Edson soils at lower elevations (below 915 m or 3,000 feet) exhibit a single, light yellowish brown to pale brown Ae horizon. At higher elevations the soils often have a thin, light-gray Ae1 horizon overlying a yellower Ae2 horizon. The double Ae horizon sequence is typical of soils which are intergrades between Orthic Gray Luvisols and Brunisolic Gray Luvisols. At still higher elevations (generally greater than 1,220 m (4,000 feet)) a thin, brighter-colored Bm horizon is frequently found between the Ae1 and Ae2 horizons. Soils with this horizon sequence are classed as Brunisolic Gray Luvisols. Although morphological variations in the upper part of the profile exist within soils of the Edson group, no attempt was made to distinguish the soils with differing morphology on the soils map.

The soils commonly have silt loam to loam surface horizons and clay to clay loam subsurface horizons. Internal soil drainage is good but perched water tables may exist for short periods during the year. A description and analyses of an Edson soil profile are presented in Appendix A.

Soil Units: Two soil units were designated for the Edson soils. They are as follows:

EDS 4 - Dominantly Orthic Gray Luvisols (comparable to Hubalta, Braeburn, Ansell, and Hillburn soil series described in some previous soil survey reports) in association with significant amounts of Brunisolic Gray Luvisols. The soils of this unit are moderately well drained. About 359,300 acres were mapped.

EDS 5 - Dominantly moderately well drained Orthic Gray Luvisols and Brunisolic Gray Luvisols (EDS 4) in association with poorly drained Gleysolic soils. This soil unit includes areas with highly variable internal soil drainage which are comparable to an Edson-Smoky area. The Gleysols generally are found on lower slopes and in landscape depressions. About 224,980 acres were mapped.

The only soil phase used in mapping the Edson group is the thin phase. "Thin" Edson soils are found in areas where soft unconsolidated sedimentary bedrock lies within 50 cm of the surface.

Map Combinations: Edson soils are commonly mapped in combination with other soil units. Edson-Eaglesham and Edson-Kenzie combinations indicate areas with highly variable soil drainage. In such areas, Edson soils always occupy the upper slope and crest positions and Organic soils are found in the depressional positions.

The Edson-Lodge and Edson-Blackmud combinations describe areas where fluvial sand deposits of varying thickness overlie the till. In most instances the till is found on the knobs and upper slopes while the sand occupies lower positions.

Combinations of Edson and Donnelly are found in regions adjacent to lacustrotill deposits and indicate areas where lacustrotill deposits overlie the till.

Edson-Marlboro combinations indicate areas in which Continental and Cordilleran tills exist in such close association that separation was not feasible. Units of this type are relatively rare.

Combinations of Edson-Copton and Edson-Torrens indicate soil areas where till deposits are generally very thin and bedrock outcrops in many places. Such conditions are most common in areas of rough topography. The bedrock material is coarser textured in Edson-Copton areas than in Edson-Torrens areas.

Marlboro Soil Group (MLB)

Marlboro soils are well to moderately well drained Gray Luvisols developed on medium textured, weakly to strongly calcareous till of Cordilleran origin. These soils are widely distributed over the northwestern and west-central portions of the map area, and are found mostly in the Alberta Plateau-Benchlands but also are present to a limited extent along the northwestern border of the Rocky Mountain Foothills. Although found at elevations ranging from 915 m (3,000 feet) to 1,615 m (5,300 feet), most Marlboro soils are situated between 1,160 m (3,800 feet) and 1,280 m (4,200 feet) above mean sea level. Soils of this group occupy about 4 percent of the map area.

Marlboro till, the parent material of the Marlboro soil group, is friable, dark grayish brown, and moderately to very stony. The material is generally loam in texture but clay loam and sandy loam textures have been observed. The stone suite is a mixture of smooth waterworn quartzite, sandstone, and sometimes limestone pebbles, depending on the lithology of the underlying materials and the source area of the glaciers which deposited the till. The absence of crystalline igneous and metamorphic pebbles indicates that this is a Cordilleran not a Continental till. Marlboro till is distinguished from Robb till by pebble lithology; the stone suite of Robb till is primarily angular sandstone fragments while that of Marlboro till is dominantly water-worn quartzites. Marlboro till varies in thickness from about 50 cm to about 5 m, but average thickness is probably less than 2m.

The Marlboro soils are found on a variety of landforms. The general landscape, which is affected strongly by the topography of the underlying bedrock, consists of irregular elevated plains separated by broad, moderately to strongly sloping valleys. In the region west of the Narraway River, bordering the Foothills, an extensive ground moraine is present in which grooves, flutings, and drumlin fields are common. End moraines intersecting till ridges occur sporadically throughout the area. Hummocky dead-ice moraines composed of knobs and kettles are rare. Most of the Marlboro soils are found in areas with gently rolling to strongly rolling topography. At higher elevations, where the underlying bedrock is near the surface, topography may be hilly.

Three forest types comprise the majority of the forest on the Marlboro soil group. At elevations less than 1,220 m (4,000 feet), the Lodgepole pine/Labrador tea/Feathermoss type (11) and the Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) are of nearly equal extent. At elevations above 1,220 m, the Lodgepole pine/False azalea/Five-leaved bramble type (13) predominates. Scattered alder and aspen are confined to some of the dryer south-facing slopes. Productivity estimates (MAI and site index) of the various forest types are given in Table 3. Detailed descriptions of the forest types are given in Appendix B.

The striking feature of Marlboro group soils is the presence of a Brunisolic sequence of Ae and Bm horizons in an Ae horizon that overlies a continuous textural Bt horizon situated less than 30 cm below surface. The Bm horizon generally does not have sufficient pyrophosphate-extractable iron plus aluminum to meet the criteria for a Bf horizon. The texture of the surface horizons is generally silt loam to loam, while that of the Bt horizon varies from clay loam to loam. The Brunisolic sequence of horizons in the soils of this group is very strongly to strongly acid; the underlying Luvisolic solum is strongly to medium acid in reaction. Lime carbonate is present at 30 to 120 cm below the surface. A detailed description and analytical data for a soil profile included in the Marlboro group are presented in Appendix A.

Soil Units: Two soil units were established for the Marlboro soils. They are as follows:

MLB 8 - Dominantly Brunisolic Gray Luvisols (comparable to the Hardisty soil series described in an earlier soil survey report) in association with significant amounts of Podzolic Gray Luvisols (comparable to the Wildhay soil series). The soils of this unit are well to moderately well drained. About 79,020 acres were mapped.

MLB 9 - Dominantly well to moderately well drained Brunisolic and Podzolic Gray Luvisols (MLB 8) in association with 15 to 40 percent poorly drained Gleysolic soils. The Gleysols are found in depressions and on lower slopes, whereas the Gray Luvisols rest on upper slopes. An area designated as MLB 9 on the soils map is comparable to a Marlboro-Smoky area. About 55,480 acres of this unit were mapped.

Both thin and stony phase notations were used with the Marlboro soil group, due to the thinness of Marlboro till deposits in some locations and the abnormally high cobble content of the soils in other places. In some areas the till is both thin and stony. Such areas are designated on the soils map by using both phase notations together (for example, MLB 9/st). The gleyed phase was not used since soil moisture conditions are implied in the definition of the MLB 9 soil unit.

Map Combinations: A Marlboro unit mapped in combination with a Kenzie unit indicates land areas where the soils are alternately well to moderately well drained and very poorly drained. In such areas water distribution is a function of groundwater movement. Marlboro units occupy well drained upper slopes while the Kenzie unit is found on lower slopes and in land depressions.

Combinations between Marlboro and Lodge soil units identify areas where shallow glaciofluvial deposits overlie the till. In general, shallow sand lies on lower slopes and in depressions, while the higher areas are till covered.

Marlboro-Copton combinations indicate areas where the thickness of the till deposit is highly variable, and outcrops of medium to coarse textured sandstone bedrock are common.

Mayberne Soil Group (MBN)

The Mayberne soil group is a collection of well to moderately well drained Gray Luvisols developed on medium to moderately fine textured Continental till. Mayberne soils are widely distributed over the central, south-central, and southwestern portions of the map area, and are found mostly at the higher elevational limits of the Alberta Plateau-Benchlands but are also present to a limited extent in the fringes of the Rocky Mountain Foothills. Although usually situated between 1,160 m (3,800 feet) and 1,525 m (5,000 feet), these soils are found at elevations ranging from 915 m (3,000 feet) in the Simonette River valley to 1,645 m (5,400 feet) at the place where the Forestry Trunk Road leaves the map area in the south. About 372,260 acres of Mayberne soils were mapped.

The parent material of the Mayberne group is a yellowish brown to brown till which is friable to firm, weakly calcareous, and moderately to exceedingly cobbly. Pebbles and cobbles are rounded to subrounded, and are usually less than 5 cm in diameter but may be much larger. Dominant lithology is metaquartzite but a few crystalline erratics of Shield origin have been found in the deeper valleys. The till is fairly thin on uplands and steep slopes but may be very thick in buried valleys. Mayberne till overlies pre-Pleistocene gravels as well as shales and sandstones of the Paskapoo Formation, and is often overlain in turn by organic materials or, in isolated localities, by glaciofluvial sands.

The landscape associated with the Mayberne soil group is controlled by the topography of the underlying bedrock and consists of undulating plateaus and broad, strongly to very steeply sloping valleys. The predominant glacial landform is a veneer of ground moraine, but end and lateral moraines also exist. Topography is usually undulating on the plateaus and moderately rolling to hilly on the valley slopes. The elevation of the upland plateaus is 1,160 to 1,340 m (3,800 to 4,400 feet) in the eastern part of the map area and 1,460 m (4,800 feet) south of the Nose Mountain tower.

Two forest types comprise the majority of the forest on the Mayberne soil group. At elevations less than 1,465 m (4,800 feet), the Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) is dominant. At elevations above 1,465 m the Lodgepole pine/False azalea/Five-leaved bramble type (13) predominates. At the upper elevational limits of this type (near 1,525 m or 5,000 feet) subalpine fir and Engelmann spruce increase in abundance. Productivity estimates (MAI and site index) are included in Table 3. Appendix B includes detailed descriptions of the forest types.

The soils of the Mayberne soil group are characterized by strongly developed Gray Luvisol features. The yellowish brown Bt horizon is firm in consistency and very strongly acid in soil reaction. Significant variations are found in the upper part of the profile in the soils of this group. At lower elevations Mayberne soils are dominantly Orthic ('Bleached') Gray Luvisols and exhibit a double Ae horizon sequence. At higher elevations the soils are somewhat coarser textured in the upper portion of the profile and exhibit a Podzolic or Brunisolic sequence of horizons in an Ae horizon overlying the textural Bt horizon. Such soils are classified as Brunisolic or Podzolic Gray Luvisols depending on the amount of pyrophosphate-extractable iron plus aluminum in the Bf or Bfj horizon.

Textures of the surface horizons of the Mayberne soils are generally silt loam, clay loam, or sandy loam. Subsoil horizon textures range from clay loam to loam. Detailed descriptions and analyses of two soil profiles common to the Mayberne soil group are presented in Appendix A.

Soil Units: The Mayberne soil group was divided into four soil units. These units are described as follows:

MBN 4 - Dominantly Orthic Gray Luvisols (comparable to the Tom Hill soil series described in an earlier soil survey report) in association with significant amounts of Brunisolic Gray Luvisols. The soils of this unit are well to moderately well drained and generally are found where the Mayberne till is at its lowest elevation. About 119,620 acres of this unit were mapped.

MBN 5 - Dominantly well to moderately well drained Orthic Gray Luvisols (MBN 4) in association with poorly drained Gleysolic soils. This soil unit describes areas where a significant proportion of the soils are poorly drained Gleysols situated on lower slopes and in depressions. About 24,040 acres were mapped.

MBN 6 - Dominantly well to moderately well drained Brunisolic Gray Luvisols (comparable to the Nosehill soil series described in an earlier soil survey report). This unit is very common on the undulating to moderately rolling topography of the upland plateaus, and occupies approximately 180,380 acres.

MBN 7 - Dominantly well to moderately well drained Brunisolic Gray Luvisols and some Podzolic Gray Luvisols (MBN 6) in combination with 15 to 40 percent poorly drained Gleysolic soils. This unit and the MBN 5 soil unit are similar except that the morphologies of their surface horizons in well drained profiles are different. This unit is common on undulating to gently rolling upland plateaus in areas where significant amounts of Gleysolic soils are present. Approximately 48,220 acres were mapped.

Units of the Mayberne soil group may have stony or thin phases. In some places the unaltered bedrock is close to the surface. In other locations the soils have a high cobble content due to glacial redistribution of pebbles and cobbles from the Judy soil group. The gleyed phase description was not necessary since soil moisture conditions are implied in the definition of the MBN 5 and MBN 7 units.

Map Combinations: Mayberne-Kenzie combinations indicate Mayberne areas in which there are many very poorly drained moss peat bogs in landscape depressions too small to delineate on the map.

Combinations between Mayberne and Copton or Torrens soil units indicate areas where till is of variable thickness and bedrock frequently outcrops. The bedrock is coarser textured in a Mayberne-Copton area than in a Mayberne-Torrens area.

Mayberne-Judy combinations identify areas of mixed Mayberne till and preglacial gravels. The till in such an area is generally exceedingly stony and is often difficult to distinguish from the preglacial deposit.

Putzy Soil Group (PZY)

The Putzy soil group is a collection of well to rapidly drained soils developed on skeletal, moderately coarse to medium textured Mountain till. A variety of soil profiles are found on this parent material. Eluviated Dystric Brunisols and Orthic Humo-Ferric Podzols appear to be the dominant soils but Brunisolic and Podzolic Gray Luvisols have also been recognized. The Putzy soil group is found in the Rocky Mountain Foothills but is restricted to the Kakwa River valley and the high upland plateaus in the southwestern portion of the map area. Elevation ranges from 1,370 to 1,525 m (4,500 to 5,000 feet) in the Kakwa River valley and 1,675 to 1,770 m (5,500 to 5,800 feet) on the upland plateaus. About 36,180 acres of the Putzy soil group were mapped.

The parent material of the Putzy soils is a friable, yellowish to dark yellowish brown, very strongly to strongly acid Mountain till. This material is gravelly loam to gravelly sandy loam texturally and is also exceedingly to excessively stony. The stones are mostly well rounded quartzites and angular sandstone fragments less than 3 cm in diameter. Crystalline granites and gneisses of Shield origin are absent from the material. The quartzites most likely are derived from the conglomerate bedrock that commonly underlies the till at shallow depths. The till is less than 2 m thick and sometimes the conglomerate bedrock is exposed. In landscape depressions organic materials may overlie the till. The stone suite, the texture, and the exceedingly stony nature of the parent material distinguishes the Putzy soil group from others developed on morainal deposits.

Morainal veneer, flutings, grooves, lateral moraine, and end moraine are common landforms associated with the Putzy soil group. The general landscape reflects the topography of the underlying bedrock. Slopes are moderately to strongly rolling in the Kakwa River valley but are gently to moderately rolling on some of the upland plateaus. Isolated eroded cliffs and scarps exhibit very steeply sloping topography.

The predominant forest type on Putzy soils is the Lodgepole pine/False azalea/Five-leaved bramble type (13). In the areas where Putzy soils occur, the white-flowered rhododendron often attains greater cover than the false azalea in this type. The Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) is also an important forest type on the Putzy soil group. On sites at the upper elevation limits of this unit (1,770 m or 5,800 feet), where fire has not occurred for 200 to 300 years, Engelmann spruce and subalpine fir are the dominant trees and the red heather (*Phyllodoce empetriformis*) and crowberry (*Empetrum nigrum*) are the dominant understory plants. Table 3 gives productivity estimates (MAI and site index) for the various forest types. Detailed descriptions of these types can be found in Appendix B.

Texturally, Putzy soils are gravelly sandy loam to gravelly loam in the surface mineral horizons and gravelly sandy loam to gravelly sandy clay loam in the subsoil. These soils generally lack an illuvial horizon (Bt) but commonly exhibit a Bf or Bm horizon near the surface (Plate 10). Surface horizons are extremely to strongly acid in reaction. Due to a high stone content, a low amount of clay, and the absence of cementing agents, Putzy soils are very friable to loose in consistency. The soils in this group are highly variable. A detailed description and analyses of a profile common to the Putzy group are presented in Appendix A.

Soil Units: The Putzy soil group is composed of two soil units. The units are:

PZY 1 - Predominantly Eluviated Dystric Brunisols and Orthic Humo-Ferric Podzols in association with lesser amounts of Brunisolic and Podzolic Gray Luvisols. Areas of PZY 1 are mainly rapidly to well drained. About 15,840 acres were mapped.

PZY 2 - Predominantly rapidly to well drained Eluviated Dystric Brunisols and Orthic Humo-Ferric Podzols (PZY 1) in association with significant amounts (15 to 40 percent) of poorly drained peaty Gleysolic soils. The Gleysols are present in landscape depressions and on lower slopes. About 20,340 acres were mapped.

The only phase description necessary was "gleyed" which was used to describe some imperfectly drained soils that were found on a high plateau in the southwestern portion of the map area near Falls Creek. The thin and stony descriptions were not needed because this soil group is defined as being exceedingly stony and somewhat thin.

Map Combinations: Putzy soil units were frequently mapped with Copton soil units. In these areas outcrops of sandstone and colluvium are common and the till is very thin in some localities. A Putzy unit combined with a Copton 3 unit indicates areas where the sandstone is consolidated, while a Putzy unit in combination with a Copton 1 unit indicates areas where the sandstone is unconsolidated.

Combinations of Putzy and Kenzie soil units indicate areas with highly variable internal soil drainage. Putzy soils always occupy the upper slope and crest positions in such areas; the Kenzie soils are found on the lower slopes or in depressions.

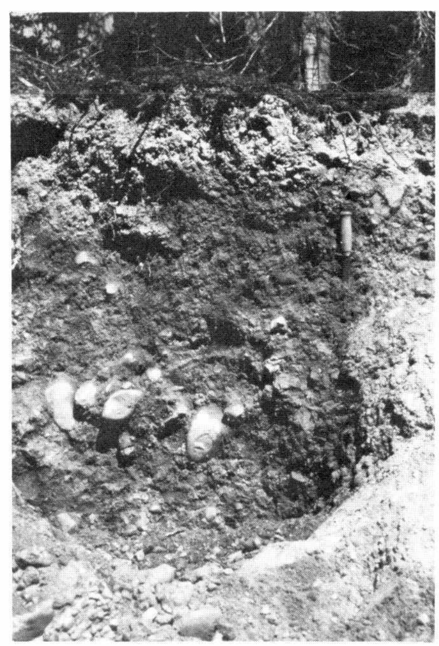


Plate 10. An Eluviated Dystric Brunisol developed on stony mountain till (Putzy soil group).

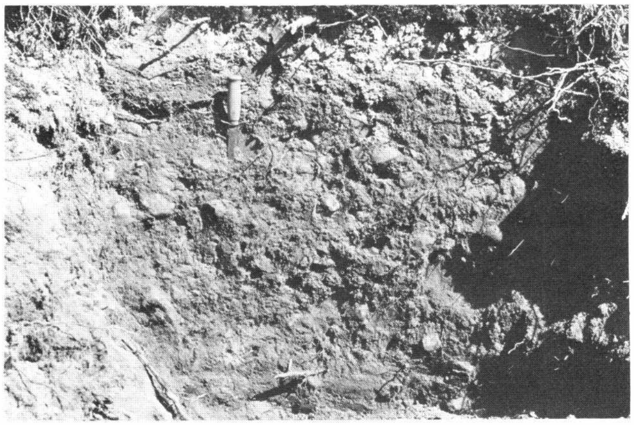


Plate 11. A Brunisolic Gray Luvisol common to the Robb soil group. Note the thick white Ae horizon.

Robb Soil Group (RBB)

Robb group soils are well to moderately well drained soils developed on a moderately coarse to medium textured mixture of Cordilleran till and colluvium. Brunisolic Gray Luvisols, Eluviated Dystric Brunisols, and Eluviated Eutric Brunisols as well as lithic soils predominate, but Orthic and Podzolic Gray Luvisols, and Orthic Humo-Ferric Podzols were also observed. Soil development is affected strongly by the texture and acidity of the parent material, the steepness of the topography, and the resulting processes of mass-wasting. Robb soils are found in the southwestern portion of the map area in the Rocky Mountain Foothills. About 130,120 acres of this group were mapped, exclusively in a northwest to southeast-trending belt parallel to the mountains. These soils are found at elevations exceeding 1,525 m (5,000 feet) on some of the upland plateaus, but generally are confined to elevations between 1,220 and 1,525 m (4,000 to 5,000 feet).

The parent material of the Robb soil group is primarily a Cordilleran till to which considerable colluvial material produced by upper slope erosion has been added. The material is dark brown to olive brown, moderately coarse to medium textured, and moderately to exceedingly stony. The till varies from strongly acid to mildly alkaline in reaction, apparently in direct correspondence to the composition of the underlying bedrock. The stones exhibit a wide variety of sizes and shapes and are dominantly angular sandstones and shales derived from the underlying bedrock, but some quartzites and limestones are also present. Thickness of the material varies, with the thinnest deposits at or near the tops of ridges and knolls and the thickest material in valley bottoms. Mean thickness is less than 75 cm. In the valleys of the South Torrens River and Mouse Cache Creek the Robb soil parent material contains a considerable amount of fan material derived from the adjacent mountain slopes. Such areas are exceedingly stony. The stone suite, consisting chiefly of angular sandstone and shales, distinguishes Robb soils from other soils developed on morainal deposits.

The most obvious landscape features associated with Robb soils are steeply sloping ridges with high local relief. These are aligned parallel to subparallel, a reflection of bedrock lithology and structure. Superimposed on these features are large areas of morainal veneer and lesser areas of small colluvial fans, flutings, and grooves. Topography commonly varies between gently to moderately rolling on the upland plateaus and strongly rolling to hilly on the valley walls.

The predominant forest type is the Lodgepole pine/False azalea/Five-leaved bramble type (13) with lesser amounts of Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12). Other important types on the unit are the Engelmann spruce - Subalpine fir/False azalea type (15) which succeeds from type 13, and the White spruce/Feathermoss type (5) in which white spruce - Engelmann spruce hybrids are often found. Productivity estimates of the various forest types are included in Table 3. Appendix B includes detailed descriptions of these types.

The Robb group soils have highly variable profiles. Generally these soils have an eluviated horizon (Ae) or a Bm or Bf horizon in the upper part of the profile. In many cases the amount of clay moving downward from the upper part of the profile is insufficient to form a Bt horizon (Plate 11, Plate 12). The surface horizons (Ae1 - Bm - Ae2) vary from extremely acid to strongly acid in reaction while the lower part of the solum is, in some cases, only slightly acid in reaction. Brunisolic and Orthic Gray Luvisols are the dominant soils on the gently rolling to moderately rolling upland plateaus. Eluviated Eutric and Eluviated Dystric Brunisols as well as lithic soils predominate on the steeply sloping areas. A detailed description and laboratory analysis of a profile included in the Robb group are presented in Appendix A.

Soil Units: Two soil units were established for the Robb soil group. These are:

RBB 7 - Dominantly Brunisolic Gray Luvisols and lithic soils in association with significant amounts of Eluviated Eutric Brunisols (comparable to the Felton soil series described in a former soil survey report) and Eluviated Dystric Brunisols (Fidler soil series in a former soil survey report). Internal and surface soil drainage of the soils of this unit is good. Ridges with steeply to very steeply sloping sides may have excessive surface drainage. About 100,200 acres were mapped.

RBB 8 - Predominantly soils of the RBB 7 soil unit in association with significant amounts (15 to 40 percent) of poorly drained peaty Gleysolics on the lower slopes and in landscape depressions. About 29,920 acres were mapped.

No soil phase notations were needed to further describe the Robb soils group. The designation "thin phase" was not used because of the overall shallowness of the soil parent materials and the soil material varies from moderately to exceedingly stony wherever it is found.

Map Combinations: Robb soil units are frequently combined with units of the Copton soil group. Such combinations indicate soil areas where the till deposits are very thin and the moderately coarse to medium textured bedrock commonly is exposed, particularly on hill crests.

Robb-Torrens combinations denote soil areas that are similar to Robb-Copton areas except the exposed bedrock is moderately fine to fine textured.

Robb-Jarvis combinations indicate areas of mixed till and fluvial outwash gravels; these are relatively rare and are found only adjacent to the Smoky River in the south-central portion of the map area.

Sheep Soil Group (SHP)

Soils of the Sheep group are predominantly moderately well drained Brunisolic Gray Luvisols developed on medium to moderately fine textured Mountain till overlying moderately fine to fine textured, slightly stony shales that have been modified somewhat by glaciation. This soil group is found in the Rocky Mountain Foothills in a narrow northwest to southeast trending belt adjacent to the mountains. These soils are generally situated on high upland plateaus and benchlands at elevations of 1,465 to 1,735 m (4,800 to 5,700 feet). An exception to this is an area near Sherman Meadows adjacent to the Torrens River, where Sheep soils are present at the much lower elevations of 1,160 to 1,220 m (3,800 to 4,000 feet) above mean sea level. Sheep soils are of limited areal extent, occupying only about 20,660 acres of the map area.

The upper part of the profile is distinctly different from the underlying parent material. The upper 40 or 50 cm (soil

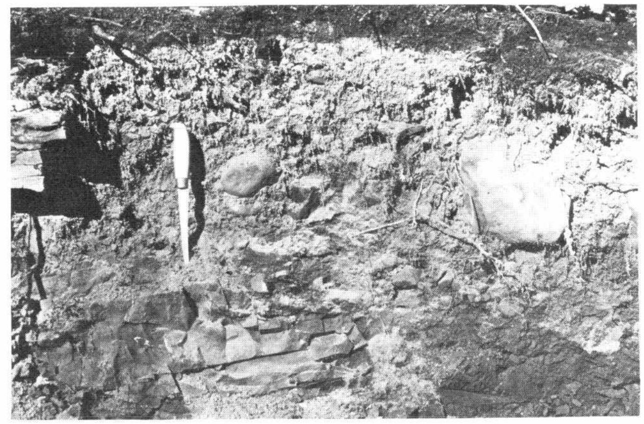


Plate 12. A lithic Eluviated Dystric Brunisol of the Robb soil group.

solum) are generally brown to yellowish brown, moderately to exceedingly stony, friable in consistency, and silt loam to clay loam in texture. The variable stone suite consists of combinations of metaquartzites, lithic sandstones, orthoquartzites, and some limestones, all of which vary considerably in size and shape. Below the solum, the material changes to a slightly stony, darker colored, massive and dense silty clay loam to heavy clay, and may be predominantly reworked dark-colored shales of the Shaftesbury Formation. The fact that this material is massive and dense and incorporates some glacial erratics suggests that it may be a basal till. The characteristics of the subsoil distinguish Sheep soils from other soils developed on morainal deposits.

Morainal veneer is the only common geomorphic landform associated with the Sheep soil group. The soils are found on gently to moderately rolling topography on elevated benchlands and high plateaus. Eroded cliffs and scarps that exhibit steeply sloping to extremely sloping topography are rare.

The Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) predominates on Sheep soils but the Lodgepole pine/False azalea/Five-leaved bramble type (13) occurs at higher elevations on this unit with Engelmann spruce and subalpine fir in mature high-elevation stands. Table 3 gives the estimates of productivity of the various forest types. Detailed descriptions are included in Appendix B.

The soils of this soil group generally exhibit an Ae1 - Bm - Ae2 - Bt, or Ae - Bm - Bt horizon sequence which is diagnostic for Brunisolic Gray Luvisols. The Bm horizon may appear at the contact between the upper and lower Ae horizons

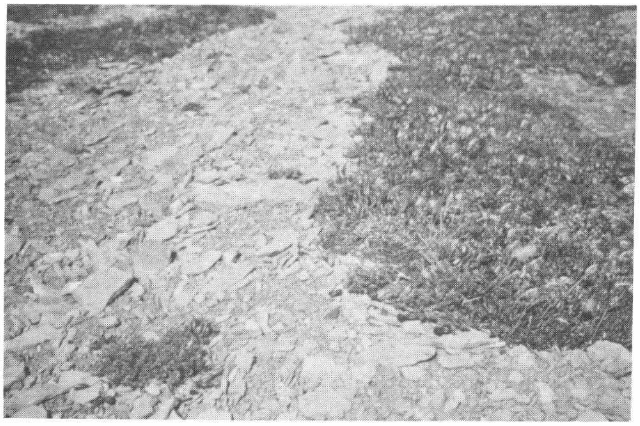


Plate 13. Sparse alpine vegetation common to the Caw soil group. Note the angular bedrock fragments on the surface which form a protective covering against wind erosion.

or may be between the Ae and Bt horizons. Commonly, the upper horizons are extremely acid, the Bt horizon very strongly to strongly acid, and the parent material medium acid to mildly alkaline in reaction. A soil profile common to the Sheep soil group was described in detail and sampled for laboratory analysis; the data are presented in Appendix A.

Soil Units: There are two soil units in the Sheep soil group. These units are:

SHP 1 - Dominantly moderately well drained Brunisolic Gray Luvisols with minor amounts of Orthic Gray Luvisols. About 4,820 acres were mapped.

SHP 2 - Predominantly moderately well drained Brunisolic Gray Luvisols (SHP 1) in association with significant amounts of Gleysolic soils lying on lower slopes and in landscape depressions. About 15,840 acres were mapped.

No soil phase notations were used with the Sheep soil group.

Map Combinations: Sheep soils have been mapped in combination with Copton soils. Such a combination indicates an area where till thickness is highly variable, and medium to moderately coarse textured, unconsolidated bedrock sometimes outcrops.

Sheep-Kenzie combinations indicate areas with highly variable soil drainage. Sheep soils always occupy the upper slope positions whereas the Kenzie soils are found in the depressions.

Combinations of Sheep-Lodge units identify areas where thin fluvial sand deposits sometimes overlie the till. In most instances, till exists on the knobs and upper slopes and sand rests in the lower positions.

Soils Developed on Colluvial Deposits

The Caw, Deep Valley, Errington, and Nickerson soil groups are all developed on colluvial deposits. All these groups are found within the Rocky Mountains physiographic division except for the Deep Valley group which rests on the eroded escarpments of Tertiary Uplands in the Alberta Plateau-Benchlands. Caw and Nickerson soils are found above tree line associated with pronounced periglacial features. Errington soils are situated on the steep but treed mountain slopes. Regosolic and Brunisolic soils predominate but Luvisolics in lesser amounts were also observed. Soils developed on colluvial deposits occupy about 4 percent of the map area.

Caw Soil Group (CAW)

Regosolic soils developed on well drained, moderately coarse to moderately fine textured, dry subalpine and alpine colluvium are the dominant soils of the Caw soil group. Caw soils are found in the Rocky Mountains in the sparsely vegetated alpine and subalpine regions above tree line at elevations exceeding 1,830 m (6,000 feet) above mean sea level. These soils occupy approximately 1 percent of the map area.

Due to the variable nature of the underlying bedrock, the parent material of these soils varies greatly in texture and stone content. The material is very dark grayish brown to dark brown, generally exceedingly stony, and neutral to mildly alkaline in reaction. The texture varies from sandy loam to silty clay loam, but silt loam textures appear to predominate. The stone suite consists of angular sandstone fragments derived mainly from the underlying bedrock. Glacial erratics are rare in the material. The colluvium appears to be less than 1 m thick and in some locations consolidated bedrock crops out. In some areas the 'fines' have been blown away leaving only angular bedrock fragments littered over the surface. These coarse bedrock fragments form a protective covering against further wind erosion (Plate 13).

The most obvious landscape feature associated with the Caw soil group is the colluvial veneer overlying the soft Cretaceous bedrock. Superimposed on this are periglacial frost features such as stone circles, stone stripes, boulder fields, and frost boils (Plate 14, Plate 15). Topography varies from gently rolling to hilly.

Forest vegetation is absent on Caw soils due to the harsh climate at high elevation. The alpine vegetation present is comprised of dwarf shrubs and cushion plants that often grow in small circles or stripes oriented downslope, the diameter or width of which is generally less than 2 m. Bedrock fragments commonly litter the surface between the circles and stripes of vegetation and generally cover more area than does the vegetation. The dominant species present are white dryad (*D. octopetala* and *D. integrifolia*), moss campion (*Silene acaulis*), Kobresia (*Kobresia myosuroides*), white mountain heather (*Cassiope tetragona*) and saxifrage (*Saxifraga tricuspidata*).

The soils show a minimal amount of development mainly because of adverse climatic conditions. The absence of lush vegetation and the constant movement of materials due to both wind and frost action keeps pedogenic processes to a minimum. Although Orthic Regosols are the dominant soils of the Caw group, variations within the Subgroup exist. Some soil profiles exhibit an organic horizon (H) mechanically mixed with the parent material (C horizon) to considerable depth (up to 80 cm), while others exhibit no organic horizon at all. The soils with H - C horizons lie in the vegetated areas of the landscape. The upper portions of the soils vary from slightly to very stony and are medium acid to mildly alkaline in reaction. A profile of a Caw soil was described and sampled for laboratory analysis. The data are shown in Appendix A.

Soil Unit: Only one soil unit was used to describe the Caw soils. The relatively inaccessible location and the scale of mapping used in this survey made the division of the Caw group into a number of soil units unwarranted. The soil unit shown on the soils map is:

CAW - Dominantly Orthic Regosols in association with significant amounts of Lithic Orthic Regosols and rock outcrops. About 43,020 acres were mapped.

No soil phase notations were used in mapping this soil group, and no combinations with other soils were mapped.

Deep Valley Soil Group (DPV)

This soil group lies on the eroded escarpments of the Tertiary Uplands near Deep Valley Creek in the eastern portion of the map area. Moderately well drained Eluviated Eutric Brunisols developed on moderately coarse to moderately fine textured colluvium predominate, but Orthic Regosols and Brunisolic Gray Luvisols are also present to some extent. Deep Valley soils are found at elevations between 1,065 m and 1,190 m (3,500 and 3,900 feet) above mean sea level, in the Alberta Plateau-Benchlands. These soils occupy approximately 0.7 percent of the map area.

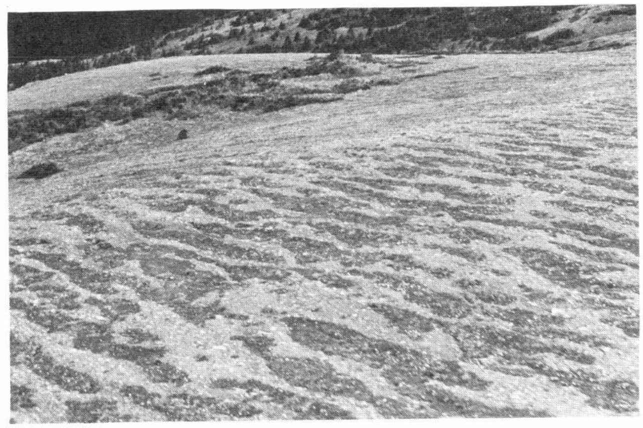


Plate 14. An area of Caw soils with stone stripes. These pereglacial features are common on steep slopes.

The parent material is a changeable mixture of Mayberne till, preglacial gravels, and unconsolidated bedrock material that is eroding due to gravity. The resulting colluvium has highly variable properties. It is moderately to exceedingly stony; and the stones are predominantly quartzites derived from the till or preglacial gravels, or sandstones derived mainly from the underlying bedrock. The material is generally friable in consistency, slightly acid to neutral in soil reaction and sandy loam to clay loam in texture. The colluvium is usually less than 1 m thick, but may be much thicker on scarps which are subject to seepage. Deep Valley soils are similar to those of the Mayberne soil group; however, Deep Valley soils can be distinguished by their position in the landscape (found on eroded escarpments) and somewhat weaker profile development.

The obvious landform feature is one of steeply sloping eroded escarpments adjacent to the Tertiary Upland plateaus. The topography is moderately to strongly rolling. Erosional problems such as gullying and development of landslides are common, especially in areas where the tree cover has been removed.

The predominant forest type on Deep Valley soils is the Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12). Aspen grows with lodgepole pine on dryer, south-facing slopes. Black spruce may achieve co-dominance with lodgepole pine on north-facing slopes that are subject to seepage.

The soils generally display weak horizonation due to downslope movement. Surface and internal drainage of these soils is good, but in some areas water from the upland plateaus seeps downslope and influences soil development. Deep Valley soils have sandy loam to loam surface horizons and sandy loam to clay loam subsoil horizons. The solum varies from strongly acid to neutral in soil reaction. No soil profiles of this soil group were described in detail or sampled for further characterization.

Soil Unit: Only one soil unit was used to map the Deep Valley soils. It is:

DPV - Dominantly Eluviated Eutric Brunisols in association with significant amounts of Orthic Regosols and Brunisolic Gray Luvisols. The steeply sloping escarpments on which these soils are found are generally moderately well drained; however, isolated seepage areas where Orthic Regosols predominate may be found on some of the north-facing slopes. About 25,380 acres were mapped.

No soil phases were employed in mapping the Deep Valley soils, and no combinations with other soils were mapped.

Errington Soil Group (ERR)

The Errington soil group includes a wide range of well drained soils developed on medium textured, moderately to exceedingly stony colluvial material. Eluviated Dystric and Eluviated Eutric Brunisols appear to be the dominant

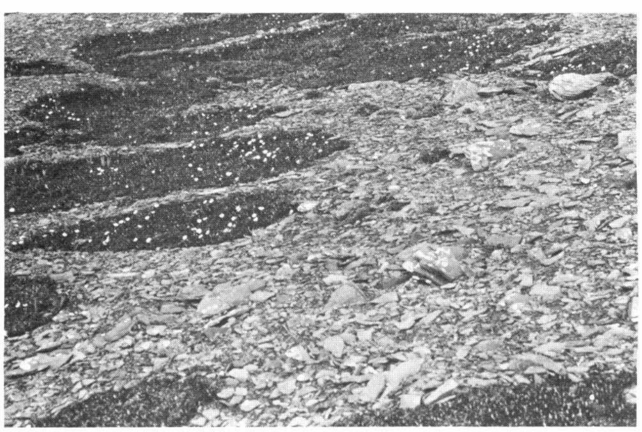


Plate 15. An area of Caw soils with stone rings. These periglacial features are common on gentle slopes.

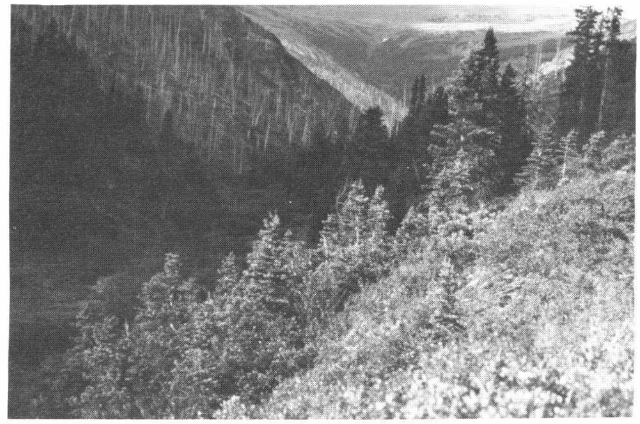


Plate 16. Hilly topography of the Errington soil group.

soils, but Brunisolic and Orthic Gray Luvisols as well as Orthic Humo-Ferric Podzols are also present to some extent. Lithic versions of the above Subgroups are also important soil types in areas where consolidated bedrock is encountered within 50 cm of the surface. Errington soils are found in the Rocky Mountains on the very steeply sloping mountain slopes below tree line at elevations between 1,525 and 1,830 m (5,000 and 6,000 feet) above mean sea level (Plate 16). This soil group occupies about 2 percent of the map area.

The parent material of the Errington soil group is medium textured colluvium which often resembles till, and is composed of angular rock fragments, generally sandstone, in a silty to sandy matrix (depending upon the local bedrock). The material is friable to very friable in consistency, dark brown to dark grayish brown in color, generally loam to silt loam in texture, and strongly acid to mildly alkaline in reaction. Soil reaction depends on the composition of the underlying bedrock. The stone suite consists dominantly of sandstones and siltstones. Paleozoic limestones and dolomites are rare. In areas where conglomerate bedrock predominates, the colluvial material may contain considerable quartzite in addition to sandstones and siltstones. The thickness of the deposits is highly variable with the thinnest deposits found at or near the top of the side slopes and the thickest near the valley bottoms. The Errington soil group is somewhat similar to the Robb soil group. The main difference is landscape position: Robb soils lie at lower elevations on 'razor back' ridges and near valley bottoms. Also, the topography associated with Robb soils is generally less steep than that associated with Errington soils.

The Errington landscape consists of steeply to very steeply sloping treed mountain slopes which have a shallow mantle of colluvium deposited over the bedrock. Also in the

Plate 17. An Eluviated Dystric Brunisol common to the Errington soil group. Profile shows a weakly developed Ae horizon and weakly developed B horizon.

landscape are rock outcrops, small fans near the bottom of the slopes, and occasional talus slopes. These landforms are very susceptible to gullying and mass wasting, especially if the native vegetation is disturbed.

The predominant forest type on Errington soils is the White spruce/Feathermoss type (5) with stunted Engelmann spruce largely replacing white spruce as the dominant tree species. Subalpine fir is usually also present. The higher elevation forests on northerly aspects often have false azalea and red heather as understory plants. Lupine (*Lupinus nootkatensis*) is locally abundant in more open forests on southerly aspects.

The development of Errington soils, like that of Copton and Robb soils, is affected strongly by the steep topography, the soil reaction of the parent material, and the processes of mass wasting. Weakly developed Eluviated Eutric and Eluviated Dystric Brunisols are dominant on the very steeply sloping mountain sides (Plate 17, 18). These soils are characterized by an Ae - Bm - Btj horizon sequence. On more stable sites soil development proceeds to the Gray Luvisol stage. These soils are characterized by eluvial (Ae) horizons and illuvial textural Bt horizons in which silicate clay is the main accumulation product. Lithic soils are prominent on very steep slopes where bedrock is near the surface. In general, the soil sola are very friable to friable in consistency, silt loam to loam in texture, and very strongly acid in the upper portions. Strongly acid to neutral conditions prevail in the lower portions of the sola. The soils are generally well drained and because of the steeply to very steeply sloping terrain, surface run-off may be excessive. A detailed description and laboratory analyses of a soil profile common to this soil group are presented in Appendix A.

Soil Unit: Due to the variability of the parent material and soil profile development as well as to the poor accessibility of the steeply sloping terrain and the scale of mapping used in this survey, only one soil unit was used to indicate the soils of the Errington group:

ERR 3 - Dominantly Eluviated Dystric and Eluviated Eutric Brunisols in association with significant amounts of Brunisolic Gray Luvisols and Lithic soils. Orthic Humo-Ferric Podzols, Orthic Gray Luvisols, and Orthic Regosols in minor amounts have also been recognized within this soil unit. About 69,160 acres were mapped.

There are no soil phases of this unit and Errington soils were not mapped in combination with units of any other soil group.

Nickerson Soil Group (NKN)

This soil group includes moderately well to poorly drained, moist, Regosolic soils developed on moderately coarse to moderately fine textured colluvium. Nickerson soils are found near or above tree line in the alpine and subalpine

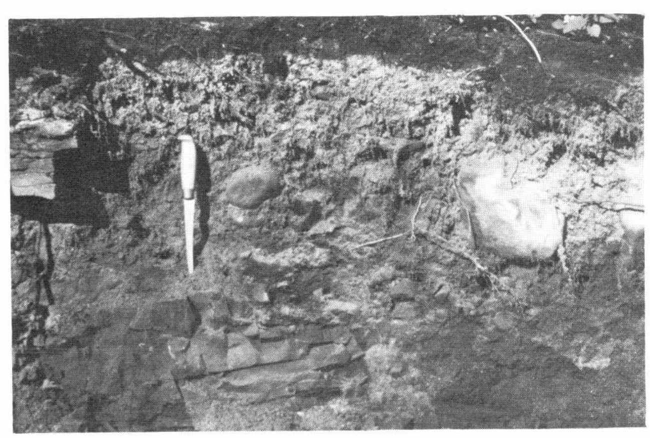


Plate 18. A lithic Eluviated Dystric Brunisol common to the Errington soil group. Stones in upper portion are rounded sandstones.

regions of the Rocky Mountains at elevations exceeding 1,830 m (6,000 feet). These soils lie in isolated areas at the bottom of sheltered cirques and along the bottom and lower slopes of some alpine valleys. They are more prominent on wetter north-facing slopes than on southern exposed slopes. Nickerson soils occupy only 0.3 percent of the map area.

Parent material of the Nickerson soil group is a very dark gray, very stony, sandy loam to sandy clay loam textured colluvial deposit. The stones, angularly shaped and highly variable in size, are commonly sandstones and siltstones, but some quartzites and limestones are evident. This colluvial material is thicker than that in other parts of the alpine region and commonly exceeds 2 m (6 feet). Nickerson and Caw soils are similar except that Nickerson soils lie in the moister landscape positions where snow accumulation is probably greater and spring melt is later than in dryer Caw areas.

A colluvial blanket modified by periglacial features such as solifluction lobes is the only landform associated with this deposit. The solifluction lobes appear to be linked to seepage areas (Plate 19). In these areas the cover of alpine and subalpine vegetation is denser and more uniform than in other regions of the mountains. The topography, generally somewhat flatter than that associated with the Caw group, varies from gently to strongly rolling.

Vegetation on the Nickerson soils is a nearly complete cover of alpine and subalpine low shrubs, herbs, mosses and lichens, characteristic of snow accumulation areas. Characteristic species include white dryad (*D. octopetala*

Plate 19. Solifluction lobes commonly found in areas of the Nickerson soil group. Note the lusher vegetation in the foreground.

Plate 20. An Orthic Regosol developed on moist colluvium. This soil is common to the Nickerson soil group.

and *D. integrifolia*), snow willow (*Salix nivalis*), white mountain heather (*Cassiope mertensiana*), alpine bistort (*Polygonum viviparum*), wormwood (*Artemisia norvegica*) and buttercup (*Ranunculus eschscholtzii*). At the lower elevational limits of the Nickerson unit are patches of dwarf birch, arctic willow (*Salix arctica*), subalpine fir krummholz and common juniper (*Juniperus communis*).

Nickerson soils show a minimal amount of development because of adverse climatic conditions and mixing action associated with downslope soil creep. No mottling and gleying features are present even though these soils commonly are saturated with water. Because of this lack of mottling, the soils are classed as Regosols rather than Gleysols (Plate 20, Plate 21). The soils are slightly acid to mildly alkaline in reaction. Rarely, in areas where the solifluction lobes have become somewhat fossilized and soil creep is minimal, Eutric Brunisols appear to be dominant. These areas are generally not as moist as other areas and the soils are strongly to medium acid in reaction. A soil profile common to the Nickerson group was described in detail and sampled for laboratory analysis. The data are presented in Appendix A.

Soil Unit: Only one soil unit was used to describe the Nickerson soils:

> NKN - Predominantly moist Orthic Regosols in association with significant amounts of Cumulic Regosols developed on colluvium situated in alpine areas. Lithic subgroups and rock outcrops are rare in this unit. About 9,680 acres were mapped.

No soil phase notations were used with this soil unit, and no combinations with soil units of other soil groups were mapped.

Soils Developed on Undifferentiated Morainal - Colluvial Deposits

The materials from which the Smoky group soils have developed are mainly till deposits in the eastern and northern portions of the map area and undifferentiated morainal-colluvial deposits in the steeply sloping southwestern portion. The Smoky soil group is a collection of poorly drained Gleysolic soils.

Smoky Soil Group (SKY)

This soil group is a collection of Gleysolic soils developed on morainal or colluvial deposits having restricted internal soil drainage. The Smoky soil group is found in all physiographic divisions but is of very limited extent in the Wapiti Plains and Rocky Mountains. Smoky soils occupy 171,520 acres or 5 percent of the map area.

The highly variable parent material exhibits the properties of all glacial tills and all colluvial deposits found below tree line that are recognized in the map area. Stone content varies from slightly to exceedingly stony with texture generally in the loam to clay loam class.

Smoky soils are usually found on lower side slopes (as steep as 30 percent) and in depressions, and are commonly associated with springs, seepages, and bogs — all features of groundwater discharge. The soils are often nearly or completely saturated throughout the growing season.

The two prevalent forest types on Smoky soils are the Black spruce/Labrador tea/Horsetail type (6) and the White spruce/Horsetail/Feathermoss type (4). Other portions of this map unit are dominated by willow (*Salix* spp.) communities with marsh reed grass (*Calamagrostis canadensis*) understories. Table 3 gives productivity estimates for the forest types. Appendix B includes descriptions of these types.

Smoky soils are classed as Gleysolics. In Smoky profiles, up to 15 cm of peat, derived primarily from the growth and decomposition of mosses, overlie various, usually mottled, mineral horizons which always show signs of being saturated for appreciable portions of the growing season. However, mottling is minimal in Smoky soils found on steeper slopes because the water is oxygenated. Orthic Gleysols and Rego Gleysols are the dominant soils of this group (Plate 22). A detailed description and an analysis of a profile common to the Smoky group are presented in Appendix A.

Plate 21. An area of Nickerson soils in the foreground with rock outcrops in the background.

Soil Units: Six soil units were used to describe the Smoky soil group. A guide to the associated till material is provided by the last five units. The six soil units are:

SKY 1 - Predominantly poorly drained Gleysolic soils. Orthic and Rego Gleysols appear to be the dominant soil types present but some Orthic Luvic Gleysols are found at lower elevations. A guide to the characteristics of the parent material is provided by the soil units mapped in the surrounding, well drained upland areas. This unit may contain up to 15 percent well drained soils. About 86,820 acres were mapped.

SKY 2 - Dominantly poorly drained Gleysolic soils, in association with significant amounts (15 to 40 percent) of moderately well drained Orthic and Brunisolic Gray Luvisols developed on Edson till parent material. The scale of mapping did not permit the separation of the poorly drained soils from those moderately well drained. About 51,880 acres were mapped.

SKY 3 - Predominantly Gleysolic soils in association with significant amounts of Orthic Gray Luvisols developed on Mayberne till parent material. About 12,660 acres were mapped.

SKY 4 - Predominantly Gleysolic soils in association with significant amounts of Brunisolic Gray Luvisols developed on Mayberne till parent material. This soil unit is generally found where the Mayberne till is at higher elevations. About 4,180 acres were mapped.

SKY 5 - Dominantly poorly drained Gleysolic soils in association with well to moderately well drained soils of the Marlboro soil group. About 9,900 acres were mapped.

Plate 22. A peaty Orthic Luvic Gleysol common to the Smoky soil group. Note the thick duff layer on the surface and mottling in the subsoil.

SKY 6 - Dominantly poorly to very poorly drained peaty Gleysols in association with well to moderately well drained soils of the Robb soil group. The Gleysolic soils of this unit contain more than 15 cm of surface peat. About 6,080 acres were mapped.

Those Gleysolic soils which have more than 15 cm but less than 50 cm of accumulated peat at the surface are designated as a peaty phase and have been indicated as such on the accompanying soils map. The character of the soils eliminates the need for the phase notations stony, thin, or gleyed.

Map Combinations: Smoky soil units commonly are mapped in combination with the Kenzie soil units. Such a combination represents an area where the accumulation of surface peat is highly variable and Organic soils derived mainly from moss material are significant.

Other map combinations appearing on the soils map are: SKY 2 - TOR 1, SKY 2 - COP 1, and SKY 2 - DON 1. Such combinations indicate areas of mixed parent materials where soils are predominantly poorly drained Gleysolics associated with Edson and other moderately well drained soils. Torrens, Copton, and Donnelly soils occupy at least 15 percent of their respective areas.

Soils Developed on Glaciolacustrine Deposits

Soil groups developed on glaciolacustrine deposits occupy approximately 12 percent of the area, and include the Donnelly, Nampa, Tri-Creek, and Snipe groups. Gray Luvisols and Gleysolics are the dominant soil types. With the exception of the Tri-Creek soil group, these soils are found on the undulating Wapiti Plains in the northern portions of the map area. The Tri-Creek soil group is found in the Foothills and Alberta Plateau-Benchlands on the relatively narrow flat stretches of terrain that lie between the major incised stream courses and the regionally dissected upland.

Donnelly Soil Group (DON)

The Donnelly soil group consists mainly of imperfectly drained Gleyed Solonetzic Gray Luvisols developed on fine to very fine textured, slightly stony, stratified, lacustrotill (glaciolacustrine) deposits. These soils are found in the Wapiti Plains in the northern portions of the map area at elevations below 855 m (2,800 feet). Soils of this group cover approximately 8.7 percent of the area.

The Donnelly parent material is a lacustrotill composed of friable to firm, yellowish brown to brown, clay loam to silty clay alternating with firm, dark grayish brown silty clay to heavy clay. Thickness of the lacustrotill varies from a few centimetres to several metres but is usually about 3 m (10 feet). This material is slightly stony, weakly to moderately calcareous, and sometimes weakly saline. Stones are quartzites, limestones, sandstones, and crystalline Precambrian Shield rocks such as granites and gneisses. In the northwestern part of the map area, the lacustrotill is relatively more stony and somewhat resembles Edson till. The lacustrotill is similar to other glaciolacustrine deposits except that it is browner, less compact, and stony.

The Donnelly soil is usually found on broad lacustrine plain landforms with undulating topography. Generally, the topography of the underlying till or bedrock is masked but not obliterated.

The predominant forest vegetation on the Donnelly soils is the Aspen/Low-bush cranberry/Dewberry type (1). On slightly moister sites and where succession is more advanced, the White spruce/Dewberry/Wild lily of the valley type (3) predominates. At higher elevations on this unit, small amounts of Lodgepole pine/Low-bush cranberry/Dewberry type (8) and Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) occur. Productivity estimates and type descriptions are given in Table 3 and Appendix B, respectively.

Some Donnelly soils have an Ah horizon up to 5 cm thick. All Donnelly soils have a light brownish gray to pale brown Ae horizon ranging from 5 to 20 cm thick, and a moderately to strongly developed textural Bt horizon. Mottling is common in the lower portion of the Ae horizon and throughout the Bt horizon, indicating imperfect internal soil drainage. The characteristics of the fine textured

Bt horizon are variable. Some profiles exhibit strong Solonetzic features such as columnar or prismatic structure and organic staining, but contain insufficient amounts of exchangeable sodium to meet the requirements for a Bn horizon; other profiles show only weak Solonetzic morphology. Those soils that have strong Solonetzic morphology often contain appreciable amounts of exchangeable magnesium in addition to exchangeable calcium.

The sola of Donnelly soils are generally medium to slightly acid in reaction and slightly stony. Except for the higher stone content and the absences of dark colored, finer textured strata in the lower portion of the sola, these soils are similar to the soils of the Nampa soil group. Data for a soil of the Donnelly group are presented in Appendix A.

Soil Units: Two soil units were established for the Donnelly soils. They are:

DON 1 - Dominantly imperfectly drained Gleyed Solonetzic Gray Luvisols (called the Donnelly soil series in former Peace River District soil survey reports) in association with significant amounts of Orthic Gray Luvisols. Gleyed Gray Luvisols are also an important constituent of this soil unit but poorly drained Gleysolic soils cover less than 15 percent of the area. About 61,160 acres were mapped.

DON 2 - Dominantly imperfectly to moderately well drained Gleyed Solonetzic Gray Luvisols (DON 1) in association with significant amounts (15 to 40 percent) of Orthic Luvic Gleysols (called the Snipe soil series in former Peace River District soil survey reports). The Gleysolic soils are found on lower slopes and in depressions where groundwater discharge and surface waters tend to accumulate. About 247,740 acres were mapped.

No soil phase notations were used to describe the Donnelly soil group.

Map Combinations: Donnelly soil units are often mapped in combination with Lodge units. This indicates areas where sands of varying thickness (generally less than 50 cm deep) overlie lacustrotill materials.

Combinations of Donnelly and Edson are used for areas where the lacustrotill deposits are shallow, and till is exposed. Such areas are found chiefly along the margins of the lacustrotill basin.

Donnelly - Davis combinations identify areas where the parent material ranges from fine textured lacustrotill to medium textured glaciofluvial deposits. Such areas are common along some of the major rivers.

Nampa Soils Group (NMP)

Nampa group soils are imperfectly to moderately well drained soils that are dominantly Gleyed Solonetzic Gray Luvisols developed on a fine to very fine textured, stone-free glaciolacustrine deposit. These soils are found exclusively within the Wapiti Plains in the northwestern portion of the map area east of the Wapiti River, at elevations below 745 m (2,450 feet). They occupy only 0.4 percent of the map area.

The parent material ranges in texture from silty clay to heavy clay and varies considerably in thickness. The stone-free, stratified material is olive brown, friable to firm, weakly to moderately calcareous, and, in some areas, weakly saline. The lack of stones, the relatively level topography, and the lower elevations distinguish lacustrine material from lacustrotill deposits.

These soils are found on broad lacustrine plain landforms with level to undulating topography. The underlying till or bedrock topography is generally masked by the glaciolacustrine deposits. The fine to very fine textured glaciolacustrine material is often overlain by medium textured or coarse textured glaciofluvial material especially adjacent to the Wapiti River and Pinto Creek.

These soils have been extensively cleared and are cultivated to coarse grains and forage near the hamlet of Wapiti. The majority of the remaining native vegetation is the Aspen/Low-bush cranberry/Dewberry type (1) with additional small areas of willow communities. Small areas are succeeding to White spruce/Dewberry/Wild lily of the valley type (3).

Nampa soils generally have a thin, partially humified L-H horizon, a thin, organo-mineral Ah horizon, a thick, light yellowish brown Aegj horizon and a brown, strongly developed Btgj horizon. The morphological characteristics of the B horizon determines the classification of these soils. Some profiles exhibit strong Solonetzic structure but lack significant amounts of exchangeable sodium. Such profiles are generally intensely mottled, indicating poor internal soil drainage, and are classified as Gleyed Solonetzic Gray Luvisols. Other profiles which exhibit no Solonetzic structure and little mottling are classified as Orthic Gray Luvisols. The two Subgroups are so intimately associated in the landscape that separation is not feasible at the scale of mapping used in this survey. Internal drainage is slow in these soils and surface runoff may or may not be slow depending upon topographic position. Only one soil profile, an Orthic Gray Luvisol, was described in detail and sampled for laboratory analysis. The description and analytical results are presented in Appendix A.

Soil Units: Two soil units were established to map Nampa soils. The units are:

NMP 1 - Dominantly Gleyed Solonetzic Gray Luvisols (called the Nampa soil series in earlier Peace River District soil survey reports) in association with significant amounts of moderately well drained Orthic Gray Luvisols. About 6,200 acres were mapped.

NMP 2 - Dominantly Gleyed Solonetzic Gray Luvisols (NMP 1) associated with 15 to 40 percent Orthic Luvic Gleysols (called the Snipe soil series in earlier Peace River District soil survey reports). This unit describes areas that alternate between the imperfectly and poorly drained condition. The Gleysols are found on lower slopes and in landscape depressions. About 6,120 acres were mapped.

No soil phase notations were used for the Nampa soil group.

Map Combinations: Soil units of the Nampa group are occasionally mapped in combination with units of the Davis soil group. Such areas are characterized by mixed deposits of glaciofluvial silts of variable thickness, and glaciolacustrine clays. In such cases the medium textured glaciofluvial material commonly overlies the finer textured glaciolacustrine material.

Snipe Soil Group (SIP)

Snipe soils are predominantly poorly drained Orthic Luvic Gleysols developed on fine to very fine textured, stone-free to slightly stony lacustrine or lacustrotill deposits. These soils have developed in poorly drained positions in the northern portions of the map area. Snipe soils are found primarily in the Wapiti Plains and to a limited extent along rivers and creeks in the Alberta Plateau-Benchlands, at elevations below 885 m (2,900 feet). The Snipe group occupies approximately 2 percent of the map area. However, the areal extent of these soils was not determined in areas where they are not dominant.

The parent materials of the Snipe soil group are undifferentiated fine to very fine textured, brown to very dark gray glaciolacustrine or lacustrotill deposits. The characteristics of the parent material in any specific area are indicated by the nearby soil units. The material is intensely mottled, stone-free to slightly stony, and weakly to moderately calcareous. Stratification and darker colored layers (which may be varves) are evident throughout. The material is probably less than 2 m thick in most areas. The glaciolacustrine material is nonsaline except in an area around the hamlet of Sylvester. In this area, weakly saline conditions were observed in some soils, but their limited areal extent made separation on the map unwarranted. Snipe soils are distinguished from other poorly drained Gleysolic soils by their low stone content and silty clay to heavy clay textures.

Snipe soils lie in landscape depressions or on flat, poorly drained areas near the margins of organic soil areas. They are developed and maintained by groundwater discharge and are often saturated or nearly saturated throughout the growing season. The topography is gently undulating and surface and internal drainage is very slow.

The predominant forest vegetation of Snipe soils includes the White spruce/Horsetail/Feathermoss type (4) and the White spruce/Dewberry/Wild lily of the valley type (3) in areas which have been fire-free for many years. Small amounts of Lodgepole pine/Labrador tea/Feathermoss type (11) on imperfectly drained portions and black spruce and willow vegetation on the poorly drained areas comprise most of the remainder of the vegetation cover on Snipe soils. Table 3 gives productivity estimates and Appendix B includes detailed descriptions of the different forest types.

Snipe soils generally contain a surface organic horizon that rests on a thin, fine textured, very dark gray to black organo-mineral horizon (Ah) that is shotty in structure and friable in consistency. Below this is a relatively thick, pale brown, iron stained medium to slightly acid Aeg horizon. The Aeg horizon overlies a fine to very fine textured Bg horizon which may or may not contain sufficient translocated clay to meet the requirements of an illuvial Btg horizon. This horizon is generally dull colored, slightly acid to neutral in reaction, and exhibits mottling and gleying features indicative of poor internal soil drainage. A soil profile common to the Snipe soil group was described and sampled for laboratory analysis. The data from this profile are presented in Appendix A.

Soil Units: Three soil units were established within the Snipe soil group. These are:

SIP 1 - Dominantly poorly drained Orthic Luvic Gleysols (called the Snipe soil series in earlier Peace

River District soil survey reports) in association with significant amounts of poorly drained Orthic Gleysols. About 23,960 acres were mapped.

SIP 2 - Predominantly poorly drained Orthic Luvic Gleysols (SIP 1), but containing a significant proportion (15 to 40 percent) of imperfectly to moderately well drained Gleyed Solonetzic Gray Luvisols and Orthic Gray Luvisols developed on slightly stony glaciolacustrine (lacustrotill) deposits (DON 1). The Luvisolic soils are found in the better drained upland positions while the Gleysols are located in the more poorly drained low lying portions of the landscape. About 43,620 acres were mapped.

SIP 3 - Predominantly poorly drained Orthic Luvic Gleysols (SIP 1) in association with Gleyed Solonetzic Gray Luvisols developed on stone-free glaciolacustrine parent material (NMP 1). This unit is similar to SIP 2. About 1,280 acres were mapped.

The peaty phase notation was used to describe more fully the SIP 1 soil unit, and indicates SIP 1 soils having greater than 15 cm but less than 50 cm of surface peat. No phase notations were used with the SIP 2 and SIP 3 units.

Map Combinations: Snipe soils were commonly mapped in combination with the Kenzie and Eaglesham Organic soils. Such combinations represent areas where the thickness of the surface peat varies and is commonly greater than 50 cm. When combined with the Kenzie unit, the peat is derived mainly from mosses, and when mapped with the Eaglesham unit, the peat consists predominantly of semidecomposed rushes, coarse grasses, and sedges.

Snipe - Gunderson combinations indicate areas of poorly drained Gleysolics that are derived from mixed parent material. Fine to very fine textured glaciolacustrine or lacustrotill deposits and coarse textured fluvial sands are intimately associated in such areas.

Snipe - Edson combinations are areas consisting predominantly of fine to very fine textured Orthic Luvic Gleysols mixed with moderately well drained soils developed on Edson till parent material. Such combinations are rare and are found only near the contact of the lacustrotill and till deposits in the map area.

Tri-Creek Soil Group (TRC)

The Tri-Creek soil group is a collection of moderately well drained Gray Luvisols developed on moderately fine to very fine textured undifferentiated glaciolacustrine and lacustrotill deposits. These soils are found mainly in the Alberta Plateau-Benchlands and to a lesser extent in the Foothills; they form terrace deposits along portions of the Little Smoky, Narraway, Cutbank, and Kakwa Rivers, and Copton and Adelade Creeks. Generally, Tri-Creek soils are found between 1,070 and 1,220 m (3,500 and 4,000 feet) above mean sea level except in the Adelade Creek area where they are found at 1,350 m (4,450 feet). Tri-Creek soils occupy only 0.5 percent of the map area.

Tri-Creek soils parent material is a dark grayish brown to very dark grayish brown glaciolacustrine or lacustrotill deposit. Pebbles and cobbles in variable but usually low concentrations are sometimes present. The material is generally fine textured, but areas of moderately fine textured and very fine textured deposits can be found. Deposits are generally stratified, compact, dense, firm, and weakly to moderately calcareous. Interbedded sand lenses are present in various locations. Thickness of the deposit varies from 50 cm to more than 3 m, but usually is less than 1 m. This material commonly overlies bedrock, till, or outwash deposits, and may underlie sand or organic materials. The material is distinguished from till by its finer texture and its position in the landscape, and from other glaciolacustrine and lacustrotill deposits (the parent materials of the Nampa and Donnelly groups respectively) by its non-Solonetzic character and its position in the landscape.

The Tri-Creek soils are found on the relatively narrow, flat stretches of terrain that lie between the major incised stream courses and the regionally dissected upland. Topography generally varies from undulating to gently rolling. Moderately rolling terrain exists along portions of the Cutbank River.

The predominant vegetation on Tri-Creek soils is the Lodgepole pine/Labrador tea/Feathermoss type (11) with Aspen/Low-bus cranberry/Dewberry type (1) and Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) at low and high elevations respectively within the Tri-Creek unit. Productivity estimates of the various vegetation types are given in Table 3. Appendix B includes detailed descriptions of each forest type.

Orthic Gray Luvisols with a double Ae horizon sequence predominate in the Tri-Creek soil group. These soils have an L-H horizon, a thin Ah horizon (which commonly is absent), a well developed grayish brown Ae1 horizon, and a pale brown to yellowish brown Ae2 horizon. The eluvial horizons are generally silt loam to loam in texture and very strongly to strongly acid in reaction. At 15 to 35 cm below the surface is a brown to dark grayish brown, moderately fine to fine textured Bt horizon, which generally is well developed, very firm in consistency, and strongly acid in reaction. Pebbles in low concentrations may be present in this horizon. Some profiles exhibit a Brunisolic-like sequence of horizons (Ae and Bm) developed in the Ae horizon of the Orthic Gray Luvisol soil. Such Brunisolic Gray Luvisol profiles are generally restricted to areas where the deposits are somewhat coarse textured. Surface drainage of these soils is generally good. Internal soil drainage may be impeded somewhat in the finer textured soils. An Orthic Gray Luvisol common to the Tri-Creek soil group has been described in detail and sampled for laboratory analysis. The data are presented in Appendix A.

Soil Units: Two soil units were used to map the Tri-Creek soils:

TRC 3 - Dominantly moderately well drained Orthic Gray Luvisols (called the Wampus soil series in an earlier soil survey report) in association with a significant proportion of moderately well drained Brunisolic Gray Luvisols. About 3,020 acres were mapped.

TRC 4 - Dominantly moderately well drained Orthic Gray Luvisols and Brunisolic Gray Luvisols (TRC 3) in association with a significant amount of Gleysolic soils. This unit describes areas that contain 15 to 40 percent poorly drained soils. Orthic Gleysols, Orthic Luvic Gleysols, and Rego Gleysols are the main Gleysolic Subgroups recognized in this soil unit. About 13,960 acres were mapped.

No soil phase notations were used to describe the Tri-Creek soil units.

Map Combinations: Tri-Creek soils are commonly mapped in combination with Kenzie soils. Such combinations represent areas which alternate between being moderately well and very poorly drained and contain significant amounts of moss-derived Organic soils in landscape depressions.

Tri-Creek-Lodge and Tri-Creek-Blackmud combinations identify areas where fluvial sand deposits of varying thickness sometimes overlie the lacustrotill or glaciolacustrine deposits. In most cases the finer textured material is found on the upper slopes or hill crests and the sand lies in the lower positions. Such combinations are common along the Little Smoky River and portions of the Kakwa River and Copton Creek.

Soils Developed on Postglacial Fluvial Deposits

Soils developed on postglacial fluvial deposits are found along the drainage channels of the major rivers and creeks throughout the map area. Only the Iosegun soil group, which consists predominantly of immature Regosolic soils, was recognized in the map area.

Iosegun Soil Group (IOS)

Iosegun soils are well to imperfectly drained Regosolic soils developed on the postglacial fluvial deposits that exist along the floodplains and drainage channels of the major rivers and creeks. The chemical and physical characteristics of the soils vary greatly due to the meandering nature of the streams and the variable lithology of the sediments. These soils are scattered throughout the map area at elevations ranging from a low of 525 m (1,750 feet) where the Smoky River leaves the map area, to a high of 1,800 m (5,900 feet) in the southwestern portion of the area. Iosegun soils occupy approximately 2 percent of the map area.

Iosegun soils are found on locally variable postglacial fluvial deposits. Texture varies considerably, both horizontally and vertically, and may range from fine sand to clay, although fine sandy loam and silt loam textures are the most common. Alternating strata of varying thickness and texture are very common. The parent material generally is very dark grayish brown to brown, very friable, slightly acid to mildly alkaline, and weakly to moderately calcareous. The deposit is generally stone-free to a considerable depth in the Interior Plains, but occasionally gravelly subsoils are encountered. The postglacial fluvial deposits in the Western Cordillera are generally moderately to very stony at shallow depths. The stone suite consists of semirounded sandstone and other local bedrock fragments of variable size as well as rounded quartzites and occasional crystalline pebbles of Precambrian Shield origin. The postglacial fluvial deposits in the Smoky River valley are usually moderately calcareous; those in the Kakwa floodplains are usually only weakly calcareous.

Iosegun soils are always found along the floodplains of aggrading rivers and streams. Meander scars are common features on floodplains of streams of low gradient. Small upper terraces, commonly too small to outline at the scale of mapping, are also included. The topography is level to undulating.

Native forest vegetation varies greatly on Iosegun soils depending upon elevation, drainage, and successional stage of the vegetation. At low elevations, the Balsam poplar/Wild rose/Meadow rue type (2) commonly grows on recent deposits (70 to 100 years) with abundant soil moisture.

Older forests at low and higher elevations are often of the White spruce/Horsetail/Feathermoss type (4). The White spruce/Feathermoss type (5) grows on well drained Iosegun soils where forest has matured. Early successional stages are dominated by heterogeneous assemblages of willows, sedges, marsh reed grass and other herbs.

Soils developed on postglacial fluvial deposits usually lack distinct horizon development but commonly exhibit buried organo-mineral (Ah) horizons. Both Cumulic and Orthic Regosols, as well as Rego Gleysols in the poorly drained positions, are found within the Iosegun soil group. The common situation is Regosolic soils on the lowest terrace where the river is actively aggrading and weakly developed Brunisolic or Luvisolic soils on the higher terraces. The upper terraces are generally too small to delineate and are grouped with the Regosolic soils of the lower terraces; however, the material on the narrow higher terraces may consist predominantly of outwash gravels of considerable thickness under a thin mantle of fluvial silts. A soil profile common to the Iosegun soils has been described and sampled for laboratory analysis. The data are presented in Appendix A.

Soil Units: There are two soil units within the Iosegun soil group. They are:

IOS 1 - Dominantly Cumulic Regosols (called the Alluvium complex in some earlier soil survey reports) in association with Orthic Regosols (also part of the Alluvium complex). This unit describes areas where Iosegun soils are predominantly well to imperfectly drained. About 55,300 acres were mapped.

IOS 2 - Dominantly Cumulic and Orthic Regosols (IOS 1) in association with significant amounts of poorly drained Rego Gleysols. This unit describes areas which are predominantly well to imperfectly drained but also contain 15 to 40 percent poorly drained areas. About 27,440 acres were mapped.

No soil phase notations were used with Iosegun units because of their extremely variable characteristics.

Map Combinations: Iosegun - Kenzie combinations identify Iosegun areas which incorporate numerous depressions filled with very small, very poorly drained moss bogs. The organic deposit overlies the postglacial fluvial material. Such a combination is common along the Little Smoky River.

Iosegun - Jarvis combinations signify areas of Iosegun soils enclosing many very small upper terraces where soils are developed on outwash gravels. These combinations are very common along the floodplains and drainage channels in the Western Cordillera.

Soils Developed on Glaciofluvial Deposits

Soils developed on medium and coarse textured glaciofluvial deposits occupy about 6 percent of the Wapiti map area. Luvisolic, Brunisolic, and Gleysolic soils dominate on deltaic, fluvial plain, and terrace landforms. Five soil groups which are differentiated mainly on texture and drainage were recognized in the map area. These are the Blackmud, Davis, Gunderson, Jarvis, and Wanham soil groups.

Blackmud Soil Group (BKM)

This soil group consists of a collection of well drained Gray Luvisols and rapidly drained Eutric Brunisols developed on fluvial sand deposits thicker than 50 cm. Blackmud soils are found primarily in the Wapiti Plains and Alberta Plateau-Benchlands but are also observed in the Foothills on some of the major upper river terraces. Blackmud soils occupy about 4 percent of the map area.

Blackmud parent material is a light olive brown to yellowish brown, moderately calcareous, fluvial sand that occasionally contains quartzite pebbles up to 2 cm in diameter. Lenses of interbedded silts, clays, and occasionally gravels may also be present. The material commonly overlies till or glaciolacustrine deposits and may underlie organic materials. Blackmud and Lodge groups differ only in that Lodge soils are developed on sand deposits *less* than 50 cm thick. Blackmud and Heart groups are similar except that Heart soils do not contain pebbles and are associated with dune topography.

Blackmud soils are commonly found on deltaic or fluvial plain landforms and may be associated with present-day, Pleistocene, or pre-Pleistocene channels. Topography is gently undulating to gently rolling but occasionally may be moderately rolling.

At low elevations on the Blackmud unit the Aspen/Low-bush cranberry/Dewberry type (1) prevails with smaller areas of the Lodgepole pine/Low-bush cranberry/Dewberry type (8) also present. At higher elevations the Lodgepole pine/ Labrador tea/Feathermoss (11) and Lodgepole pine/ Blueberry/Lichen (14) types are common. Table 3 gives productivity estimates for the vegetation types, and Appendix B includes descriptions of these types.

The basis for differentiating among the soils within the Blackmud soil group is the presence or absence of a textural B horizon (Bt). A textural B horizon may have developed either because of the high incidence of interbedded clay lenses in the parent material or because of the pedological processes of clay translocation. This horizon is sandy loam to sandy clay loam in texture, generally neutral in soil reaction, weakly developed, and finer textured than the horizons above and below. Due to a higher clay content this horizon has a lower permeability and higher water-holding capacity than the horizons above and below, and is important in regulating the moisture regime of these soils. Thus two soil units were established to distinguish between the Blackmud soils: 1) BKM 8 with no textural B horizon; and 2) BKM 6 with a textural B horizon.

Soils of the BKM 8 soil unit are classified as Eluviated Eutric Brunisols. These soils are characterized by strongly acid to slightly acid, coarse textured eluvial (Ae) horizons overlying coarse textured Bm horizons that are medium acid in reaction. They lack a textural B (Bt) horizon; drain rapidly. Soils of the BKM 8 unit are drier than those of the BKM 6 unit. The BKM 6 unit consists dominantly of Brunisolic Gray Luvisols which are characterized by the presence of a textural B horizon. Two soil profiles common to the Blackmud soil group were described and sampled for laboratory analysis. The data are given in Appendix A.

Soil Units: Four soil units were used to map the Blackmud soil group. They are:

BKM 6 - Dominantly well drained Brunisolic Gray Luvisols in association with Orthic Gray Luvisols (called the Culp soil series in earlier soil survey reports). This unit is common in the northern portion of the map area, in the Wapiti Plains. About 28,940 acres were mapped.

BKM 7 - Dominantly well drained Brunisolic and Orthic Gray Luvisols (BKM 6) in association with significant amounts of poorly drained undifferentiated Gleysolic soils. The Gleysolic soils occupy the lower slopes and the landscape depressions. About 4,760 acres were mapped.

BKM 8 - Dominantly Eluviated Eutric Brunisols (called the Bickerdike soil series in an earlier soil survey report). The soils in areas designated by this unit are generally rapidly drained, but poorly drained Gleysolic soils may form up to 15 percent of these areas. About 74,340 acres were mapped.

BKM 9 - Dominantly rapidly drained Eluviated Eutric Brunisols (BKM 8) in association with significant amounts (15 to 40 percent) of undifferentiated poorly drained Gleysolic soils. About 22,520 acres were mapped.

Both gleyed and stony soil phase notations were used occasionally with Blackmud soil units. The gleyed phase was used to indicate BKM 7 soils which exhibit restricted soil drainage and are imperfectly drained. The stony phase notation identifies BKM 8 soils having variable, but generally high, pebble concentrations. These soils are moderately to exceedingly stony.

Map Combinations: The Blackmud soil units are often mapped in combination with units of the Lodge soil group. Such combinations indicate areas where the thickness of the sand deposit is highly variable. Lodge units identify soils developed on sand deposits less than 50 cm thick.

Combinations of Blackmud and Davis represent areas of complex parent materials ranging from glaciofluvial sands to glaciofluvial silts.

Blackmud - Jarvis combinations indicate parent material complexes of glaciofluvial sand and outwash gravel.

Blackmud - Edson combinations refer to areas where soil parent materials are mixtures of glaciofluvial sand and till.

Blackmud soils are also commonly mapped with units of the Kenzie and Eaglesham Organic soil groups. In these cases the organic deposits occupy the landscape depressions. The organic deposits consist primarily of semidecomposed moss in Kenzie areas and semidecomposed sedge in Eaglesham areas.

Blackmud - Heart combinations indicate the presence of both glaciofluvial and eolian sands. Such an area is found near Economy Lake in the northeastern portion of the map area.

Davis Soil Group (DVS)

Davis soils are well drained Gray Luvisols developed on medium textured, stone-free glaciofluvial silts. This group lies exclusively within the Wapiti Plains at elevations below 790 m (2,600 feet). Relatively large tracts of these soils are found east of the point where Pinto Creek empties into the Wapiti River, west of Big Mountain Creek, and east of the Latornell River. Davis soils are predominant in only about 1 percent of the map area.

Parent material of the Davis soil group is dark yellowish brown to light brownish gray glaciofluvial silts that usually contain finer textured strata at depth. These strata, occasionally as fine textured as silty clay, vary considerably in thickness and depth below the surface. The glaciofluvial material is stone-free, stratified, moderately to strongly calcareous, and generally silt loam in texture. The lime horizon is normally encountered less than 60 cm below the surface. Thickness of the material varies from a few centimetres to greater than 3 m but is usually about 1 m. These glaciofluvial silts overlie gravel, sand, glaciolacustrine deposits, and till, and may underlie glaciofluvial and eolian sands as well as organic deposits. The silty texture distinguishes Davis soils from other soils in the map area.

Davis soils usually lie on broad glaciofluvial plain landforms that exist near major present-day or historical rivers. The glaciofluvial silts are commonly present as a veneer on the underlying material since the topography of the underlying material is generally still evident. Topography is gently undulating to undulating.

The predominant forest vegetation is the Aspen/Low-bush cranberry/Dewberry type (1) and, where the forest is more mature, the White spruce/Dewberry-Wild lily of the valley type (3). A small area of Davis soils has been cleared and cultivated near the South Wapiti Ranger Station. This land is used mainly for forage production and grazing.

Davis soils are characterized by strongly developed Gray Luvisolic features (L-H-Ae-Bt horizon sequence); however, morphological variations are evident in the upper portions of the profile. Some profiles exhibit the standard L-H-Ae-Bt horizon sequence. Others have a double Ae horizon sequence overlying the Bt horizon. Still others exhibit a thin, brighter-colored Bm horizon between the Ae1 and Ae2 horizons. No attempt was made to delineate these soils with differing morphology. The illuvial (Bt) horizon is yellowish brown to brown, silt loam to silty clay in texture, and slightly acid in reaction, and exhibits moderately developed subangular blocky structure. The surface horizons are characterized by a pale brown to yellowish brown color, silt loam texture, platy structure, and medium acid soil reaction. Surface drainage of Davis soil areas ranges from good to poor depending on topography. Internal soil drainage varies from good to slightly imperfect with the finer textured soils in the latter category. A description and analyses of a soil profile common to the Davis group are given in Appendix A.

Soil Units: Two soil units were used to map the distribution of the Davis group:

DVS 1 - Dominantly Orthic Gray Luvisols (called the Davis soil series in earlier soil survey reports) in association with a significant amount of Brunisolic Gray Luvisols (called the Toad soil series in earlier soil survey reports.) This unit describes areas of Gray Luvisols that are generally well drained. About 3,500 acres were mapped.

DVS 2 - Dominantly well drained Orthic and Brunisolic Gray Luvisols (DVS 1) in association with a significant amount of poorly drained Orthic Luvic Gleysols (called the Wanham soil series in earlier Peace River District soil survey reports). This unit represents areas where well drained Gray Luvisols predominate, but 15 to 40 percent poorly drained Orthic Luvic Gleysolic soils are present on lower slopes and in depressions. About 41,700 acres were mapped.

Only the thin and gleyed soil phase designations were used with Davis units. The gleyed phase indicates areas of Davis soils that show restricted soil drainage and are imperfectly drained. The thin phase notation is reserved for areas where the thickness of the glaciofluvial silts is less than 50 cm. Such areas are underlain by fine to very fine textured lacustrine or lacustrotill deposits at shallow depths. The stony phase notation was not used since stones are rarely observed in these soils.

Map Combinations: Davis soil units are sometimes mapped in combination with Blackmud or Lodge units. These are complex areas where either glaciofluvial silt and glaciofluvial sand parent materials are so mixed that they cannot be separated on the map, or sands of varying thickness overlie the glaciofluvial silts.

Combinations of Davis and Nampa or Davis and Donnelly soils represent areas of complex parent materials varying respectively between glaciofluvial silts and lacustrine clay or glaciofluvial silts and lacustrotill.

Davis - Kenzie and Davis - Eaglesham combinations identify areas containing a significant number of very poorly drained organic deposits that are individually too small to delineate. The organic deposits consist predominantly of moss in Kenzie areas and sedge in Eaglesham areas. In such combinations, the Davis soils are always the better drained.

Gunderson Soil Group (GUN)

The Gunderson soil group is a collection of poorly drained Gleysolic soils developed on coarse textured glaciofluvial deposits. These soils occupy only about 0.5 percent of the map area, and are found chiefly in the Wapiti Plains but also to a limited extent in the Alberta Plateau-Benchlands.

Gunderson parent material is a dull colored, coarse textured, stone-free to slightly stony, glaciofluvial deposit which commonly exhibits yellowish brown to reddish brown mottles. This material sometimes contains interbedded silts, clay, and gravel. The deposit is weakly to moderately calcareous and highly variable in thickness. It overlies till or glaciolacustrine deposits and commonly is overlain by organic materials. The coarse texture and low stone content distinguishes Gunderson soils from other Gleysolic soils in the map area.

Gunderson soils occupy level to depressional positions in the landscape and are commonly found interspersed with Organic soils. Their surface drainage is slow and internal drainage is impeded because of a high water table. Topography is gently undulating to undulating.

The forest vegetation of the Gunderson soils is predominantly the White spruce/Horsetail/Feathermoss type (4) and the White spruce/Dewberry - Wild lily of the valley type (3). Non-forested areas on Gunderson soils are dominated by willow thickets and sedge fens with scattered black spruce and paper birch. Productivity estimates of the various forest types are included in Table 3. Appendix B includes detailed descriptions of the forest types.

A number of profiles with differing morphology are found in this soil group. The Orthic Gleysol, Orthic Luvic Gleysol, and Rego Gleysol appear to be the most common; however, soils with differing morphologies are not distinguished on the soils map. The one characteristic common to these poorly drained soils is their development on coarse textured, stone-free to slightly stony glaciofluvial deposits. A detailed description and an analysis of a peaty Rego Gleysol soil profile that is common to the Gunderson soil group are presented in Appendix A.

Soil Units: Four soil units were established within the Gunderson group. They are:

GUN 1 - Dominantly poorly drained Gleysolic soils Orthic and Rego Gleysols as well as Orthic Luvic Gleysols appear to be the dominant soil types. About 12,140 acres were mapped.

GUN 2 - Dominantly poorly drained Gleysolic soils (GUN 1) in association with significant amounts of well drained Orthic Gray Luvisols that are developed on thin (less than 50 cm thick) glaciofluvial or eolian sand (LDG 6). The Luvisols are found in the better drained positions of the landscape. The scale of mapping does not permit the separation of the poorly drained and well drained soils. About 1,960 acres were mapped.

GUN 3 - Dominantly poorly drained Gleysolic soils (GUN 1) in association with significant (15 to 40 percent) amounts of well drained Brunisolic Gray Luvisols (LDG 8) developed on glaciofluvial or eolian sand deposits less than 50 cm thick. About 1,900 acres were mapped.

GUN 4 - Dominantly poorly drained Gleysolic soils (GUN 1) in association with significant amounts of rapidly drained Eluviated Eutric Brunisols (BKM 8) developed on deep, coarse textured glaciofluvial deposits. The Brunisols are found in the better drained uplands. About 3,260 acres were mapped.

The peaty soil phase notation identifies areas of Gunderson soils with greater than 15 cm but less than 50 cm of surface peat.

Map Combinations: Soil units of the Gunderson soil group are occasionally mapped in combination with units of other Gleysolic soils found in the map area. Gunderson - Smoky combinations indicate areas of poorly drained Gleysolics developed on mixtures of glaciofluvial sand and glacial till. Gunderson - Wanham combinations indicate areas where the parent material is mixed glaciofluvial sands and silts. Gunderson - Snipe combinations identify areas of poorly drained Gleysolics developed on either glaciofluvial sands or glaciolacustrine clays.

In Gunderson - Kenzie areas, Gleysolics are associated with significant amounts of organics. The organic material is greater than 50 cm thick and is composed primarily of moss remains.

Drainage and parent materials are complex in Gunderson - Edson areas. In such areas poorly drained Gleysolics are associated with 15 to 40 percent moderately well drained Edson soils. The Edson soils are found on the better drained uplands.

Jarvis Soil Group (JRV)

This soil group consists of a collection of rapidly drained soils developed on skeletal, coarse textured outwash gravels. Gray Luvisols predominate, but this group also includes some small areas of Brunisolic and Regosolic soils lying on the lower terraces of some of the smaller high gradient streams. Significant areas of Jarvis soils are present on some of the terraces of the Smoky, Wapiti, Narraway, and Torrens Rivers and along Sheep Creek, particularly where it empties into the Smoky River. These soils were also mapped in a kame and esker complex near the Little Smoky River. Jarvis soils occupy only 0.5 percent of the map area.

Outwash gravels form the parent material of the Jarvis soils. The material, grayish brown to dark brown in color, gravelly sandy loam in texture, and moderately calcareous, has a variable but generally high content of well-rounded quartzite cobbles except along Beaverdam, Laforce, Copton, and Sheep (southern part) Creeks and the Torrens River where cobbles are mainly rounded bedrock fragments. The quartzitic gravel found on the terraces at the northern end of Sheep Creek and along the Smoky, Wapiti, and Narraway Rivers are suitable as aggregate sources, unlike the gravels composed of bedrock fragments. Thickness of the outwash deposits varies from a few metres to a few hundred metres. These gravels often overlie bedrock or till and may in turn be overlain by sands of the Blackmud group, till of the Edson, Marlboro, Mayberne, or Robb groups, clays or silts of the Nampa, Donnelly or Davis groups, or organic material. Jarvis soils differ from Judy soils in position — Judy soils lie on elevated plateaus.

Outwash terraces and kame and esker complexes are the usual landforms associated with the Jarvis group (Plate 23). Topography is variable and ranges from gently undulating to moderately rolling.

At lower elevations Jarvis soil is covered by the Lodgepole pine/Labrador tea/Feathermoss type (11) with the Aspen/Low-bush cranberry/Dewberry type (1) growing in some areas. The Lodgepole pine/Blueberry/Lichen type (14) occurs sporadically. At higher elevations on this soil, the White spruce/Feathermoss type (5) predominates, particularly on northerly aspects. Table 3 lists productivity estimates for the various forest types. Detailed descriptions of the different forest types can be found in Appendix B.

Commonly in Jarvis soils, a sandy surface mantle 5 to 15 cm thick overlies coarser gravelly material. A typical Jarvis profile includes a Brunisolic-like sequence of horizons (Ae and Bm) developed within the Ae horizon of an Orthic Gray Luvisol profile. The Bm horizon is brown to yellowish brown but does not have the chemical characteristics of a Bf horizon. Those soils which have sufficient iron plus aluminum in their Bf horizons are classified as Podzolic Gray Luvisols. Upper horizons may or may not contain stones, depending on whether the sandy mantle is absent

Plate 23. Outwash gravels which constitute the parent material of the Jarvis soils. Photo taken on a terrace of Sheep Creek.

or present. A firm Bt horizon 10 to 20 cm thick, in which fine textured material clings to stones and rootlets, is generally present in the gravelly material. The solum is usually 25 to 50 cm thick. Surface drainage of Jarvis soils is good while internal drainage is commonly very rapid, resulting in some of the droughtiest soils in the map area. A description and analyses of a soil profile common to the Jarvis group are presented in Appendix A.

Soil Units: Two soil units were used to describe the distribution of the Jarvis group:

JRV 4 - Dominantly Brunisolic Gray Luvisols in association with significant amounts of Podzolic Gray Luvisols (called the Nose and Hightower soil series in some earlier soil survey reports). Minor amounts of Brunisolic and Regosolic soils are also included in this soil unit. These soils are all rapidly drained. About 17,580 acres were mapped.

JRV 5 - Dominantly rapidly drained Brunisolic and Podzolic Gray Luvisols (JRV 4) in association with significant amounts (15 to 40 percent) of poorly drained Gleysolic soils on lower slopes and in depressions. About 1,280 acres were mapped.

No soil phase notations were used to describe Jarvis units. The designation "thin phase" was not used because of the overall thickness of the soil parent materials. The "stony" phase notation was not employed because the soil group is inherently excessively stony. Soil drainage characteristics are inferred in the definition of the JRV 5 unit and therefore the gleyed phase notation was not necessary.

Map Combinations: Jarvis soil units commonly are mapped in combination wtih Lodge or Blackmud soil units. Such combinations identify areas where glaciofluvial or eolian sand deposits of varying thickness overlie outwash gravel materials. In areas where the overlying sand is greater than 50 cm thick, the combination is with Blackmud; where it is less than 50 cm thick, the combination is with Lodge.

Wanham Soil Group (WHM)

Wanham soils are poorly drained Orthic Luvic Gleysols developed on medium textured, stone-free glaciofluvial deposits. These soils are found exclusively within the Wapiti Plains at elevations below 880 m (2,900 feet) and are of limited areal extent, occupying only 0.4 percent of the map area. They lie in poorly drained positions in the same regional areas as the Davis group of soils.

The parent materials of this group are friable, stone-free, weakly to strongly calcareous, gleyed and mottled silts that commonly contain finer textured silty clay loam material in layers of varying thicknesses. The lime horizon generally lies within 15 to 40 cm of the surface. The deposit is probably less than 1 m thick in most areas, and commonly overlies glaciolacustrine deposits. The material may be overlain by glaciofluvial sands, eolian sands, or organic material. The silty texture and lack of stones distinguishes Wanham soils from other Gleysolic soils of the map area.

Wanham soils are found where glaciofluvial silts occur in low-lying level to depressional positons. Surface drainage is slow and internal drainage is impeded because of a high water table. The topography is gently undulating.

Mature forest vegetation on Wanham soils is predominantly the White spruce/Horsetail/Feathermoss type (4), but much of the area of these soils is vegetated by willow thickets and young Aspen/Low-bush cranberry/Dewberry type (1). Productivity estimates for the different forest types are listed in Table 3. Appendix B includes detailed descriptions of the various types.

Wanham soils are distinguished by a thin organic horizon underlain by a fairly thick, iron stained, brown Aeg horizon that is neutral in reaction. This horizon rests on a dark yellowish brown to dark gray, silt loam to silty clay loam textured Btg horizon which shows evidence of iron staining and is neutral to mildly alkaline in reaction. The subsoil is usually dull colored and exhibits bright mottles. Profile characteristics of the Wanham soils are relatively similar throughout the area with the exception of texture which ranges from silt loam to silty clay loam. A description and analyses of a soil profile common to this soil group are presented in Appendix A.

Soil Units: Two soil units were used to describe the Wanham group. They are:

WHM 1 - Dominantly poorly drained Orthic Luvic Gleysols (called the Wanham soil series in earlier soil survey reports). Areas where this unit is mapped may contain up to 15 percent well drained soils. About 7,240 acres were mapped.

WHM 2 - Dominantly Orthic Luvic Gleysols (WHM 1) in association with significant amounts (15 to 40 percent) of Orthic and Brunisolic Gray Luvisols (DVS 1). This soil unit describes areas where poorly drained Gleysolic soils developed on glaciofluvial silts predominate, but significant amounts of well drained Gray Luvisols developed on similar parent material are present. The Gray Luvisols lie on the better drained uplands. About 5,100 acres were mapped.

The peaty soil phase notation is used to describe Wanham soils with more than 15 cm but less than 50 cm of peat at the surface.

Map Combinations: Soil units of the Wanham group are sometimes mapped in combination with Kenzie soil units. Such a combination indicates an area where the thickness of accumulated surface peat is highly variable.

A Wanham - Snipe combination represents an area of poorly drained Orthic Luvic Gleysols where both glaciofluvial silts and glaciolacustrine clays are present. The two materials are so intimately associated in the landscape that separation at the scale of mapping used in this survey was not feasible.

Wanham - Blackmud and Wanham - Lodge combinations identify areas where the parent material is primarily poorly drained glaciofluvial silts but incorporates a significant amount of well to rapidly drained glaciofluvial or eolian sand deposits of varying thickness. In areas where the overlying sand is greater than 50 cm thick and is of glaciofluvial origin, the combination is made with Blackmud; where it is less than 50 cm thick and of undifferentiated glaciofluvial or eolian origin, the combination is made with Lodge.

Soils Developed on Thin Undifferentiated Glaciofluvial or Eolian Deposits

This group includes soils developed on coarse textured undifferentiated glaciofluvial or eolian deposits that are less than 50 cm thick. The underlying deposits are finer textured and commonly consist of glaciolacustrine clays or till. These well drained Gray Luvisols are found principally in the Wapiti Plains and Alberta Plateau-Benchlands.

Lodge Soil Group (LDG)

Lodge soils are characterized by the presence of a thin deposit of undifferentiated glaciofluvial or eolian textured material resting on finer textured deposits. Lodge soils are common in the Wapiti Plains where the underlying material is glaciolacustrine clay and in portions of the Alberta Plateau-Benchlands where the underlying material is generally till. These soils occupy approximately 4 percent of the map area.

Soils of the Lodge group are found on mixed parent materials. In general the surface material is stone-free to slightly stony sand (less than 50 cm thick) that is similar in every respect to the parent material of the Blackmud and Heart soil groups. This material is commonly underlain by Donnelly, Tri-Creek, or Nampa glaciolacustrine materials; by Edson, Mayberne, or Marlboro tills; or in rare instances by Jarvis outwash gravels or Copton bedrock materials. The soils were not categorized on the basis of differences in the underlying materials but the associated soil group indicated on the map provides a guide to the characteristics of the underlying material. The Lodge soil group is distinguished from the Blackmud and Heart soil groups by having less than 50 cm of sandy overlay material. This thickness was arbitrarily selected as the limit below which texture of the underlying material has a minimal effect on plant growth.

Landforms associated with the Lodge group are reflections of the landforms of the underlying material. The sandy overlay, being relatively thin, modifies the existing landscape only slightly. Lodge soils are found commonly as a glaciofluvial or eolian veneer over glaciolacustrine or morainal plains (Plate 24). They are also present along postglacial Pleistocene or pre-Pleistocene drainage channels. Topography generally varies between gently undulating and gently rolling.

On Lodge soils the predominant forest vegetation at low elevations (below 910 m or 3,000 feet) is the Aspen/Low-bush cranberry/Dewberry type (1). At elevations above 915 m, the Lodgepole pine/Labrador tea/Feathermoss type

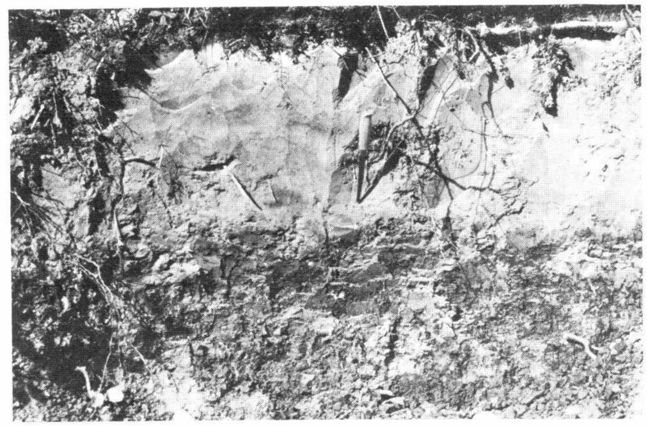


Plate 24. A Lodge soil profile with coarse textured fluvial/ eolian material overlying lacustrine.

(11) predominates, but representatives of the Lodgepole pine/Low-bush cranberry/Dewberry type (8) and Lodgepole pine/Meadowsweet/Bunchberry type (9) are common. Table 3 gives the productivity estimates for the various forest types, and Appendix B includes descriptions of each type.

The morphology of the Lodge soils changes with both vegetation and elevation. At lower elevations under an aspen poplar vegetative community the soils are primarily Orthic Gray Luvisols. These soils are characterized by relatively thick, light gray to pale brown Ae horizons overlying a textural Bt horizon. At higher elevations and under a lodgepole pine vegetation community the soils exhibit a Bm horizon or an Ae - Bm horizon sequence in the Ae horizon of the Orthic Gray Luvisol. Such profiles are classified as Brunisolic Gray Luvisols. The soils generally have eluvial horizons positioned in the sandy overlay and illuvial horizons in the underlying material. Because of variable origin, the overlay material in Lodge soils varies fairly widely in texture, sandy loam being the most common. Surface drainage of Lodge soil areas is rapid to good, but internal drainage may be impeded by the finer textured unconformity present in these soils. Brunisolic Gray Luvisol and Orthic Gray Luvisol profiles common to the Lodge soil group were described and sampled for laboratory analysis. The data are presented in Appendix A.

Soil Units: Four soil units were used to describe the Lodge group. These are:

LDG 6 - Dominantly well drained Orthic Gray Luvisols (called the Codesa soil series in earlier soil survey reports). This unit is found mainly in the most northerly portions of the map area and covers approximately 36,560 acres.

LDG 7 - Dominantly well drained Orthic Gray Luvisols (LDG 6) in association with significant amounts of undifferentiated poorly drained Gleysolic soils. The Orthic Gray Luvisols lie on the uplands while the poorly drained Gleysolic soils are found on lower slopes or in depressions. About 37,960 acres were mapped.

LDG 8 - Dominantly well drained Brunisolic Gray Luvisols (called the Peppers soil series in an earlier soil survey report). This unit is found primarily under a lodgepole pine vegetative community at higher elevations. About 67,920 acres were mapped.

LDG 9 - Dominantly well drained Brunisolic Gray Luvisols (LDG 8) in association with significant amounts (15 to 40 percent) of poorly drained undifferentiated Gleysolic soils. Orthic Luvic Gleysols, Orthic Gleysols, and Rego Gleysols have been recognized in the poorly drained positions. About 12,340 acres of this unit were recognized and mapped.

The gleyed and stony soil phase notations were used to describe more fully some of the Lodge soil units. The gleyed phase designation indicates areas of Lodge soils with imperfect internal drainage. The stony soil phase notation identifies areas of Lodge soils that have an abnormally high content of pebbles in the overlay material. Within such areas a thin deposit of very stony (S3) glaciofluvial sand rests on finer textured deposits.

Map Combinations: Units of the Lodge soil group commonly are mapped in combination with units of the Donnelly, Edson, Marlboro, Mayberne, Copton, and Jarvis soil groups. Such combinations indicate areas of mixed parent materials where thin sand deposits commonly overlie various other deposits.

Lodge - Blackmud combinations identify areas with varying thickness of sand. The sand in such areas is generally of glaciofluvial origin.

Combinations of Lodge and Kenzie units represent areas of Lodge soils containing moss-derived Organic soils in poorly drained depressions.

Soils Developed on Preglacial Fluvial Gravel Deposits

Soils developed on preglacial fluvial gravel deposits are of limited areal extent, occupying only about 1 percent of the Wapiti map area. These soils lie on the upland plateaus found east of the Simonette tower in the southeastern portion of the map area. The parent material consists mainly of rounded metaquartzite cobbles and pebbles. The Simonette and Judy soil groups, which include, respectively, undifferentiated Gleysolic soils and Gray Luvisols, were recognized. The topography associated with these soils is usually relatively flat to undulating but moderately rolling topography is present in isolated areas.

Judy Soil Group (JUY)

The Judy soils are composed primarily of rapidly drained Gray Luvisols developed on pre-Pleistocene cobbly gravels. Judy soils are found on elevated plateaus, such as those near the Simonette and Smoky fire towers and in the region southeast of the Simonette River, at elevations of 1,140 to 1,340 m (3,750 to 4,400 feet) above mean sea level. A very minor amount of these soils also lies on the elevated plateaus in Tp 62 R 10 at the much higher elevation of 1,585 m (5,200 feet) above mean sea level. Judy soils predominate only on about 1,480 acres, all lying in the Alberta Plateau-Benchlands.

The parent materials of this group are gravels with a very high content of rounded metaquartzite and sandstone cobbles. The inter-cobble spaces are filled with yellowish brown to dark yellowish brown loam to loamy sand, which varies from strongly acid to mildly alkaline in reaction. The gravels are normally about 1 m thick but may be as thick as 10 m. The deposits overlie bedrock material and may be overlain by Mayberne till or organic material. Judy soils are distinguished from Jarvis soils by their position in the landscape and stratigraphic relationship to till. Jarvis soils are found on outwash terraces and commonly overlie till deposits, whereas Judy soils are found primarily on elevated plateaus and associated escarpments and are sometimes overlain by till deposits.

Landforms associated with the Judy soil group are mainly elevated plateaus and tablelands. The topography in such areas is gently undulating to gently rolling. Limited areas of Judy soils are also found on the upper slopes of the erosional scarps that exist along the edges of the plateaus. The soils on these escarpments are primarily the colluvial deposits of the Deep Valley soil unit, but on the upper slopes Judy soils commonly have developed on pre-Pleistocene cobbly gravels. The topography in these areas is generally strongly rolling.

The predominant forest type on Judy soils is the Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12). Subalpine fir is an important forest component at elevations above 1,525 m (5,000 feet).

Judy soils consist primarily of Brunisolic and Podzolic Gray Luvisols, although some Orthic Humo-Ferric Podzols were also recognized. It is believed that the upper soil sequence, Ae and Bf, indicates the development of a Podzol profile in the Ae horizon of an older Orthic Gray Luvisol soil. These soils have a variable pyrophosphate-extractable Fe + Al content in the Bm or Bf horizon, so are classified as both Brunisolic and Podzolic Gray Luvisols. The soils are characterized by a thin organic (L-H) surface layer, a light brownish gray Ae1 horizon, a strong brown to yellowish red Bm or Bf horizon, a yellowish brown Ae2 horizon, and a yellowish brown Bt horizon. The Bt horizon is encountered 30 to 45 cm below the surface. The upper horizons (Ae1 and Bf or Bm) may be developed in a stone-free sandy overlay but the Bt horizon normally lies in the cobbly gravels where the finer textured material tends to cling to the pebbles and to plant rootlets. The texture of the surface horizon is normally sandy loam to loam, whereas the Bt horizon is sandy loam to sandy clay loam in texture. Soils of the Judy group have good surface drainage, and internal soil drainage is generally rapid. A detailed description and laboratory analyses of a soil profile common to the Judy group are presented in Appendix A.

Soil Units: Two units were used to describe the Judy soils. These are:

JUY 1 - Dominantly rapidly drained Brunisolic Gray Luvisols (called the Judy soil series in earlier soil survey reports) in association with significant amounts of Podzolic Gray Luvisols. About 680 acres were mapped.

JUY 2 - Dominantly rapidly drained Brunisolic and Podzolic Gray Luvisols (JUY 1) in association with significant amounts of poorly drained, undifferentiated peaty Gleysolic soils that are developed on similar parent material. The Gleysols are present in the level to depressional landscape positions where surface waters and groundwaters tend to accumulate. About 800 acres were mapped.

No soil phase notations were used to describe more fully the Judy units. However, the soils of other groups mapped in combination with Judy soils are usually stony phases.

Map Combinations: Judy soils are sometimes mapped in combination with units of the Mayberne group. Such combinations are common in regions where shallow till materials overlie the preglacial gravels. In such cases, Mayberne units generally are mapped as a stony phase or as a thin phase or as both.

Judy - Kenzie combinations represent Judy areas which include a significant number of very poorly drained, moss peat bogs (Organic soils) in landscape depressions.

Combinations between Judy and Copton or Torrens units represent areas where the gravels are of variable thickness and bedrock commonly outcrops. The texture of the bedrock is loam to sandy loam in a Judy - Copton area and silty clay to clay loam in a Judy - Torrens area.

Simonette Soil Group (STT)

These soils are primarily poorly drained, undifferentiated peaty Gleysolic soils developed on pre-Pleistocene cobbly gravels. They are found exclusively in portions of the Alberta Plateau-Benchlands on relatively flat, elevated plateaus near Deep Valley Creek in the eastern part of the map area. Elevations of the plateaus range from 1,140 to 1,280 m (3,750 to 4,200 feet) above mean sea level. Simonette soils cover approximately 1.1 percent of the map area.

Except for color and the presence of prominent mottles, the parent material of the Simonette group is similar to the parent material of the Judy group. The material consists of gravels with a high content of rounded quartzites and sandstones. The matrix, generally a grayish brown to pale brown sandy loam, exhibits prominent, strong brown to yellowish brown mottles. Soil reaction varies from very strongly acid to mildly alkaline. The deposit is relatively thin with bedrock commonly encountered within 1 m of the surface. The presence of the less permeable bedrock at shallow depths probably explains why these soils are saturated most of the year. Very poorly drained organic deposits of variable thickness commonly overlie the gravels.

Simonette soils lie on elevated plateaus and tablelands where there are also a number of sinuous channels filled to a considerable depth with moss-derived organic material. The topography is level to undulating and sometimes depressional. Soil mottling indicating impeded soil drainage is common in these regions.

The predominant forest type on Simonette soils is the Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12). Black spruce is the dominant tree species over much of the Simonette soil group.

Soil development is strongly affected by the high water table and poor drainage conditions. Although a number of profile types exist within the Simonette group, the most common are peaty Orthic Luvic Gleysols, peaty Rego

Plate 25. Sand dunes near the Smoky River. Heart soils are found on this material.

Gleysols, and peaty Orthic Gleysols. Simonette soils always have accumulations of semidecomposed peat on the surface of the mineral soil. This material, derived primarily from the growth and decomposition of mosses, ranges in thickness from 15 to 50 cm and overlies a mottled mineral zone. Below this the soil is either saturated or shows signs of being saturated for appreciable portions of the growing season. Only one soil profile, a peaty Fera Gleysol, was described in detail and sampled for laboratory analysis. The description and analytical results are presented in Appendix A. This type of Gleysolic soil is not commonly found in the Simonette soil group.

Soil Unit: Only one unit was used to indicate the distribution of the Simonette soil group:

STT 2 - Dominantly poorly drained undifferentiated peaty Gleysolic soils in association with significant amounts (15 to 40 percent) of rapidly drained Brunisolic and Podzolic Gray Luvisols (JUY 1) developed on cobbly gravels. This unit is found in areas where the flat, poorly drained terrain is punctuated with isolated upland knolls. The upland knolls, which consist of Judy soils, may comprise up to 40 percent of the area, but probably do not exceed 25 percent in most areas. About 38,720 acres were mapped.

Soil phase notations were not employed with this unit. The designations peaty phase or stony phase were not necessary because the soils are defined as being peaty and stony. The thin phase was not used because of the overall thickness of the parent material.

Map Combinations: The Simonette soil unit is always combined with the unit of the Kenzie soil group. Such a combination indicates soil areas where the thickness of accumulated surface peat is highly variable and Organic soils derived mainly from moss material are significant. The organic material that fills the sinuous channels consists primarily of a variety of semidecomposed mosses, so these areas were designated as bogs (KNZ) rather than fens (EGL).

Soils Developed on Eolian Deposits

Deposits of postglacial eolian materials occupy extensive areas east of the Smoky and Wapiti Rivers in the northern portion of the map area. The materials are stone-free, very fine to fine grained sands which form U-shaped and longitudinal dunes with a local relief up to 5 m. The Brunisolic, Podzolic, and Luvisolic soils that have developed on these sands were mapped as the Heart soil group. The dune fields are presently stabilized by vegetation.

Heart Soil Group (HRT)

Heart soils are rapidly to well drained Brunisolic, Luvisolic, and Podzolic soils developed on stone-free eolian sands. This soil group, found east of the Wapiti and Smoky Rivers in the northern portion of the map area, lies mainly within the Wapiti Plains at elevations of 640 to 760 m (2,100 to 2,500 feet). Smaller areas are found at elevations as high as 940 m (3,100 feet). Heart soils occupy about 1.8 percent of the map area.

The eolian sand which constitutes the parent material of the Heart soil group is loose, light olive brown to yellowish brown, and dominantly fine sand to loamy fine sand in texture. The material may be moderately to strongly calcareous and mildly alkaline in reaction in some localities, but noncalcareous and medium acid in others.

This soil group is restricted to those areas where sand has been transported by wind and is characterized by U-shaped or longitudinal dunes (Plate 25), well stabilized with tree cover. Topography is undulating to moderately rolling with gently rolling to moderately rolling topography the most common.

The vegetation cover of Heart soils is dependent upon slope position, aspect, elevation, and soil drainage. The prevalent forest type is the Lodgepole pine/Labrador tea/Feathermoss type (11) with lesser amounts of Lodgepole pine/Low-bush cranberry/Dewberry type (8) and Lodgepole pine/Alder/Bunchberry type (10). The Lodgepole pine/ Black spruce/Labrador tea - Tall bilberry type (12) occurs on Heart soils at higher elevations. Table 3 gives productivity estimates for the different types. Detailed descriptions of the various types are given in Appendix B.

Heart soils were separated into two main groups according to whether an illuvial (Bt) horizon is present or absent. One group (HRT 1) consists of rapidly drained Eluviated Eutric Brunisols (Plate 26) and Orthic Humo-Ferric Podzols. These soils are characterized by a thin organic conifer needle and moss mat overlying a light gray, leached Ae horizon. The underlying B horizon is yellowish red to yellowish brown but generally does not have the chemical characteristics required of a Bf horizon. Those soils which have insufficient pyrophosphate-extractable Fe + Al in their Bm horizons are classified as Eluviated Eutric Brunisols while those which have sufficient amounts are classified as Orthic Humo-Ferric Podzols. These soils are loose in consistency, loamy fine sand to fine sand in texture, very strongly to medium acid in reaction, and very permeable with no restrictions to downward or lateral movement of water. The other group of soils (HRT 3) consists of well drained Brunisolic and Podzolic Gray Luvisols. These soils have a morphology similar to that of the previously described group but differ in that a continuous textural Bt horizon is encountered 20 to 40 cm below the surface. The Bt horizon is 20 to 35 cm thick, sandy loam to sandy clay loam in texture, slightly acid in reaction, and yellowish brown to brown in color. This horizon is finer textured and has a lower permeability and higher water-holding capacity than the horizons above and below and is important in regulating the moisture regime of these soils. Two soil profiles common to the Heart group were sampled for laboratory analysis. The detailed descriptions and analyses are presented in Appendix A.

Soil Units: Four soil units were used to map the Heart group. These are:

HRT 1 - Dominantly rapidly drained Eluviated Eutric Brunisols (called the Heart complex in earlier soil survey reports) in association with significant amounts of rapidly drained Orthic Humo-Ferric Podzols. About 41,620 acres were mapped.

HRT 2 - Dominantly Eluviated Eutric Brunisols and Orthic Humo-Ferric Podzols (HRT 1) in association with significant amounts of undifferentiated Gleysolic soils developed on similar parent material. This unit describes areas of HRT 1 soils that contain 15 to 40 percent poorly drained Gleysolic soils on lower slopes and in the depressions between the dunes. About 4,980 acres were mapped.

HRT 3 - Dominantly well drained Brunisolic Gray Luvisols in association with significant amounts of well drained Podzolic Gray Luvisols. This unit is common in areas adjacent to Pinto Creek where about 13,460 acres were mapped.

HRT 4 - Dominantly Brunisolic and Podzolic Gray Luvisols (HRT 3) in association with significant amounts of undifferentiated Gleysols. This unit describes areas of HRT 3 soils that contain 15 to 40 percent poorly drained Gleysolic soils in the inter-dune areas. It is common in an area east of Nose Creek where about 2,480 acres were mapped.

No soil phase notations were used with any of these soil units.

Map Combinations: Heart soils are mapped most commonly with the Kenzie unit. In these areas the Organic Kenzie soils occupy depressional areas among the dunes.

Heart - Blackmud and Heart - Lodge combinations are sometimes found on the soils map. These indicate areas where both glaciofluvial and eolian deposits of varying thickness can be found.

Soils Developed on Sedimentary Bedrock Deposits

In the Wapiti area two soil groups, Copton and Torrens, have developed on sedimentary bedrock. The Copton soil group is a collection of Brunisolic and Luvisolic soils developed on medium to coarse textured sandstones. Lithic members are common in this group. Soils of the Torrens group are Gray Luvisols developed on moderately fine to fine textured shale and siltstone deposits. These two groups cover extensive portions of the Alberta Plateau-Benchlands and Foothills, and occupy about 14 percent of the map area.

Plate 26. An Eluviated Eutric Brunisol developed on eolian dune sand. This soil is common to the HRT1 soil unit.

Copton Soil Group (COP)

Well drained Brunisolic and Luvisolic soils developed on medium to moderately coarse textured, weathered sandstone make up the Copton soil group. Lithic members are common as well, and in these soils consolidated sandstone lies within 50 cm of the surface. Copton soils are found in the Alberta Plateau-Benchlands and Foothills wherever sandstone bedrock outcrops or lies within 15 cm of the surface. Large areas were mapped near Copton tower where upland plateaus and elongated razorback ridges are common. Copton soils occupy about 8.1 percent of the map area.

The parent material of the Copton group is weathered sandstone and colluvium derived mainly from sandstone beds. Soils developed on such material reflect the nature of the bedrock and thus exhibit widely varying chemical and physical characteristics. In general the sandstone material is sandy loam to loam in texture, strongly to slightly acid in reaction, and lacks carbonates. Fragments of bedrock are often found throughout the material, and bedrock exposures are often visible at road cuts (Plate 27). Generally, Copton soils found in the Alberta Plateau-Benchlands are developed on sandstones of the Paskapoo Formation. This material is weathered to a depth of 2 m. Copton soils mapped in the Foothills are developed primarily on sandstones of the Blackstone, Cardium, Wapiabi, and Brazeau Formations. Weathering in this material is commonly less than 50 cm deep.

The most commonly associated landform is steeply sloping erosional scarps and ridges of high and moderate relief. Copton soils are also present on some of the relatively flat upland plateaus and some of the hills, particularly in the Alberta Plateau-Benchlands. Topography varies according to the nature of the associated landform.

Plate 27. An outcrop of sandstone bedrock. Lithic soils of the COP3 soil unit normally occur in such areas.

The type of vegetation cover on Copton soils is determined by a number of quite variable environmental factors of which exposure, topography, and elevation are most important. At lower elevations, the Lodgepole pine/Low-bush cranberry/Dewberry type (8) is often found with large amounts of aspen in the overstory. At higher elevations up to 1,460 m (4,800 feet) where large areas of Copton soils are found, the predominant forest vegetation includes Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12) and Lodgepole pine/Labrador tea/Feathermoss type (11) with lesser amounts of White spruce/Feathermoss type (5). At elevations between 1,460 m and 1,680 m (5,500 feet) the Lodgepole pine/False azalea/Five-leaved bramble type (13) predominates, with white-flowered rhododendron and false azalea together forming a dense shrub understory. Subalpine fir and Engelmann spruce are often important components of the forests that grow on Copton soils at high elevations, on very steep, dry south and southwest facing slopes. Such slopes usually lack trees and the primary vegetation is abundant hairy wild rye and a few herbs including lupine, especially at elevations above 1,680 m (5,500 feet).

Soil development is highly variable and is strongly affected by steep topography, soil reaction of the parent material, and the processes of mass wasting. Eluviated Dystric and Eluviated Eutric Brunisols as well as Brunisolic Gray Luvisols predominate on gently rolling to strongly rolling terrain. These soils are characterized by an eluvial horizon (Ae) overlying a B horizon. In many cases there has been insufficient downward movement of clay from the upper part of the profile into the B horizon to produce a Bt horizon. The solum varies from sandy loam to loam in texture and strongly acid to slightly acid in reaction. Lithic soils are prominent on very steep slopes where consolidated bedrock is near the surface (Plate 28). These lithic soils are generally very strongly acid in reaction. Some Podzols were recognized, but they probably form only a minor portion of the total group. Surface and internal soil drainage of Copton soils is good. On steeply and very steeply sloping terrain surface runoff may be excessive. Two profiles were described and sampled for laboratory analysis. The data are presented in Appendix A.

Soil Units: In the map area three Copton soil units were used to describe the distribution of the Copton group. These are:

COP 1 - Dominantly well drained Eluviated Dystric and Eluviated Eutric Brunisols in association with significant amounts of well drained Brunisolic Gray Luvisols. The Luvisols are generally found on the more stable sites. Lithic soils are only a minor component in areas where this soil unit is mapped. About 233,340 acres were mapped.

COP 2 - Dominantly well drained Eluviated Dystric and Eluviated Eutric Brunisols (COP 1) in association with significant amounts of poorly drained, undifferentiated Gleysolic soils. This unit describes areas of COP 1 soils that contain 15 to 40 percent poorly drained Gleysolic soils on the lower slopes and in depressions. About 16,880 acres were mapped.

COP 3 - Dominantly well drained Lithic Eluviated Dystric Brunisols in association with well drained Lithic Brunisolic Gray Luvisols. This soil unit describes areas where consolidated sandstone is encountered within 50 cm of the surface. These soils are generally found on very steeply sloping terrain where surface runoff may be excessive. About 36,620 acres were mapped, exclusively in the Foothills.

No soil phase notations were used with the Copton soil group.

Map Combinations: Soil units of the Copton group commonly are mapped in combination with units of the various soil groups developed on till and in particular with the Robb, Edson, and Mayberne units. Such complex units represent areas where till deposits are relatively thin and sandstone bedrock is exposed. Usually bedrock is exposed on the hill crests and steep side slopes while till occupies the lower slopes and valley areas.

Combinations of Copton and Torrens identify areas where the bedrock is complex and soils developed on sandstone and finer textured shales are intimately associated.

Torrens Soil Group (TOR)

Torrens soils are moderately well drained Orthic and Brunisolic Gray Luvisols developed on moderately fine to fine textured unconsolidated mudstones. These soils are widespread in the south-central and central portions of the map area, mainly in the Alberta Plateau-Benchlands. This group occupies about 5.9 percent of the map area.

The Torrens parent material is, in the main, the product of the in situ weathering of siltstones and shales (mudstones), although colluvial deposits of similarly textured bedrock material may also be present in areas where steep slopes are prominent. The material is light olive brown to dark

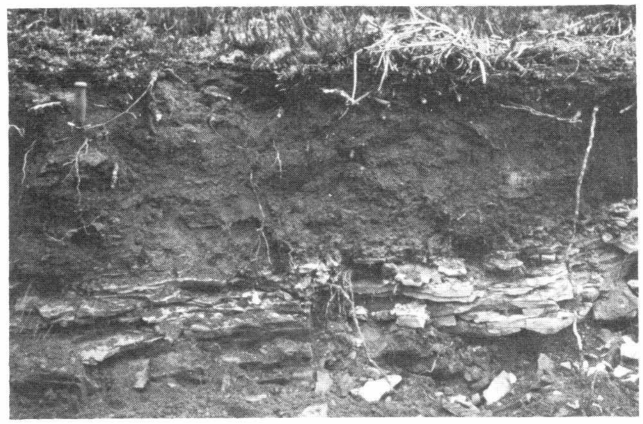


Plate 28. A lithic Eluviated Dystric Brunisol developed on shallow weathered sandstone. Note the lithic contact to consolidated sandstone (COP3 soil unit).

brown in color, clay loam to silty clay in texture, weakly to moderately calcareous, and often contains low amounts of highly weathered sandstone and siltstone fragments which can be crushed easily by hand. An occasional quartzite pebble may also be present. Unlike the Copton group, the Torrens group includes few lithic soils because the siltstone and shale are more deeply weathered than the sandstones on which Copton soils are developed. A lithic contact is encountered only where consolidated sandstones lie at shallow depths. The Torrens parent material is usually stratified and can easily be mistaken for a glaciolacustrine deposit, but position in the landscape and the presence of bedrock fragments differentiates Torrens soils from those developed on glaciolacustrine materials.

The Torrens soil group is generally found on undulating to moderately rolling upland plateaus. In areas where the plateaus have been deeply incised by drainage channels the topography is strongly rolling to hilly. Steeply sloping erosional escarpments generally consist of sandstone bedrock materials rather than shale or siltstone materials. When the protective vegetation is removed, the stratified nature and textural characteristics of these mudstones may lead to erosional problems such as gullying and landslides, even on gentle slopes.

Three forest types are nearly equally common on Torrens soils: Lodgepole pine/Alder/Bunchberry (10), Lodgepole pine/Labrador tea/Feathermoss (11) and Lodgepole pine/Black spruce/Labrador tea - Tall bilberry type (12). The Lodgepole pine/Low-bush cranberry/Dewberry type (8) can be found at lower elevations on Torrens soils.

Plate 29. An area of Eaglesham soils developed on sedge peat.

The predominant soils in the Torrens group are well developed Orthic Gray Luvisols with a double Ae horizon sequence. These soils are characterized by a thin L-F or L-H organic horizon, a well developed light brownish gray Ae1 horizon, and a yellowish brown Ae2 horizon. The eluvial horizons are generally silt loam to silty clay loam in texture and very strongly acid in reaction. At 20 to 35 cm below the surface lies a light olive brown, strongly acidic, clay loam to silty clay Bt horizon. This horizon is generally well developed and exhibits moderate subangular blocky structure and thick clay skin development on the ped surfaces. Some profiles display a Brunisolic-like sequence of horizons in which a brighter colored Bm horizon is developed between the Ae1 and Ae2 horizons. The Bm horizon normally either has insufficient pyrophosphate-extractable Fe + Al or too high a clay content to be called a Bf horizon. Surface drainage of these soils generally is good, but internal drainage may be impeded somewhat in the finer textured members of this group. A description and laboratory analysis of a soil profile common to the Torrens group are presented in Appendix A.

Soil Units: Two soil units were used to map the Torrens group. The units are:

TOR 1 - Dominantly moderately well drained Orthic Gray Luvisols in association with significant amounts of Brunisolic Gray Luvisols. About 190,160 acres were mapped.

TOR 2 - Dominantly moderately well drained Orthic and Brunisolic Gray Luvisols (TOR 1) in association with a significant amount of undifferentiated Gleysolic soils. This unit describes areas of TOR 1 soils that include 15 to 40 percent poorly drained Gleysolic soils on lower slopes and in depressions. About 18,220 acres were mapped.

No soil phase notations were employed with these Torrens units.

Map Combinations: Torrens units are commonly combined with units of the Mayberne and Edson groups and to a lesser extent with units of the Robb group. Such combinations represent areas where the till deposit is relatively thin and unconsolidated shale or siltstone (mudstone) bedrock is exposed in some locations.

Torrens - Kenzie combinations identify areas where Organic soils derived primarily from mosses occupy a significant proportion of the landscape.

Soils on Organic Deposits

Soils of the Organic Order are very poorly drained and are characterized by an accumulation of peat exceeding a compact thickness of 50 cm. In the Wapiti map area two types of Organic soils were mapped - one is peat developed from sedge (Eaglesham soil group) while the other is peat developed from moss (Kenzie soil group). These soils are mostly Mesisols. The limited investigation of the Organic Order at the time of mapping does not permit a more detailed classification of these soils. Organic soils occupy approximately 7 percent of the map area and are derived mainly from moss peat. Soils developed on sedge peat are of minor areal extent and are found only in the northern portion of the map area.

Eaglesham Soil Group (EGL)

These soils are very poorly drained Organic soils characterized by more than 50 cm of compacted sedge peat (Plate 29). The stage of decomposition and the thickness of the peat vary considerably. Eaglesham soils are of limited areal extent (about 1,360 acres only) and are found in the Wapiti Plains in the most northerly portion of the map area.

The topography is mainly depressional, and the predominant vegetation cover is sedge fen with species *Carex aquatalis* and *C. rostrata* comprising much of the plant cover in the wettest areas. Willow and swamp birch thickets and marsh reed grass make up much of the remaining vegetation cover.

The profile description is based on the color and degree of decomposition of the peat material. The sedge peat seldom exceeds 150 cm in thickness. A description and analyses of a Terric Mesic Fibrisol profile which is common to the Eaglesham group are given in Appendix A.

Soil Unit: Only one soil unit was used to describe the Eaglesham group:

EGL - Dominantly Mesisols in association with significant amounts of Fibrisols and Humisols. This broad soil grouping covers essentially all the Organic soils developed on sedge peat. The most common Subgroups are Terric Mesisols, Typic Mesisols, Fibric Mesisols, Terric Fibrisols, and Terric Mesic Fibrisols.

Kenzie Soil Group (KNZ)

The soils developed on organic materials derived primarily from mosses are called the Kenzie soils group; all these soils belong to the Organic Order. Kenzie soils are found in all physiographic regions and occupy about 7 percent of the map area.

Kenzie soils lie in very poorly drained concave or level topographic positions. Vegetation varies with the water regime or water movement pattern. The prevalent forest type on Kenzie soils is the Black spruce/Labrador tea/Cloudberry type (7) that is characterized by stunted black spruce; tamarack and large amounts of sphagnum moss are often common. String fen communities develop on Kenzie soils in some areas on gentle slopes, where the presence of moving water results in a pattern of alternating sedge fen and forest or shrub vegetation. The peat formed under the string fen communities originates primarily from aquatic mosses (Plate 30).

No attempt was made to separate soils developed under the black spruce bog type (7) from those developed under sedge fen, even though some differences were observed.

Kenzie soils are developed and maintained in areas of permanent groundwater discharge which manifests itself as seepages, springs, and swamps. Thus, these soils are usually saturated almost to the surface. Topography is generally gently undulating to undulating but slopes up to 15 percent were observed.

The Kenzie soils include several soil types which are differentiated according to the nature and extent of decomposition of the peat-forming vegetation. At the surface the material is usually raw and undecomposed. Below this lies a zone extending to the mineral soil in which the peat is primarily semidecomposed. Occasionally in this zone are individual strata which are either raw or highly humified. The darkest and most decomposed layer is usually found immediately above the mineral layer. The underlying mineral soil, which may be derived from any one of the previously discussed soil parent materials, is commonly pale bluish-gray and may show faint mottling. The thickness of peat in the map area is highly variable; however, organic deposits in the Interior Plains appear to be much thicker than those in the Western Cordillera. A detailed description and analyses of a soil profile common to the Kenzie group are presented in Appendix A.

Soil Unit: There is only one soil unit in the Kenzie group in the map area. It is:

KNZ - Dominantly Mesisols in association with significant amounts of Fibrisols and Humisols. This is a broad soil grouping which essentially covers the Organic Order. The most common Subgroups include Typic Mesisols, Terric Mesisols, Fibric Mesisols, Terric Mesic Fibrisols, and Typic Humisols. Kenzie soils are dominant on about 248,300 acres.

Miscellaneous Land Types

Three miscellaneous land types, Disturbed Land, Rock Land, and Rough Broken Land, were recognized in the map area. Overlain by undifferentiated soils, these land areas have distinctive, easily recognizable physical characteristics.

Plate 30. An area of Kenzie soils showing the native vegetation. These soils are developed on peat moss and occur in approximately 7 percent of the map area.

Disturbed Land Type (DL)

Disturbed lands are areas where the soils have been disturbed by open pit mining activities, and coal has been or is being mined. The landscape is marked by excavation pits and piles of overburden. About 1,520 acres of Disturbed Land has been delineated in the south-central portion of the map area in the vicinity of Sheep Creek.

Rock Land Type (R)

The Rock Land type includes all exposures of bare rock or rock covered by 10 cm or less of mineral or organic deposits. This land type occupies about 26,180 acres or 0.7 percent of the map area, and is found exclusively above tree line in the Rocky Mountains.

The consolidated bedrock is composed mainly of bedded and fractured sandstones and in some localities conglomerate. Rock outcrops (non-soil) make up a major portion of this land type; however, some soils, classified as Lithic Orthic Regosols, are present to a limited extent. This land type occupies glacially abraded mountain tops, steep mountain side slopes, talus slopes, and cliffs and walls of canyons. The topography is strongly rolling to very hilly. Vegetation is sparse or absent.

Rough Broken Land Type (RB)

This is a strongly eroded, continuous landform created by relatively recent river erosion. It includes the steeply sloping channels which parallel river and stream courses and may also include some of the smaller postglacial fluvial floodplains that are too small to be delineated. This land type is common in the Interior Plains where eroded stream banks are prominent. Because of the overall steepness of the terrain, very little land in the Western Cordillera is classed as Rough Broken even though unstable, erodible stream banks are common. Soils in Rough Broken areas are generally shallow and lithic in character, and much of the land may be exposed bedrock. This land type covers about 174,800 acres or about 5 percent of the map area.

SOIL SURVEY INTERPRETATIONS

In the past the supply of land suitable for human activity exceeded the demand. Now such land is becoming scarce, and increasing energy, food, and recreational demands are putting stress on the lands available. If conflicts are to be avoided, the community must carefully develop its approaches to land use planning.

Soil, an integral part of the land, is also integral to the community's well-being. The community depends on soil for food, for watershed protection, for building materials, for waste disposal sites, for places to live, to work, and to enjoy the fruits of work. Mismanaging this resource produces drastic economic, social, and environmental results.

Careful land use planning, including the proper management of the soil, requires information. Thus, surveys are performed to help define the capabilities of an area and so help prevent deterioration and destruction of important resources. Soil surveys provide data on soil properties and distribution, and consolidate this information into evaluations of soil performance, but not into recommendations for land use (Steele, 1967). Other factors including economic, social, and political conditions as well as the presence of other raw material resources such as coal and timber must also be considered to determine optimal land use.

The soil resource of the Wapiti area was evaluated according to its performance for agricultural, forestry, and engineering applications, with emphasis on forestry and engineering considerations. Limitations imposed by climate as well as soils and topography will hinder extensive agricultural development. The erosion hazard presented by each soil was also evaluated, using a comparative rating (slight, moderate, severe) that applies to potential water erosion of Wapiti area soils only.

SOIL INTERPRETATIONS FOR FOREST MANAGEMENT

Soil management interpretations for timber production consist of ratings for a number of soil-related characteristics that affect growth and management of trees. Such ratings, although subjective in detail, are useful in planning the soil management programs that are necessary to maintain or enhance the productivity of a soil area (Dumanski *et al.* 1972).

Soil management interpretations for soils of the Wapiti area, relative to dominant tree production, are shown in Table 6. This table was compiled on the basis of forest type (Table 3). It shows soil interpretations for timber production based on the chemical and physical properties of the soil series or collections; land characteristics such as topography and aspect are not considered. Information contained in Table 6 is intended to complement and supplement that outlined on the completed soil maps (in pocket). Final decisions on practical soil-land management must be based on both sources of information.

Moisture Status for Tree Growth

Moisture status refers to the inferred quantity of moisture that should be available for tree growth during the growing season. This is based on knowledge of water-holding capacities of soils as well as on moisture distribution patterns over the area. Soils are rated as good (g), moderate (m), or poor (p), wet or dry, for the dominant species on that soil.

Potential Windthrow Hazard

Windthrow hazard ratings reflect soil characteristics affecting development of tree roots, and hence, the risk of trees being blown over by normal winds. These ratings, cited as high, moderate, or low in Table 6, are estimated from knowledge of root development under varying soil conditions and from field observations. It appears that trees are most subject to windthrow on soils having thick organic surface horizons that are affected by high water tables, or on lithic soils having shallow sola overlying consolidated bedrock. Thus windthrow is often a problem on Organic and Gleysolic soils and on certain of the Smoky and Gunderson soils. Soils characterized as having deep rooting zones are described as having moderate or low windthrow hazards.

Inferred Transplant Mortality

Potential mortality of planted seedlings has been rated as high (H), moderate (M), or low (L), on the basis of the soils chemical and physical conditions. The rating was based largely upon early survival of very young transplants in unprepared, natural soils in the Hinton-Edson map area on soil units that also are found in the Wapiti map area. Transplant mortality ratings are extrapolated for Wapiti soil units that are not present in the Hinton-Edson map area, on the basis of the physical and chemical properties of the soils and the climate.

Inferred Fire Hazard

Fire hazard ratings are based upon the values assigned to the predominant forest type on a map unit. Fire hazard is inferred from knowledge of the flammability of the component species of the forest types and from observed fire behavior in various forest types. These ratings were assigned for "cured dormant state" (early spring and late fall) and "active growth state" (late spring to early fall) for both "crownfires" and "surface fires" with the help of the Fire Research unit of the Northern Forest Research Centre, Edmonton. The ratings are subjective and will be greatly influenced by weather, topography, and by local fuel loading.

Forest Productivity Potential of the Forest Vegetation Types

The gross Mean Annual Increment (MAI) and Site Index (SI) at 70 years for the dominant tree species in the 15 forest vegetation types is shown in Table 3. The dominant soil units associated with each of the vegetation types is indicated.

In general, the highest productivity is found at the lower elevations in the northern portion of the map area and decreases to the southwest with increasing elevation and presumably harsher climate.

The areal extent of the forest types may be determined in a general way by consulting the soil map in combination with the soil group descriptions.

The statistical significance of the differences in MAI and SI among the various forest vegetation types is reported by Corns (1978).

AGRICULTURAL INTERPRETATIONS

Any system of classifying the capability of soils for agriculture is an interpretive grouping of soils using soil survey data. In the classification scheme used in this report (Canada Land Inventory, 1972), mineral soils are grouped into seven classes according to their limitations for agricultural use. Class 1 soils, having few limitations, can be used for the widest range of agricultural activities with the least risk of damage. The soils in the other classes have progressively greater natural limitations.

Soils in the first three classes are capable of supporting sustained production of common field crops; soils in the fourth class are only marginally suitable for sustained crop production. Soils of the fifth class can support improved permanent pasture and hay production, but soils of the sixth class are suitable only for supporting wild pasture. Soils of the seventh class cannot support permanent pasture of any kind nor crop production. Organic soils are not classified in this system.

TABLE 6
Some Soil Interpretations for Forest Management

Soil Unit	Moisture Status for Dominant Tree Species[1]	Potential Windthrow Hazard	Inferred Transplant Mortality	Inferred Fire Hazard[2]
EDS 4	M (IP)	M	M	M-L M-L / H M-L
EDS 5	M-G (IP)	M	M	M-L M-L / H M-L
MLB 8	G (IP)	M	M-H	M-H M-H / H M-H
MLB 9	M-G (IP)	M-H	M-H	M-H M-H / H M-H
MBN 4	G (IP)	M-L	L	M-H M-H / H M-H
MBN 5	M-G (IP)	M-H	L-M	M-H M-H / H M-H
MBN 6	G (IP)	M	M-H	M-H M-H / H M-H
MBN 7	M-G (IP)	M	M-H	M-H M-H / H M-H
PZY 1	L (IP)	M	M	M-H M-H / H M-H
PZY 2	M-G (IP)	M	M	M-H M-H / H M-H
RBB 7	G (IP)	H	M-H	M-H M-H / H M-H
RBB 8	G-M (IP)	H	M-H	M-H M-H / H M-H
SHP 1	G (IP)	M	M	M-H M-H / H M-H
SHP 2	G (IP)	M	M	M-H M-H / H M-H
CAW	n/a	n/a	n/a	L L / L L
DPV	P (IP)	M-H	M-H	M-H M-H / H M-H
ERR 3	G (wS)	H	H	M M / L L
NKN	n/a	n/a	n/a	L L / L L
SKY 1	P (wet)(bS&wS)	M-H	M-H	H-M H-M / M H-M
SKY 2	P (wet)(bS&wS)	M-H	M-H	H-M H-M / M H-M
SKY 3	P (wet)(bS&wS)	M-H	M-H	H-M H-M / M H-M
SKY 4	P (wet)(bS&wS)	M-H	M-H	H-M H-M / M H-M
SKY 5	P (wet)(bS&wS)	M-H	M-H	H-M H-M / M H-M

TABLE 6 (continued)

SKY 6	P (wet) (bS&wS)	M-H	M-H	H-M H-M / M H-M
DON 1	G (wS)	M	M	L L / H-L L
DON 2	M-G (wS)	M-H	M-H	L L / H-L L
NMP 1	G (wS)	M	M	L L / H-L L
NMP 2	M-G (wS)	M-H	M-H	L L / H-L L
SIP 1	M (wS)	M-H	M-H	M M / M M
SIP 2	G (wS)	M	M	M-L M-L / M-L M-L
SIP 3	G (wS)	M	M	M-L M-L / M-L M-L
TRC 3	G (IP)	M	M	M-H M-H / H M-H
TRC 4	M-G (IP)	M-H	M-H	M-H M-H / H M-H
IOS 1	G (wS)	M	L	L-M L-M / L-H L-M
IOS 2	M-G (wS)	M-H	M	L-M L-M / L-H L-M
BKM 6	M (IP)	L	L	L-M L-M / H L-M
BKM 7	M-P (IP)	M	M-L	L-M L-M / H L-M
BKM 8	M (IP)	L	L	L-M L-M / H L-M
BKM 9	M-P (IP)	M	M-L	L-M L-M / H L-M
DVS 1	G (wS)	L	L	L L / H-L L
DVS 2	M (wS)	M	M	L L / H-L L
GUN 1	M (wS)	H	H	L L / L L
GUN 2	M-G (wS)	H-M	H-M	L-M L-M / L-M L-M
GUN 3	M-G (wS)	H-M	H-M	L-M L-M / L-M L-M
GUN 4	M-G (wS)	H-M	H-M	L-M L-M / L-M L-M

TABLE 6 (continued)

JRV 4	P (dry) (lP)	M	M-H	M-H M-H / H M-H
JRV 5	P-M (lP)	M	M-H	M-H M-H / H M-H
WHM 1	P (wet) (wS)	H	H	M M / M M
WHM 2	P-M (wS)	M-H	M-H	L-M L-M / M-H L-M
LDG 6	G (lP)	M	M	L-M L-M / H
LDG 7	G-M (lP)	M	M	L-M L-M / H L-M
LDG 8	G-(lP)	M	M	L-M L-M / H L-M
LDG 9	G-M (lP)	M	M	L-M L-M / H L-M
JUY 1	G (lP)	M	M	M-H M-H / H M-H
JUY 2	G-M (lP)	M	M	M-H M-H / H M-H
STT 2	P (wet) (lP)	M-H	M-H	M-H M-H / H M-H
HRT 1	P (dry) (lP)	M	M-H	M-H M-H / H M-H
HRT 2	P-M (lP)	M	M-H	M-H M-H / H M-H
HRT 3	P (dry) (lP)	M	M-H	M-H M-H / H M-H
HRT 4	P-M (lP)	M	M-H	M-H M-H / H M-H
COP 1	M (lP)	M	M-H	M-H M-H / M-H M-H
COP 2	M (lP)	M-H	M-H	M-H M-H / M-H M-H
COP 3	M (lP)	H	M-H	M-H M-H / M-H M-H
TOR 1	M (lP)	M	M-H	M-H M-H / M-H M-H
TOR 2	M (lP)	M-H	M-H	M-H M-H / M-H M-H
KNZ	P (wet) bS	H	H	M-H M-H / H H
EGL	P (wet) bS	H	H	L L / H L

[1]Tree species code: lP - lodgepole pine, wS - white spruce, bS - black spruce

[2]Inferred fire hazard

cured dormant crown / cured dormant surface   active growth crown / active growth surface

Under this classification system soils are assigned to a capability class and a capability subclass. The capability class is a grouping of soils having the same relative degree of limitations and hazards, while a capability subclass is a grouping of soils with similar kinds of limitations and hazards. The major kinds of limitations are: adverse climate (C); undesirable soil structure and low permeability (D); susceptibility to erosion (E); low fertility (F); susceptibility to overflow (I); moisture limitation due to coarse texture (M); excessive stoniness (P); presence of consolidated bedrock (R); adverse topography, slope and pattern (T); wetness (W); and cumulative minor adverse characteristics (X), where two or more adverse characteristics, singly not serious enough to affect the class rating, together moderate the rating.

Climate, soil properties, and topography are prime considerations when assessing areas for agricultural use. In the Wapiti area, climate is probably the most important factor, because a wide range of climatic conditions exists in the area.

On an agroclimatic map prepared by Bowser (1967) the Wapiti area lies in two Climatic Subregions, labeled 3H and 5H. Climatic Subregion 2H is just to the north of the map area. The main criteria used for establishing these Subregions are length of frost-free period (period between last frost before July 15 and first frost after July 16) (Longley, 1967) and the number of degree-days above 5°C (42°F). These were estimated using a formula modified from Hopkins (1938), which takes into account the effects of elevation, latitude, and longitude on climate. Subregion 3H includes areas with elevation less than 915 m (3,000 feet) and covers about 30 percent of the map area. This Climatic Subregion has a frost-free period of 60 to 75 days and 970 to 1050 degree-days above 5°C (1,750 to 1,900 degree-days above 42°F). All of the area of limited agricultural development that is found in this map area lies in this Climatic Subregion. Barley, oats, and forages are the dominant crops with forages the most common. Wheat production is limited due to a high risk of frost damage.

Climatic Subregion 5H, which includes all land at elevations greater than 915 m (3,000 feet), covers the remaining 70 percent of the map area. Within this Climatic Subregion the frost-free period is less than 60 days and the number of degree-days above 5°C is less than 970 (there are less than 1,750 degree-days above 42°F). This Subregion is unsuitable for cultivated crops and is limited mainly to unimproved pasture land. However, most of the vegetation cover is coniferous forest with few palatable grasses, so the potential for natural grazing is very limited. As a result, areas with additional soil or topography limitations are usually placed in Capability Class 7. The entire Mountain region and the Foothills are placed in Class 7 because of the restrictive climate, lack of palatable grasses, and rough topography. The capability of the soils in each Climatic Subregion is discussed separately.

Agricultural Capabilities of Soils in Climatic Subregion 3H

The agricultural capabilities of soils in Climatic Subregion 3H are only broadly evaluated. The numerous soil types combined with diverse topography tend to produce innumerable areal variations. Only single soil units and their phases were considered, so areas where soils are complex combinations of units may have a capability rating different from that of any of the simple units. Topography, except for the Rough Broken land type, was ignored. Table 7 lists the soil units and phases in Climatic Subregion 3H and their capability classes and subclasses.

In general, soils in Subregion 3H lie on undulating to gently rolling topography so the rating shown in Table 7 is not altered by the topography. However, Edson and Torrens soils, when found on moderately rolling topography (9 to 15 percent slopes), should be rated one class lower (that is 4D to 5DT). The ratings may be further altered if soils are combinations of soil units.

Agricultural Capability of Soils in Climatic Subregion 5H

Soils in Climatic Subregion 5H are placed in Classes 5, 6, or 7 depending on their limitations for agricultural use. All of the Western Cordillera as well as most of the Alberta Plateau-Benchlands lie in this Climatic Subregion. The frost-free period is short, and the vegetation is predominantly coniferous forest. Rough topography characterizes most of the area. Due to these conditions, the only soil placed in the 5C Capability Class are those with favorable textures lying on undulating to moderately rolling topography at lower elevations. These soils are limited by adverse climate but are capable of supporting forage crops. Soils included are some units of the Edson, Mayberne, Marlboro, Tri-Creek, Iosegun, Copton, and Torrens soil groups. These soils, where present on strongly rolling to hilly topography, are rated 6T or 7T depending on the steepness of slope and grazing potential.

Class 6 soils can be utilized as unimproved pasture. Some Heart, Blackmud, Putzy, Sheep, Smoky, Jarvis, and Judy

TABLE 7
Agricultural Capability of Soils in Climatic Subregion 3H

Soil Group	Soil Unit and Phase	Soil Capability Classification	Limitations
EDSON	EDS 4	4D	adverse structure
	EDS 4/t	4D	adverse structure
	EDS 5	4D5W	adverse structure and excessive wetness
	EDS 5/t	4D5W	adverse structure and excessive wetness
SMOKY	SKY 1	5W	excessive wetness
	SKY 1/p	6W	excessive wetness and peaty
	SKY 2	5W4D	excessive wetness and adverse structure
	SKY 2/p	6W4D	peaty, excessive wetness and adverse structure
DONNELLY	DON 1	4D	adverse structure
	DON 2	4D5W	adverse structure and excessive wetness
NAMPA	NMP 1	4D	adverse structure
	NMP 2	4D5W	adverse structure and excessive wetness
SNIPE	SIP 1	5W	excessive wetness
	SIP 1/p	5W	excessive wetness and peaty
	SIP 2	5W4D	excessive wetness and adverse structure
	SIP 3	5W4D	excessive wetness and adverse structure
IOSEGUN	IOS 1	4I	inundation
	IOS 2	4I5W	inundation and excessive wetness
BLACKMUD	BKM 6	5M	droughty
	BKM 7	5M6W	droughty and excessive wetness
	BKM 7/g	4D6W	adverse structure and excessive wetness
	BKM 8	6M	droughty
	BKM 8/s	6M	droughty
	BKM 9	6M6W	droughty and excessive wetness
DAVIS	DVS 1	4D	adverse structure
	DVS 1/g	4D	adverse structure
	DVS 2	4D5W	adverse structure and excessive wetness
	DVS 2/g	4D5W	adverse structure and excessive wetness
	DVS 2/t	4D5W	adverse structure and excessive wetness
GUNDERSON	GUN 1	6W	excessive wetness
	GUN 1/p	6W	excessive wetness and peaty
	GUN 2	6W4M	excessive wetness and droughty
	GUN 3	6W4M	excessive wetness and droughty
	GUN 4	6W6M	excessive wetness and droughty
JARVIS	JRV 4	6M	droughty
	JRV 5	6M6W	droughty
WANHAM	WHM 1	5W	excessive wetness
	WHM 1/p	5W	excessive wetness and peaty
	WHM 2	5W4D	excessive wetness and adverse structure
LODGE	LDG 6	4M	droughty
	LDG 6/s	4M	droughty
	LDG 7	4M6W	droughty and excessive wetness
	LDG 7/g	4D6W	adverse structure and excessive wetness
	LDG 8	4M	droughty
	LDG 9	4M6W	droughty and excessive wetness
	LDG 9/s	4M6W	droughty and excessive wetness

TABLE 7 (continued)

HEART	HRT 1	6M	droughty
	HRT 2	6M6W	droughty and excessive wetness
	HRT 3	5M	droughty
	HRT 4	5M6W	droughty and excessive wetness
COPTON	COP 1	5M	droughty
	COP 2	5M5W	droughty and excessive wetness
TORRENS	TOR 1	4D	adverse structure
	TOR 2	4D5W	adverse structure and excessive wetness
EAGLESHAM	EGL	0 (Organic)	excessive wetness; may have some grazing potential
KENZIE	KNZ	0 (Organic)	excessive wetness; no grazing potential
MISCELLANEOUS LAND TYPE			
	Symbol		
Rough Broken	RB	6T	adverse topography

soils, when found on slopes of less than 30 percent, fall into the Class 6 category. These soils commonly have different limitations in varying degrees. Soils of the Heart, Blackmud, Jarvis, and Judy groups are generally rated as 6M due to their sandy texture and rapid drainage, and vegetation on these soils will suffer from lack of moisture during some part of the growing season. Jarvis and Judy soils are also exceedingly to excessively stony or cobbly. Some Putzy group soils are also exceedingly stony. Putzy and Sheep soils are rated as 6T due to a number of factors of which location is probably the most important. These soils are confined to the larger valleys well within the Foothills and generally support a vegetative community that has some limited grazing potential. The topography is generally very 'choppy', producing a poor pattern. When found on slopes greater than 30 percent, these soils are rated as 7T. Poorly drained Smoky soils may be utilized for hay crops or limited grazing in dry years. These soils are generally excessively wet and are rated as 6W in the Alberta Plateau-Benchlands.

All soils in the map area resting on hilly topography (slopes greater than 30 percent) are rated as Class 7T, not capable of supporting agricultural activities. Most of the soils of the Western Cordillera are rated as Class 7 due to adverse topography, shallowness of the soil profiles to bedrock, and low grazing potential for domestic animals. Soils of the Robb, Errington, Nickerson, Copton, and Caw groups as well as Rock Outcrops also fall into this category. Poorly drained Smoky soils in the Foothills and Simonette soils in the Alberta Plateau-Benchlands are rated as 7W due to excessive wetness and a thick peaty horizon. Such soils have a low grazing potential. Soils on the steep unstable slopes of the Rough Broken land unit and the Deep Valley soil group, which is found on eroded escarpments, are rated as 7T.

The ratings given here are general and are not to be considered the actual rating of soil areas. Each individual area must be assessed on its own merits to provide a meaningful and useful capability rating for agriculture.

ENGINEERING INTERPRETATIONS

Soil is the most used construction material, whether for roads or parks, airports or residential areas. Thus, the people planning such projects need accurate, complete information on soil character and behavior. The prime function of a soil survey is to provide this information to be used as a reliable basis for design and construction (Aandahl, 1958). Soil surveys, which describe soils in their natural setting, also provide environmental information because soils are produced by environmental factors acting on parent material. Soil survey interpretations can thus be very useful for predicting performance and identifying problem areas when new developments are planned. The information provided by soil surveys is not intended to be site-specific nor a substitute for on-site investigations, but should be used as a basis for regional planning to reduce the amount of further investigation and to minimize costs. The interpretations are evaluations of performance and not recommendations for use.

The soil properties most important to the engineer are grain size, plasticity, compaction and shrink-swell characteristics, strength, permeability to water, soil drainage, and salinity.

Other factors such as topography and depth to the water table and to bedrock are also important. To aid in the evaluation of the soils for engineering purposes, especially in terms of these properties, soil samples of 21 of the principal soil groups were analyzed according to procedures outlined in the ASTM Book of Standards, Part II (American Society for Testing and Materials, 1972). The data are listed in Table 8. The soils are grouped according to parent material. In most cases, several samples of the same soil group were collected to show the variations within a soil group. Relatively stone-free, coarse textured soils were generally considered to be nonplastic and were not sampled for engineering analyses. Soil groups not tested were Heart, Blackmud, and Lodge. Organic soils of the Eaglesham and Kenzie groups also were not sampled because of lack of mineral material.

The soil classification for engineering purposes given in Table 8 is based on data obtained from particle size analyses and from tests to determine the liquid and plastic limits. Particle size analyses were made by combined sieve and hydrometer methods.

The tests for liquid limit and plastic limit measure the effects of water on the consistence of soil material. As the moisture content of an expandable clay soil increases from a dry state, the material changes from a semisolid to a plastic. As the moisture content increases further, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil passes from a semisolid to a plastic. The liquid limit is the moisture content at which the soil passes from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and plastic limit. This parameter indicates the range of possible moisture contents in soil material that is in a plastic condition. Soils for which the liquid or plastic limit cannot be determined, or for which the plastic limit is equal to the liquid limit, are termed nonplastic.

There are two systems in general use among engineers for classifying soil materials. One system is that approved by the American Association of State Highway Officials and referred to as the AASHO Classification System. The other is the Unified Soil Classification System.

Under the AASHO System soil material is classified into one of seven groups. These groups range from A-1, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clay soils having low strength when wet. Within each group the relative engineering value of the soil material is indicated by an index number. These numbers range from 0 for the best material to 20 for the poorest. The index number is shown in parentheses following the soil group symbol. The classification is based on particle size, liquid limit, plastic limit, calculated plasticity index, and the calculated group index numbers.

In the Unified Soil Classification System the soils are identified according to their performance as engineering construction materials. This system recognizes eight classes of coarse-grained soils, six classes of fine-grained soils, and one class of highly organic soils. In coarse-grained soils, 50 percent or more of the material cannot pass through a No. 200 sieve; fine-grained soils are those with more than 50 percent of the material fine enough to pass through the No. 200 sieve. The letters G, S, C, M, and O stand for gravel, sand, clay, silt, and organic material respectively; the letters W, P, L, and H refer to well graded, poorly graded, low liquid limit, and high liquid limit respectively. For example, the designation SM means sand mixed with silt, while ML means silt with a low liquid limit (less than 50). Also recognized in the Unified System are organic silts (OL), organic clays (OH), and peat or other highly organic soils (PT).

Soil limitation or suitability ratings indicate the suitability of soils for specific uses (United States Department of Agriculture, 1972) in their natural undisturbed state (Montgomery and Edminster, 1966). Other factors such as location, accessibility, esthetic values, and nearness to population centers are not considered. Soils are normally evaluated to a depth of about 1 m, but sometimes the depth is greater depending on the particular purpose in mind. These interpretations are based on detailed soil descriptions obtained during the field mapping program, selected chemical and physical analyses, and the engineering properties of the soil groups.

It is obvious that flood-prone soils are unsuitable for housing, that poorly drained soils are severely limited for use as sewage disposal fields, and that soils on steep slopes are generally unfit for many purposes. It is equally important to consider carefully soil survey interpretations in land use planning. However, the limitations of soil surveys must be realized. Soil surveys and interpretations are only a guide to proper land use planning.

The various soil groups in the Wapiti area were placed into one of three categories according to their limitations or suitabilities for specific uses. These interpretations closely follow the *Guide for Interpreting Engineering Uses of Soils* (United States Department of Agriculture, 1972). Slight modifications for local conditions were made. The interaction of various soil properties was interpreted to

TABLE 8

Engineering Test Data and Classification for some of the Soil Groups in the Wapiti Map Area

Soil Group	Location	Depth (cm)	Percentage Passing Sieve							Percentage smaller than				Atterberg Limits		Classification		
			1"	3/4"	5/8"	#4	#10	#40	#200	0.05 mm	0.005 mm	0.002 mm	0.001 mm	Liquid Limit	Plastic Limit	USDA	Unified	AASHO
EDSON	SW33-64-1-6	120	100	100	99	98	97	94	74	72	53	43	36	41	19	C	CL	A-7-6(12)
	SE11-63-7-6	120	83	83	80	78	78	73	66	65	41	31	24	35	16	SiCL	CL	A-6(9)
	SE27-62-4-6	85	100	100	100	99	99	97	85	80	57	46	42	40	17	C	CL	A-7-6(12)
	SW4- 61-6-6	60	100	100	100	99	98	96	78	66	45	35	30	32	15	CL	CL	A-6(10)
	NW16-63-9-6	50	100	100	100	100	100	100	88	84	60	50	43	43	20	C	CL	A-7-6(13)
	NE33-67-13-6	50	93	93	90	90	88	87	86	76	58	47	42	48	23	C	CL-CH	A-7-6(15)
MARLBORO	NW14-63-12-6 *	120	92	89	88	81	75	67	32	32	16	12	11	21	6	SL	SMd	A-2-4(0)
	SE13-67-14-6	50	94	94	92	90	87	83	61	55	26	20	18	41	24	L	CL	A-7-6(11)
	NE17-65-13-6 *	65	90	82	77	61	55	51	34	29	13	9	8	20	2	L	GMd	A-2-4(0)
	SW34-65-13-6	50	89	86	86	84	79	74	55	51	32	26	22	32	16	CL	CL	A-6(6)
	SW30-66-13-6	45	100	100	100	100	99	99	63	60	32	25	22	32	15	L	CL	A-6(8)
	NE25-65-14-6	60	100	100	100	99	96	94	75	72	34	28	25	28	13	L-CL	CL	A-6(9)
	NW36-64-14-6	60	100	100	98	98	88	75	53	46	24	18	14	31	14	L	CL	A-6(5)
MAYBERNE	NE4-62-2-6	120	91	88	86	82	82	80	58	58	37	29	24	36	15	CL	CL	A-6(7)
	SW22-61-2-6	130	88	83	82	80	79	78	63	61	40	33	28	41	16	C-CL	CL-ML	A-7-6(8)
	SE21-62-10-6	95	90	90	90	84	81	78	54	52	34	27	23	31	12	CL	CL	A-6(5)
	SW14-63-10-6	60	100	100	100	97	94	92	68	65	36	28	23	30	12	L-CL	CL	A-6(7)
	NW33-59-3-6	75	100	100	100	98	97	96	88	85	46	30	26	32	14	SiCL	CL	A-6(10)
	NW30-61-3-6	75	100	97	97	97	97	96	87	84	48	37	32	30	14	SiCL	CL	A-6(10)
	SE10-59-2-6	60	100	96	94	92	90	87	60	53	26	21	19	25	9	L	CL	A-4(5)
	NW30-60-1-6	75	93	93	93	91	90	89	68	61	38	32	31	28	8	CL	CL	A-4(7)
PUTZY	SW30-59-13-6	110	81	68	64	49	45	36	19	16	7	5	3	NL	NP	gv.SL	GP-Gw	A-1-a(0)
	NW19-59-13-6	100	97	86	78	58	56	54	36	35	14	9	6	18	2	gv.L	GP-GW	A-2-4(0)
	SW12-59-11-6	38	100	90	90	88	84	79	63	54	29	22	18	24	7	L	CL-ML	A-4(6)
	NW29-59-10-6	35	75	73	72	68	63	56	39	35	17	14	13	26	9	gv.L	GC	A-4(1)
	NW11-60-11-6	53	100	97	96	91	85	80	66	51	21	13	9	21	6	L	CL-ML	A-4(6)
	SW6-59-11-6	50	100	100	100	98	95	89	65	53	21	15	12	20	5	L	CL-ML	A-4(6)
	SW15-58-12-6	50	100	100	98	98	95	93	71	46	19	12	9	19	3	L-SL	CL-ML	A-4(7)
	SE25-58-13-6	58	86	76	74	59	56	54	39	33	10	7	6	19	14	L	GP	A-2-6(2)
	SW10-59-12-6	70	92	92	92	90	80	77	56	40	20	15	12	22	6	L	CL-ML	A-4(4)
	NW22-59-13-6	40	100	100	100	95	89	85	66	56	27	20	17	26	9	L	CL	A-4(6)
ROBB	SE7-60-13-6	90	100	98	96	94	93	91	59	42	19	13	9	23	3	SL-L	CL-ML	A-4(5)
	SE35-61-13-6	90	77	73	70	64	62	58	41	39	15	12	10	22	7	L	GMd	A-4(1)
	SE21-59-10-6	40	100	100	100	99	94	81	59	57	29	19	14	23	5	L	CL-ML	A-4(5)
	SE20-58-7-6	58	100	96	96	95	95	93	62	62	26	18	16	23	7	L	CL-ML	A-4(5)
	SW14-59-8-6	50	88	85	85	83	81	77	51	49	27	20	16	27	10	L	CL	A-4-6(3)
	NW30-61-10-6	50	86	86	86	86	85	84	69	64	41	32	27	39	20	CL	CL	A-6(11)
	NE17-58-11-6	60	100	100	100	98	91	87	66	55	24	16	11	29	11	L	CL	A-6(6)
	SE16-59-13-6	50	91	91	91	90	86	83	65	57	26	21	18	28	10	L	CL	A-4-6(6)
	NW23-59-14-6	40	92	92	92	92	91	90	80	64	26	17	12	28	9	SiL	CL	A-4(8)
SHEEP	NE25-60-12-6	50	100	100	100	100	99	97	92	87	62	48	40	35	16	SiC-C	CL	A-6(10)
	NW22-61-13-6	50	100	100	100	100	100	100	97	93	76	63	53	49	26	HC	CL-CH	A-7-6(16)
	NW33-60-12-6	40	82	80	80	78	75	74	61	55	29	24	21	28	13	CL	CL	A-6(6)
	NE30-59-11-6	40	90	90	90	89	85	82	70	62	32	27	25	32	15	CL	CL	A-6(9)
	NE1-59-13-6	35	100	100	100	100	100	100	96	85	52	35	27	40	20	SiCL	CL	A-7-6(12)
	SW23-59-11-6	35	100	100	100	99	96	93	73	63	36	31	27	26	11	CL	CL	A-6(8)
	NW10-59-11-6	38	94	94	93	92	89	85	67	62	35	26	24	23	5	CL	CL-ML	A-4(6)

*stony phase

TABLE 8 (continued)

CAW	NW18-60-13-6	20	65	61	59	59	57	55	47	38	22	16	13	33	12	L-CL	CL	A-6(3)
	SW31-60-13-6	20	100	100	99	93	87	73	54	46	25	17	12	29	7	L	ML	A-4(4)
	NW29-60-13-6	84	98	98	94	93	92	92	75	60	34	24	18	29	9	SiL	CL	A-4(8)
	NW8-58-13-6	65	100	100	100	100	100	100	93	75	21	13	11	28	6	SiL	CL-ML	A-4(8)
ERRINGTON	SW7-61-13-6	92	81	70	68	63	61	59	39	34	17	13	11	26	8	SiL	GM	A-4(1)
	SE11-61-14-6	56	88	87	86	70	60	50	28	28	15	12	10	22	5	L	GMd	A-2-4(0)
	NE20-60-13-6	65	100	100	100	100	100	99	91	91	56	33	20	41	15	SiCL	ML	A-7-6(10)
	SE30-60-13-6	80	97	92	87	83	78	74	45	39	18	14	12	23	5	L	SMd	A-4(2)
	NE9-61-13-6	65	91	89	89	86	81	75	59	49	24	17	13	23	5	L	CL-ML	A-4(5)
SMOKY	SW9-62-7-6	88	95	95	95	94	93	91	72	66	35	29	25	28	9	CL	CL	A-4(7)
	NE5-66-12-6	50	100	96	95	92	91	89	57	55	33	28	25	31	13	CL	CL	A-6(5)
	SW10-63-12-6	40	98	98	97	97	96	93	61	57	32	24	19	25	8	L	CL	A-4(5)
DONNELLY	SE16-67-5-6	85	100	100	100	100	100	100	97	95	92	78	65	60	32	HC	CH	A-7-6(20)
	SE16-67-5-6	95	100	100	100	100	99	97	80	75	57	45	36	39	20	C	CL	A-6(12)
NAMPA	SW23-68-9-6	60	100	100	100	100	100	99	95	95	83	69	58	53	21	HC	MH	A-7-5(15)
	NE32-67-4-6	75	100	100	100	100	100	100	99	99	75	54	40	40	13	SiC	ML	A-7-6(9)
SNIPE	NE11-68-7-6	75	100	100	100	100	99	98	94	94	84	71	59	55	23	HC	CH	A-7-5(16)
TRI-CREEK	NW2-61-10-6	70	100	100	100	100	100	100	99	96	78	53	47	43	20	SiC	CL	A-7-6(12)
	SW27-60-9-6	82	100	100	100	100	100	100	99	98	48	31	21	27	6	SiCL	ML	A-4(8)
	NE29-58-2-6	55	100	100	100	100	100	100	100	100	83	65	54	47	25	HC	CL-CH	A-7-6(15)
	NE18-59-1-6	60	100	100	100	100	100	99	97	96	73	52	43	40	18	SiC	CL	A-7-6(11)
	SW26-58-3-6	65	100	100	100	100	100	100	98	86	34	24	22	27	9	SiL	CL	A-4(8)
	NE11-61-9-6	60	100	100	100	100	99	99	96	92	72	58	49	44	22	C	CL	A-7-6(14)
	SW3-60-10-6	50	100	100	100	100	99	99	97	90	69	54	44	46	24	C	CL-CH	A-7-6(15)
IOSEGUN	SW31-67-4-6	75	100	100	100	100	100	100	38	38	19	16	11	NL	NP	SL	SMd	A-4(0)
	SE5-62-5-6	60	100	100	100	100	100	100	83	61	30	23	20	30	10	L	CL	A-4(8)
DAVIS	NE21-69-6-6	65	100	100	100	100	100	100	93	83	40	36	34	36	14	SiCL	CL	A-6(10)
	NW10-68-5-6	70	100	100	100	100	100	100	94	79	26	20	16	27	5	SiL	ML	A-4(8)
	SW29-62-3-6	75	100	100	100	100	100	100	97	91	14	12	11	NL	NP	Si-SiL	ML	A-4
JARVIS	NE31-58-7-6	75	72	65	62	50	47	36	17	17	8	6	5	30	5	gv.SL	GW	A-1-b(0)
WANHAM	NE20-65-2-6	70	100	100	100	100	100	99	92	87	42	35	30	36	15	SiCL	CL	A-6(10)
	SW23-68-9-6	40	100	100	100	100	100	100	94	78	36	28	24	27	5	SiL	ML	A-4(8)
	SE23-68-9-6	90	100	100	100	100	100	100	98	88	32	24	19	25	4	SiL	CL-ML	A-4(8)
JUDY	SE20-61-3-6	80	49	45	44	42	41	40	27	23	12	9	8	24	7	gv.L	GP-GW	A-2-4(0)
	SW15-61-2-6	120	76	68	66	45	36	24	10	9	5	4	3	NL	NP	gv.SL	GW	A-1-a(0)
	SE18-58-3-6	45	39	36	33	26	22	18	10	8	5	3	2	NL	NP	gv.SL	GP	A-1-a(0)
SIMONETTE	NW4-61-2-6	48	50	36	33	22	20	16	10	8	5	4	3	21	4	gv.SL	GP-GW	A-1-a(0)
COPTON	NW6-60-8-6	50	100	100	100	99	96	94	62	34	20	14	12	27	8	L	SP	A-4(1)
	NW23-59-9-6	60	100	100	100	100	100	100	71	64	33	22	18	28	8	L	CL	A-4(7)
TORRENS	NE4-62-12-6	50	100	100	100	100	100	100	97	84	52	37	28	37	13	SiCL	CL	A-6(9)
	SE8-59-4-6	70	100	100	100	100	100	100	87	82	49	38	29	36	12	SiCL	CL-ML	A-6(9)
	SW30-59-7-6	60	100	100	100	100	100	100	97	88	44	33	27	40	11	SiCL	ML	A-7-6(8)
	SW4-60-7-6	60	100	95	95	92	92	90	74	66	42	33	28	31	12	CL	CL	A-6(9)
	SE14-62-11-6	50	100	100	100	100	99	98	79	78	47	29	20	35	18	CL-SiL	CL	A-6(11)
	NE2-64-13-6	50	100	100	100	100	100	99	89	77	45	32	24	47	24	CL	CL-CH	A-7-6(15)

give an overall degree of limitation or suitability to each soil group. The three categories of limitations are as follows:

(1) S - *None to slight soil limitations:* Soils relatively free of limitations that affect the intended use, or the limitations are easily overcome.

(2) M - *Moderate soil limitations:* Soils having limitations that need to be recognized but can be overcome with proper planning, careful design, and good management.

(3) X - *Severe soil limitations:* Soils with limitations severe enough to make the proposed use questionable. It does not mean the soil cannot be used for a specific purpose but it does mean that very careful planning and design and very good management are needed. In many cases, it would not be economically feasible to correct the limitations.

Each soil group was rated according to its limitation to single family dwellings, on-site sewage disposal, underground pipe installation, and road location. The soils were also rated as good (G), fair (F), or poor (P) sources of sand and gravel and road subgrade material. The definitions of these ratings correspond to the three previously defined limitation categories and are essentially the same.

These evaluations of soil limitations are based on soil properties such as: texture, which affects the stability and bearing strength for roads and foundations; shrink-swell potential, risk of frost heave, and rate of infiltration and internal drainage-soil moisture conditions which affect the location of buildings, roads, and services; flooding hazard which affects the location of buildings, roads and services; and soluble salt content which affects concrete foundation construction and underground pipe installations. Several terms used to describe soils, such as texture, structure, and consistence, are used differently by pedologists and engineers. The pedological definitions are intended in this report and many are given in the glossary. The ratings are given in Table 9.

The soils were not evaluated for specific uses at the mapping unit level due to the relatively small scale of mapping and the complexity of soil groups within any specific area. Topography was not considered in the evaluation except for soils of the Deep Valley and Errington groups. However, Table 9 used in conjunction with the soils map, which defines slope and indicates the complexity of soil groups within an area, will serve as a general guideline to the suitability of the soil material in a specific area for a specific use. The point when slope becomes a limiting factor can be determined from the tables of guidelines for specific uses presented in Appendix C.

Single Family Dwellings (with and without basements)

These interpretations indicate limitations for construction and maintenance of houses and small buildings (United States Department of Agriculture, 1972). The guidelines used to evaluate the soils are given in Table 13 (Appendix C) and the evaluation of the soil groups for this use are in Table 9. Slope was not considered in the evaluation except for soils of the Deep Valley and Errington groups which are always found on steep slopes. Areas with slopes greater than 15 percent should be given a severe rating for this use.

Generally the relatively stone-free, well to rapidly drained, coarse and medium textured soils have slight limitations for single family dwellings with and without basements. The well to moderately well drained till and colluvial soils have a moderate or severe limitation due to their susceptibility to frost heave or excessive surface stoniness or both. The moderately well to imperfectly drained, fine textured glaciolacustrine soils have a severe limitation because of their high shrink-swell potential and their susceptibility to frost heave. The well drained coarse textured gravelly soils, although suitable as a construction material, have some limitations because of surface stoniness. Gleysolic and Organic soils have severe limitations for single family dwellings due to wetness. On-site investigations will be needed to collect the data for detailed design of foundations and for determining specific placement of buildings and utility lines.

On-Site Sewage Disposal

These interpretations relate to soil limitations that inhibit the ability of the soil to absorb and filter the effluent passed through a tile filter (United States Department of Agriculture, 1972). Filter fields are influenced by the ease of downward movement of effluent through the soil. The guidelines used to evaluate the soils are given in Table 14 (Appendix C) and the evaluation of the soil groups for on-site sewage disposal are in Table 9. Except for soils of the Errington and Deep Valley groups, which always lie on steep slopes, the degree of slope was not considered in the evaluation of the soil groups. Areas with slopes greater than 15 percent should be given a severe rating for this use. Soils with slopes of less than 9 percent are the best sites for sewage disposal systems in terms of construction and successful operation of an absorption field. Mechanical problems of layout and construction increase with steepness of slope. Lateral seepage or downslope flow is a problem on sloping soils, especially where bands of impermeable material lie within 120 cm of the surface.

TABLE 9
Rating of Soil Groups for Selected Uses

Soil Group	Soil Phase	Single Family Dwellings With Basements	Single Family Dwellings Without Basements	On-site Sewage Disposal	Corrosivity of Underground Pipelines	Road Location	Suitability as a Source of Road Subgrade Material	Suitability as a Source of Sand and Gravel
EDSON	EDS	M1	M1	M13	M13	X1	P	P
	EDS/t	X1,9	M1	M11	M13	X1,9	P	P
MARLBORO	MLB	M2	M2	S	S	M1	F	P
	MLB/t	M2,9	M2	M11	M13	M1,9	P	P
	MLB/s	X2	X2	S	S	S	G	F
	MLB/st	X2,9	X2	M11	M13	M9	F	P
MAYBERNE	MBN	S	S	S	M13	M1	F	P
	MBN/t	M9	S	M11	M13	M1,9	P	P
	MBN/s	X2	X2	S	S	S	G	F-P
	MBN/st	X2,9	X2	M11	M13	M9	F	P
PUTZY	PZY	X2,5	X2	M5	S	S	G-F	G-F
	PZY/g	X2,5,10	X2	X5,11	M10	M10	F	G-F
ROBB	RBB	X2,5	M2	M5	M13	M1	F	P
SHEEP	SHP	X2,9	M2	X12	X12	M-X1,9	F-P	P
CAW	CAW	X2,5	M2	M5	M13	M1	F	P
DEEP VALLEY	DPV	X7	X7	X7	M13	X7	P	P
ERRINGTON	ERR	X7	X7	X7	M13	X7	P	P
NICKERSON	NKN	X6,9	X6,9	X6,11	X6	X6,9	P	P
SMOKY	SKY	X6	X6	X6,11	X6	X6	P	P
DONNELLY	DON	X8	X8	X12	X12,15	X8	P	P
NAMPA	NMP	X8	X8	X12	X12,15	X8	P	P
SNIPE	SIP	X6	X6	X6,11	X6	X6	P	P
TRI-CREEK	TRC	X1,9	M1	M13	M13	X1,9	P	P
IOSEGUN	IOS	X4	X4	X4,11	X6	X4	G-F	G-P
BLACKMUD	BKM	S	S	S-M11	S	S	G	G
	BKM/s	S	S	S-M11	S	S	G	G
	BKM/g	M10	S	S-M11	M10	M10	F	G
DAVIS	DVS	S	S	S	S-M13	M1	F	P
	DVS/t	M9	S	X12	M13-X12	M-X1,9	F-P	P
	DVS/g	X9,10	M10	M11	X10,13	M1,10	F	P
GUNDERSON	GUN	X6	X6	X6,11	X6	X6	P	P
JARVIS	JRV	X2	X2	S-M11	S	S	G	G
WANHAM	WHM	X6	X6	X6,11	X6	X6	P	P
LODGE	LDG	M or X*	S	S,M or X*	M13	M1 or X8*	P-F*	P
	LDG/s	M or X*	S	S,M or X*	M13	M1 or X8*	P-F*	P
	LDG/g	X9,10	S	S,M or X*	X10,13	M1,10 or X8,10*	P-F*	P
JUDY	JUY	X2	X2	S-M11	S	S	G	G
SIMONETTE	STT	X6	X6	X6,11	X6	X6	P	P

TABLE 9 (continued)

Soil Group	Soil Phase	Single Family Dwellings: With Basements	Single Family Dwellings: Without Basements	On-site Sewage Disposal	Corrosivity of Underground Pipelines	Road Location	Suitability as a Source of: Road Subgrade Material	Suitability as a Source of: Sand and Gravel
HEART	HRT	S	S	S-M11	S	S	G	G
COPTON	COP1	S	S	S-M11	S	S-M1	G-F	F-P
	COP3	X5	X5	X5	S	X5	P	P
TORRENS	TOR	X1,9	M1	M13	M13	X1,9	P	P
EAGLESHAM	EGL	X3	X3	X6,11	X6	X3	P	P
KENZIE	KNZ	X3	X3	X6,11	X6	X3	P	P

NOTE: Slope is not considered in the above ratings of the soil groups for specific uses except for soils of the Deep Valley and Errington groups, which always lie on steep slopes. The point when the degree of slope becomes a limiting factor can be determined from the tables of guidelines for specific uses presented in Appendix C.

* Depends on characteristics of underlying material

/t = thin phase /s = stony phase /g = gleyed phase

Degree of Limitation

S - Slight
M - Moderate
X - Severe

Degree of Suitability

G - Good
F - Fair
P - Poor

Soil Properties Limiting Certain Uses

1. Moderate shrink-swell potential
2. Surface stoniness
3. Organic soil
4. Flooding hazard
5. Shallow depth to consolidated bedrock
6. Seasonally high groundwater table or surface ponding
7. excessive slope
8. High shrink-swell potential
9. Susceptibility to frost heave
10. Restricted drainage
11. Groundwater contamination hazard
12. Slow permeability
13. Moderate permeability
14. Rapid permeability
15. Possible steel corrosion hazard

Generally the well to rapidly drained, coarser textured soils which exhibit very rapid to moderate permeability have slight limitations for this use. However, although these soils have slight soil limitations a contamination hazard may exist if water supplies, streams, ponds, lakes, or water courses are nearby and receive seepage from the absorption field. All poorly and very poorly drained Gleysolic and Organic soils have severe limitations due to a seasonally high groundwater table and a groundwater contamination hazard. The thin tills have a moderate limitation due to an unconformable layer at shallow depths which may force the effluent to travel long distances, resulting in groundwater contamination. The moderately well to imperfectly drained, fine textured glaciolacustrine soils have a severe limitation due to slow permeability. Soils with consolidated bedrock at shallow depths have a moderate to severe limitation depending on the depth and characteristics of the consolidated bedrock. Soils of the Iosegun group, which may be periodically flooded, have a severe limitation because of possible stream and river contamination. Without protection, areas subject to flooding should not be considered for on-site sewage disposal systems.

Corrosivity of Underground Pipelines

These interpretations relate to soil properties and characteristics that lead to the corrosion of uncoated steel (United States Department of Agriculture, 1972). Before corrosion can take place, soil moisture is needed to form solutions of soluble salts. Any factors that influence the soil solution or the oxidation-reduction reactions taking place in the soil also influence the operation of corrosion. Some of these factors are: the soil moisture content, the conductivity of the soil solution, the hydrogen ion activity of the soil solution (pH), the oxygen concentration (aeration), and the activity of organisms capable of causing oxidation-reduction reaction. The guidelines used to evaluate the soils for this use are in Table 15 (Appendix C). The evaluations of the soil groups in the Wapiti area are given in Table 9.

It is important to note that these interpretations relate only to corrosivity potential for uncoated steel installations. Application of these interpretations to other materials such as coated steel, cast iron, or aluminum could be misleading since the degree of limitation (Appendix C) may not be applicable for other materials. Also not considered in these interpretations is the effect to which certain terrain characteristics, such as slope, have on the installation of the pipe (construction costs).

Generally rapidly and well drained, deep, coarse textured soils such as soils of the Copton, Heart, Judy, Jarvis, Blackmud, Putzy, Mayberne stony, and Marlboro groups have slight limitations for underground pipe installations.

The medium to moderately fine textured soils that are well to moderately well drained have a moderate limitation due to moderate permeability. This includes some of the finer textured till and colluvial deposits and those soils which have unconformable layers at shallow depths producing differential permeability. Moderately well to imperfectly drained, fine textured soils, such as soils of the Donnelly, Nampa, and Sheep groups, have severe limitation due to slow permeability. Also, analyses indicate that some Donnelly and Nampa soils may have a salinity limitation in addition to a slow permeability limitation.

Poorly drained Gleysolic and Organic soils with fluctuating water tables have a severe limitation due to wetness.

Road Location

Interpretations for this use are based on features that affect the performance of soils for the location of roads (United States Department of Agriculture, 1972). Roads usually are constructed and maintained from local soil material, whether cut or fill, and are also graded to shed water. Conventional drainage measures are utilized. The guidelines used to evaluate the soils for road location are given in Table 16 (Appendix C) and the evaluation of the soil groups for this use are shown in Table 9. Slope was not considered in the evaluation except for soils of the Deep Valley and Errington groups which have a severe rating due to excessive slope; however, all areas with slopes greater than 15 percent should be given a severe rating for this use regardless of soil type.

Generally the rapidly and well drained coarse textured soils have no limitations for this use. This includes some of the soils of the Copton, Heart, Judy, Jarvis, Blackmud, Putzy, Mayberne stony, and Marlboro stony groups. Most of the well and moderately well drained till and colluvial soils have a moderate limitation for road location due to a moderate shrink-swell potential. Davis soils also fall into this category. Those till and colluvial soils which have an unconformity at shallow depths are susceptible to frost heave. All poorly drained Gleysolic and Organic soils have a severe limitation due to wetness. Fine textured soils of the Donnelly, Nampa, Tri-Creek, and Torrens groups have a severe limitation for this use, due mainly to a high shrink-swell potential and susceptibility to frost heave. Some of the soils of the Sheep group also fall into this category.

Source of Road Subgrade Material

Interpretations for this use pertain to the suitability of soils as a source of road fill or construction material (United States Department of Agriculture, 1972). The ratings good, fair, and poor reflect the soil's performance after it is removed from its original location and is used as road subgrade material elsewhere. The ratings also reflect the evaluation of soil characteristics, such as slope and drainage, that determine the ease or difficulty of excavating the soil. The guidelines for evaluating the soil groups are given in Table 17 (Appendix C), and the actual evaluations are presented in Table 9. Slope was not considered, except in the case of Deep Valley and Errington soils which have a poor rating due to excessive slope; however, all areas with slopes greater than 30 percent, regardless of soil type, would have a poor suitability rating for road subgrade material.

Only the coarser textured, rapidly to moderately well drained soils are good sources of road subgrade material. Soils of the Marlboro, Mayberne, Robb, Caw, and Davis groups generally are rated as fair sources of material for this use. All finer textured soils, all soils with unconformities at shallow depth, and all poorly drained Gleysolic and Organic soils are rated as poor sources of road subgrade material.

Source of Sand and Gravel

These interpretations relate only to the suitability of the soils as a source of sand and gravel. No attempt was made to rate the quality of sand and gravel for specific uses such as road base and concrete aggregate. Quality determinations should be made at the site of the source (United States Department of Agriculture, 1972). The guidelines for evaluating the suitability of the soils as a source of sand and gravel are given in Table 18 (Appendix C), and the evaluations are presented in Table 9.

Only Jarvis, Judy, Putzy, Iosegun, Blackmud, and Heart soils are considered to be good sources of sand or gravel or both. Blackmud and Heart soils are good sources of sand while Jarvis and Judy soils are good gravel sources. Soils of the Putzy group are highly variable in stone content and may or may not be a good source of gravel in specific areas. Conglomerate bedrock may be present at shallow depth in areas of Putzy soils which leads to excavation difficulties. Soils of the Iosegun group are also variable in texture and may not be good sources of sand and gravel. Commonly, these soils are stony and gravelly at depth, but the coarse fragments are usually sandstone and siltstone bedrock fragments which could easily break down to silt and sand sized particles when used as road building material.

TABLE 10
Rating of Soil Groups and Phases for Water Erosion Hazard

Soil Group	Soil Unit and Phase	Enclosed Depressional	Slope (%)				
			<5	5-9	9-15	15-30	30-60+
EDSON	EDS	NA	S	S	M	M-X	X
	EDS/t	NA	S	S	M	X	X
MARLBORO	MLB	NA	S	S	S	M	X
	MLB/t	NA	S	S	S-M	M-X	X
	MLB/s	NA	S	S	S	S-M	M
	MLB/st	NA	S	S	S-M	M	X
MAYBERNE	MBN	NA	S	S	M	M	X
	MBN/t	NA	S	S	M	X	X
	MBN/s	NA	S	S	S	M	X
	MBN/st	NA	S	S	S-M	X	X
PUTZY	PZY	NA	S	S	S	S	M
	PZY/g	NA	S	S	S	S	M
ROBB	RBB	NA	S	S	S	M	M-X
SHEEP	SHP	NA	S	S	M	M-X	X
CAW	CAW	NA	S	S	S	S	M
DEEPVALLEY	DPV	NA	NA	NA	X	X	X
ERRINGTON	ERR	NA	NA	NA	NA	M	M-X
NICKERSON	NKN	NA	M	M	X	X	X
SMOKY	SKY	S	M	X	X	X	NA
DONNELLY	DON	NA	M-X*	X	X	NA	NA
NAMPA	NMP	NA	M-X*	X	X	NA	NA
SNIPE	SIP	S	M	NA	NA	NA	NA
TRI-CREEK	TRC	NA	M-X*	X	X	NA	NA
IOSEGUN	IOS	NA	M	X	NA	NA	NA
BLACKMUD	BKM	NA	S	M	X	NA	NA
	BKM/s	NA	S	M	X	NA	NA
	BKM/g	NA	S	M	X	NA	NA
DAVIS	DVS	NA	M-X	X	X	NA	NA
	DVS/t	NA	M-X	X	X	NA	NA
	DVS/g	NA	M-X	X	X	NA	NA
GUNDERSON	GUN	S	X	X	NA	NA	NA
JARVIS	JRV	NA	S	S	S	NA	NA
WANHAM	WHM	S	X	X	NA	NA	NA
LODGE	LDG	NA	S-M*	M	X	NA	NA
	LDG/s	NA	S-M*	M	X	NA	NA
	LDG/g	NA	S-M*	M	X	NA	NA

TABLE 10 (continued)

JUDY	JUY	NA	S	S	S	NA	NA
SIMONETTE	STT	S	S	M	NA	NA	NA
HEART	HRT	NA	S	S	M	NA	NA
COPTON	COP 1	NA	S	M	X	X	X
	COP 3	NA	M	X	X	X	X
TORRENS	TOR	NA	M	M-X*	M-X*	X	X
EAGLESHAM	EGL	S	S	M	X	NA	NA
KENZIE	KNZ	S	S	M	X	NA	NA
MISCELLANEOUS LAND TYPES							
ROUGH BROKEN		NA	NA	NA	X	X	X
ROCK		NA	S	S	S	S	S

Degree of Hazard: S - Slight or None, M - Moderate, X - Severe, NA - Not Applicable
*Depending on nature of slope. Given a more severe rating on long slope.

Some of the Marlboro stony and Mayberne stony soil areas are fair sources of gravel; however, the thickness of the stony material may be less than 150 cm. Areas where soils of the Copton 1 (COP 1) soil unit predominate may be fair sources of sand to depths not exceeding 150 cm. Below this depth consolidated sandstone is often encountered. All other soils in the Wapiti area are rated as poor sources of sand and gravel.

SOIL EROSION HAZARD INTERPRETATIONS

Soil erosion hazard is the expected rapidity and amount of soil loss due to wind or water or both that may be expected following removal of the protective vegetative cover in areas where the proper erosion control measures are not implemented (Dumanski *et al.*, 1972). In the Wapiti area, wind erosion was not considered. The rate of water erosion depends on several factors: the amount, intensity, and seasonal distribution of rainfall; the steepness, and length of the slope; the absence or presence of channels of concentration; the type of vegetative cover; and the nature of the soil. Infiltration capacity and structural stability are the two most significant soil characteristics influencing erosion (Buckman and Brady, 1960). In the Wapiti area, the major erosion agent is spring snowmelt. The rainfalls from summer storms are not usually intense or long-lasting to create runoff problems.

All soils in the Wapiti area are somewhat erodible, but some are more susceptible than others. Accordingly the susceptibility of the soils to erosion has been rated as slight, moderate, or severe. This is a comparative rating that applies only to the soils in the Wapiti map area and is highly subjective, being based mainly on field observations. Since an innumerable number of map combinations on differing topography classes are found in the map area, no attempt was made to evaluate each individual mapping area. Only soil groups and soil phases on the various topography classes found in the area were evaluated. The ratings given to a particular soil group or phase could be misleading if applied to specific areas on the soils map. The erosion rating of an area might also be altered if the soils are combinations of units, as map combinations were not evaluated. The water erosion hazard ratings for the various soil groups and soil phases on differing topography classes are given in Table 10.

Soils on morainal deposits generally are only slightly susceptible to water erosion on slopes of less than 9 percent. Edson soils, because of their moderately fine to fine texture and low concentration of coarse fragments, were given a moderate erosion hazard rating on slopes of 9 to 15 percent and a moderate to severe rating on slopes greater than 15 percent. Thin Edson soils because of a textural unconformity at shallow depths, were given a severe rating on slopes greater than 15 percent. Mayberne soils were rated similarly to Edson till except the Mayberne stony phase is not erodible on slopes up to 15 percent. Medium textured and very stony Marlboro soils are not as erodible as Mayberne and Edson soils on comparable slopes. The stony phase of the Marlboro soil group was given a moderate erosion hazard rating on slopes of 30 to 60 percent. Putzy and Robb tills generally contain high concentrations of coarse fragments and are moderately coarse to medium textured. Tills with such characteristics have a high infiltration rate and a protective covering of coarse fragments, so Robb till was given a moderate erosion hazard rating on slopes of 15 to 30 percent, and Putzy till was given a moderate erosion hazard rating on slopes of 30 to 60 percent. Sheep till, because of a textural unconformity at shallow depths, was rated similarly to Edson till even though the surface material is generally stony. The erosion susceptibility rating of the tills (from least erodible to most erodible) on a comparable slope is as follows: Putzy, Robb, Marlboro, Mayberne, Edson, and Sheep.

Colluvial materials of the Caw soil group are not susceptible to water erosion on slopes up to 30 percent due to the protective covering of angular bedrock fragments on the surface. However, if this protective covering is disturbed, water and wind erosion may be severe. Nickerson soils, due to seepage, were rated as having a moderate erosion hazard on slopes less than 5 percent. Colluvial materials of the Errington soil group are moderately erodible on slopes of 15 to 30 percent and moderately to severely erodible on slopes of 30 to 60 percent. Some protection is furnished by a relatively high concentration of coarse angular bedrock fragments in the material.

Depending on the nature of the slope, fine textured glaciolacustrine materials may be severely erodible on slopes of less than 5 percent (Plate 31). Severe sheet and gully erosion have been observed on long gentle slopes that have gradients as low as 2 percent. The fine texture and stratified nature of these soils makes them some of the most erodible in the area.

Glaciofluvial sands and silts are also highly erodible. These materials were rated as being severely erodible on slopes of less than 9 percent due to their stratified nature, lack of coarse fragments, and lack of cohesive particles. The silts are considered to be more highly erodible than the sands. Gleysolic soils developed on glaciofluvial sands and silts are highly erodible on low gradient slopes. In enclosed depressional areas these soils probably receive additions of material from the surrounding landscape.

Areas of outwash gravels of the Jarvis group and of preglacial gravels of the Judy group are not erodible due to a high concentration of coarse fragments and high infiltration rates. However, areas of Judy soils may be susceptible to erosion on low gradient slopes if bedrock is encountered at shallow depths (Plate 32).

Because of the landform associated with eolian deposits, Heart soils are considered to be moderately erodible on slopes exceeding 9 percent. Eolian deposits may be subject to severe wind erosion if the protective vegetation is removed.

Unconsolidated bedrock materials were rated as being severely erodible on slopes greater than 9 percent. Soils of the COP 1 soil unit are moderately erodible on slopes of 5 to 9 percent and essentially non-erodible on slopes less than 5 percent. Lithic soils within this soil group are considered to be more highly erodible because of the unconformity at shallow depths. Due to the stratified nature and the lack of coarse fragments, moderately fine

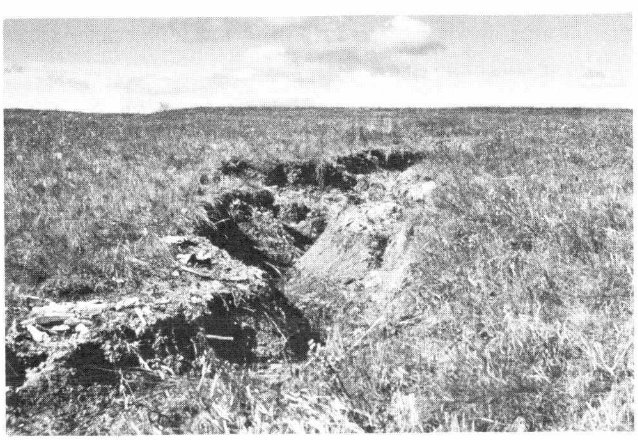


Plate 31. Severe gully erosion in a cultivated field of Donnelly soils.

Plate 32. Severe gully erosion on a cutline in which thin preglacial gravels overlie weathered sandstone bedrock.

to fine textured unconsolidated bedrock materials were rated as being moderately erodible on slopes of less than 5 percent. A more severe rating is given to these soils on long, gentle slopes.

Organic deposits are not susceptible to water erosion on slopes of less than 5 percent. In most cases these materials are subject to additions rather than losses. Severe gully erosion may occur in areas where the slope exceeds 9 percent.

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APPENDIX A

CHEMICAL AND PHYSICAL ANALYSES, MORPHOLOGICAL AND ANALYTICAL DATA FOR REPRESENTATIVE SOIL PROFILES

All particles less than 2 mm in size were analyzed. The analytical methods used in the various determinations were:

1. **Reaction (pH)** - Soil paste method of Doughty; a Coleman glass electrode was used [Doughty, J.L. (1941): Advantages of a soil paste for routine pH determination; Scientific Agriculture, Vol. 22, p. 135-138].

2. **Nitrogen** - Macro Kjeldahl method of Jackson; the catalyst used is a commercially available Kel-pak which contains HgO, $CuSO_4$, and K_2SO_4 [Jackson, M.L. (1958): Soil chemical analysis; Prentice-Hall, Inc., Englewood Cliffs, N.J.; 498 pages].

3. **Organic Carbon** - Determined by difference between total carbon and inorganic carbon; total carbon by dry combustion (induction furnace) as per instruction manual for operation of Leco Carbon Analyzer #577-100.

4. **Exchange Capacity** - Ammonium acetate method by displacement of ammonium chloride [American Society of Agronomy (1965): Methods of soil analysis; Agronomy No. 9, part 2, p. 890-901].

5. **Exchangeable cations** - Calcium, magnesium, sodium and potassium were determined by atomic absorption spectrophotometry [Association of Official Agricultural Chemists (1955): Official Methods of Analysis; 8th Edition, Washington D.C.].

6. **Calcium Carbonate Equivalent** - Manometer method of Bascomb; a Smolik calcimeter was used [Bascomb, C.L. (1961): Calcimeter for routine use on soil samples; Chemistry and Industry, Vol. II, p. 1826-1827].

7. **Particle size analysis** - Pipette method of Kilmer and Alexander as modified by Toogood and Peters [Toogood, J.A. and Peters, T.W. (1953): Comparison of methods of mechanical analysis of soils; Canadian Journal of Agricultural Science, Vol. 33, p. 159-171].

8. **Pyrophosphate-Extractable Iron and Aluminum (Fe+Al)** - Extracted using an 0.1 M pyrophosphate extraction as outlined by McKeague; iron and aluminum were determined by atomic absorption spectrophotometry [McKeague, J.A. (1967): An evaluation of 0.1 M pyrophosphate and pyrophosphate-dithionite in comparison with oxalate as extractants of the accumulation products in podzols and some other soils; Canadian Journal of Soil Science, Vol. 47, p. 95-99].

9. **Rubbed and Unrubbed Fiber Content** - Determined by syringe method of W.S. Lynn (SCS, Lincoln, Nebraska) as outlined in *The System of Soil Classification in Canada* [Canada Department of Agriculture (1974): The System of Soil Classification in Canada; Canada Department of Agriculture Publication 1455 (1974-revised), p. 148-151].

10. **Pyrophosphate color** - The Munsell color notation derived from the pyrophosphate solubility test.

11. **Electrical Conductivity** - Determined according to the procedure outlined in United States Department of Agriculture Handbook 60; the saturation extract was obtained by suction and the conductivity measured with a direct-reading Solu-Bridge [United States Department of Agriculture (1954): Diagnosis and improvement of saline and alkali soils; United States Department of Agriculture, Agricultural Handbook 60].

SOIL REACTION (pH)

Soil reaction is expressed in terms of the pH scale. Soils with pH 7 are neutral. Values below 7 indicate a degree of acidity while those above 7 indicate a degree of alkalinity. Most soils within the map area are very strongly acid to slightly acid.

Usually the highest acidity is found in the Ae horizon or upper portion of the Bt horizon of Gray Luvisols. Some of the Podzol soils of the Putzy soil group are extremely acid in reaction. Gleysolic soils are generally not as acidic as other soils because of bases contained in the groundwater. Regosolic soils of the Caw and Nickerson soil groups are primarily neutral to mildly alkaline, probably because of the turbation that is common in areas of these soils. The C horizons of most soils in the Interior Plains are neutral to moderately alkaline in reaction while many of those in the Western Cordillera are strongly acidic.

TOTAL NITROGEN

Nitrogen is an important plant nutrient. In soils the main source of nitrogen is the well-decomposed organic matter in the Ah horizon; L-H and L-F horizons contain nitrogen also, but the nitrogen must humify and mineralize to become available for plants. Consequently, soils that have the darkest, thickest Ah horizons are generally the most fertile. In the Wapiti area, most of the soils lack an Ah horizon or have thin versions only, so the amount of nitrogen in the soils is relatively low. Some Nickerson and Caw soils contain appreciable amounts of nitrogen to some depth because of an organic-mineral admixture, but this is usually not available for plant growth.

ORGANIC CARBON

Determining the amount of organic carbon in a soil is considered to be the best method of estimating the amount of organic matter in that soil. Organic matter is assumed to contain 58 percent carbon, so the amount of organic matter present can be estimated by multiplying the organic carbon value by 1.724. An organic horizon is defined as having greater than 17 percent organic carbon; the ratio of carbon to nitrogen indicates the amount of easily decomposed organic matter in such a horizon. A high carbon-nitrogen ratio indicates that the organic matter is relatively undecomposed, so nitrogen and other vital nutrients are not available for plant growth. Ideally in a soil the ratio is less than 15 for a horizon and less than 17 for mixed surface horizons to a depth of 15 cm.

In the Wapiti area, most soils have low organic matter contents except in surface organic horizons, and most of these horizons have high carbon-nitrogen ratios. Some horizons in Caw and Nickerson soils have abnormally high organic matter contents and carbon-nitrogen ratios which may be due to the presence of significant quantities of coal in these soils.

EXCHANGEABLE CATIONS AND CATION EXCHANGE CAPACITY

Cation exchange capacity in soil varies with the clay and organic matter content. The higher the exchange capacity, the greater the ability of the soil to retain certain plant nutrients against the action of leaching. A high base saturation usually implies that adequate amounts of calcium, magnesium, and potassium are available for plant growth. Even though acidic reactions are common in the soils of the map area, the base saturation is quite high, suggesting that liming may not be necessary for satisfactory plant growth. In some of the strongly to extremely acid soils aluminum may dominate the exchange sites and block them from further cation exchange reactions (Dumanski *et al.*, 1972). Results using buffered ammonium acetate indicate that cation exchange sites are mainly occupied by calcium and magnesium. Sodium and potassium are found only in very low concentrations.

A criterion used to help classify Solonetzic soils is the ratio of exchangeable calcium to exchangeable sodium. A ratio of less than 10 is considered as diagnostic for this Order of soils. Some of the Donnelly soils lying in the northwestern portion of the map area were classified morphologically as Gray Solods at the time of mapping. However, these soils were found to contain low concentrations of exchangeable sodium and therefore, were reclassified into the Luvisolic Order as Solonetzic Gray Luvisols. It is interesting that magnesium rather than calcium is the dominant exchangeable cation in these same profiles.

CALCIUM CARBONATE EQUIVALENT

The calcium carbonate equivalent is an indication of the amount of calcium and magnesium carbonates present in a soil. In the Wapiti area the lime content and depth to lime are highly variable throughout, reflecting the lithologies of the parent materials. In general the C horizons of the soils in the Western Cordillera lack calcium and magnesium carbonates. Parent materials of the soils in the Interior Plains are generally weakly to moderately calcareous with the exception of those of the Judy and Simonette soil groups. Some of the soils of the Nampa, Donnelly, and Davis groups are developed on strongly calcareous materials.

PARTICLE SIZE ANALYSIS

An analysis of particle size distribution was carried out only on particles less than 2 mm in size and therefore, stony and gravelly soils are not identified as such by the analysis. The sieve analysis data that are found in the engineering interpretations section of this report provide a guide to the size and amount of coarse fragments within the soils.

Particle size distribution varies according to the nature of the parent material. Soils developed on till are usually moderately fine to moderately coarse textured. Glacio-lacustrine soils contain considerable amounts of silts and clays while fluvial and eolian soils are sandy. Soils developed on colluvium reflect the lithology of the surrounding landscape but are generally medium textured. Sheep soils are moderately fine to fine textured in the subsoil but may be stony and medium textured in the surface horizons. Soils of the Putzy, Jarvis, and Judy groups are generally gravelly sandy loam to gravelly loam in texture. The clay soils, that is those with 40 percent or more of clay-size particles, have high moisture-holding capacity and high cation exchange capacity, but often low permeability. The sandy soils, on the other hand, usually have low moisture-holding and cation exchange capacities, but high permeability.

PYROPHOSPHATE-EXTRACTABLE IRON AND ALUMINUM

This analysis is carried out on Bm and Bf horizons to determine the classification of some of the soils of the area. Soils which have a Podzolic B horizon (Bf) must contain 0.6 percent or more pyrophosphate-extractable Fe + Al in textures finer than sand. The Fe + Al to clay ratio must also be greater than 0.05. Those horizons which contain less than 0.6 percent pyrophosphate-extractable Fe + Al or have an Fe + Al to clay ratio of less than 0.05 are designated as Bm or Bfj horizons.

Some of the soils in the area contain Podzolic B horizons. Podzolic soils are found only sporadically but appear to be more common in some of the coarser textured soils of the Putzy, Errington, Robb, Copton, Jarvis, and Judy groups. Podzolic B horizons are also common in the Heart soil group as well as in some of the coarser textured Mayberne and Marlboro soils.

FIBER AND ASH CONTENT

Fiber and ash content are determined on Organic soils to determine the state of decomposition and to aid in classification. Ash content is expressed as percentage on an air-dry basis after ignition in a muffle furnace at 500°C.

ELECTRICAL CONDUCTIVITY AND SOLUBLE CATIONS

These analyses were carried out on the C horizons of some Nampa, Donnelly, and Snipe soils to determine the salinity levels in these soils. Electrical conductivity is a measure of the degree of salinity. Soils with electrical conductivity values of less than 4 mmhos/cm are considered to be nonsaline.

All soils of the map area are nonsaline with the exception of some Donnelly and Snipe soils located in the northwestern portion of the map area (at 12-69-12-W6th and 7-69-11-W6th). These soils are weakly saline and contain appreciable amounts of soluble magnesium, calcium, and sodium salts. Magnesium salts are dominant.

DETAILED DESCRIPTIONS AND ANALYSES OF THE SOILS

Eighty-nine soil profiles were described in detail and sampled for laboratory analyses. Representative descriptions and accompanying analyses for the major soils of the area are presented in this section of the report. Data from engineering tests are available for many soils; this information is included in the engineering section. The analytical data and descriptions should be most useful to those engaged in site-specific work; however, further on-site investigations will still be required.

Color notations refer to the Munsell Color Chart. Definitions of explanations of many of the terms are given in Appendix D.

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE EDSON 4 SOIL UNIT

Soil Unit: EDS 4
Location: SE 17-65-7-W6th
Topography: moderately rolling
Elevation: 1,010 m (3,300 feet)
Vegetation: lodgepole pine, white spruce, aspen poplar, alder, willow, raspberry, Labrador tea, bog cranberry, blueberry
Drainage: moderately well drained
Parent Material: Continental till
Classification: Orthic Gray Luvisol

L - F 8 to 0 cm; relatively undecomposed conifer needles and moss; abundant, fine and medium roots; clear, smooth boundary.

Ae_1 0 to 8 cm; pinkish gray (7.5YR 6/2 m) silt loam; moderate, fine to medium platy; very friable; plentiful, fine roots; slightly stoney; clear, irregular boundary.

Ae_2 8 to 13 cm; light yellowish brown (10 YR 6/4 m) silt loam to loam; weak, fine platy; friable; plentiful, fine roots; slightly stony; gradual, wavy boundary.

AB 13 to 23 cm; brownish yellow (10YR 6/6 m) loam to clay loam; moderate, coarse subangular blocky; friable; plentiful, fine roots; moderately stony; gradual, smooth boundary.

Bt_1 23 to 35 cm; yellowish brown (10 YR 5/4 m) clay loam to clay; moderate to strong, medium subangular blocky; firm; few, fine roots; moderately stony; gradual, smooth boundary.

Bt_2 35 to 58 cm; olive brown (2.5Y 4/4 m) clay loam; moderate, medium subangular blocky; firm; very few, fine roots; moderately to very stony; diffuse, smooth boundary.

Ck 58+ cm; olive brown (2.5Y 4/4 m) clay loam; pseudo, weak, moderate subangular blocky; firm; no roots; moderately to very stony.

Analyses of an Edson Soil Profile (EDS 4)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ae_1	0-8	26	65	9	0	4.5	0.04	0.46	12	-	-	0.15	0.09	0.6	0.2	7.2
Ae_2	8-13	25	51	24	7	5.1	0.06	0.60	10	-	-	0.02	0.14	3.3	1.1	14.3
AB	13-23	26	46	28	9	5.4	0.06	0.40	7	-	-	0.11	0.15	4.5	1.5	16.2
Bt_1	23-35	21	39	40	16	5.4	0.06	0.97	16	-	-	0.05	0.21	7.7	2.8	23.1
Bt_2	35-58	23	41	36	18	6.5	0.06	1.34	22	-	-	0.09	0.19	15.9	4.2	22.3
Ck	58+	26	44	30	10	7.7	-	-	-	9.2	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE MARLBORO 8 SOIL UNIT

Soil Unit: MLB 8
Location: NW30-65-12-W6th
Topography: gently rolling
Elevation: 1,100 m (3,600 feet)
Vegetation: lodgepole pine, white spruce, black spruce, aspen poplar, alder, raspberry, Labrador tea, bog cranberry, blueberry, bunchberry, lichen, moss
Drainage: well to moderately well drained
Parent Material: Cordilleran till
Classification: Brunisolic Gray Luvisol

L - F 10 to 0 cm; relatively undecomposed moss, pine needles and roots; abundant, fine and medium roots; clear, wavy boundary.

Ae 0 to 8 cm; light brownish gray (10YR 6/2 m) silt loam; moderate, fine to medium platy; very friable; plentiful, fine and medium roots; moderately stony; clear, smooth boundary.

Bf_j 8 to 20 cm; yellowish brown (10YR 5/8 m) loam; weak to moderate, fine subangular blocky; very friable; plentiful, fine roots; very stony; clear, irregular boundary.

Bt 20 to 33 cm; light olive brown (2.5Y 5/4 m) clay loam; moderate, fine subangular blocky; friable; plentiful, fine roots; very stony; abrupt, smooth boundary.

Ck 33 to 60 cm; dark grayish brown (2.5Y 4/2 m) loam; weak, fine subangular blocky to single grain; very friable; few, fine roots; very stony.

Analyses of a Marlboro Soil Profile (MLB 8)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	10-0	-	-	-	-	4.2	-	-	-	-	-	0.49	0.55	4.4	1.8	46.9
Ae	0-8	35	59	6	2	4.5	0.04	0.63	16	-	0.10	0.02	0.06	0.2	0.1	5.2
Bfj	8-20	34	45	21	10	5.2	0.05	0.77	15	-	0.47	0.05	0.14	1.7	0.9	12.0
Bt	20-33	32	37	31	18	5.9	0.06	1.03	17	-	0.38	0.03	0.15	5.8	3.0	16.7
Ck	33-60	46	40	14	6	8.0	-	-	-	16.2	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE MAYBERNE 6 SOIL UNIT

Soil Unit: MBN 6
Location: 13-58-5-W6th
Topography: gently rolling
Elevation: 1,570 m (5,150 feet)
Vegetation: lodgepole pine, alpine fir, some white spruce regeneration, honeysuckle, Labrador tea, highbush cranberry, bunchberry, bog cranberry, moss
Drainage: moderately well drained
Parent Material: Continental till
Classification: Brunisolic Gray Luvisol

L - H 3 to 0 cm; semidecomposed moss and pine needles; abundant, fine and medium roots; abrupt, smooth boundary.

Ae_1 0 to 8 cm; light brownish gray (10YR 6/2 m) silt loam; strong, medium platy; very friable; plentiful, fine roots; exceedingly stony; clear, wavy boundary.

Bf_j 8 to 15 cm; strong brown (7.5YR 5/8 m) loam to clay loam; weak, fine subangular blocky; friable; plentiful, fine and medium roots; exceedingly stony; diffuse, irregular boundary.

Ae_2 15 to 23 cm; brownish yellow (10YR 6/6 m) loam; weak, medium platy; friable; plentiful, fine and medium roots; exceedingly stony; diffuse, irregular boundary.

Bt 23 to 70 cm; yellowish brown (10YR 5/4 m) clay loam; moderate, medium subangular blocky; friable to firm; very few, fine roots; exceedingly stony; clear, wavy boundary.

Ck 70+ cm; brown to yellowish brown (10YR 5/3 - 5/4 m) clay loam; pseudo, weak, fine subangular blocky; friable; no roots; exceedingly stony.

Analyses of a Mayberne Soil Profile (MBN 6)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	3-0	-	-	-	-	4.0	0.35	20.89	60	-	-	0.01	0.45	3.5	0.9	48.8
Ae_1	0-8	36	54	10	2	4.3	0.05	1.00	20	-	-	0.03	0.06	0.3	0.1	8.8
Bfj	8-15	30	43	27	17	4.8	0.07	0.96	14	-	1.28	0.02	0.18	1.3	0.4	21.3
Ae_2	15-23	30	47	23	18	5.0	0.05	0.48	10	-	-	0.05	0.07	2.0	0.7	19.6
Bt	23-70	24	44	32	16	4.8	0.05	0.47	9	-	-	0.05	0.09	5.8	1.4	19.0
Ck	70+	22	44	34	16	7.1	0.05	-	-	1.9	-	0.03	0.10	24.7	2.2	19.5

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE MAYBERNE 4 SOIL UNIT

Soil Unit: MBN 4
Location: NE 4-62-2-W6th
Topography: strongly rolling
Elevation: 1,170 m (3,850 feet)
Vegetation: lodgepole pine, white spruce, aspen poplar, rose, fireweed, bog cranberry, kinnikinnick, bunchberry, vetch, lichen, moss, grass
Drainage: moderately well drained
Parent Material: Continental till
Classification: Orthic Gray Luvisol

L - H 6 to 0 cm; semidecomposed plant remains; plentiful, fine and medium roots; abrupt, wavy boundary.

Ae_1 0 to 8 cm; pale brown (10YR 6/3 m) silt loam; moderate, medium platy; very friable; plentiful, fine and medium roots; very stony; gradual, irregular boundary.

Ae_2 8 to 21 cm; yellowish brown (10YR 5/4 m) clay loam; weak, medium platy breaking to weak, medium subangular blocky; very friable; plentiful fine and medium roots; very stony; clear, smooth boundary.

AB 21 to 29 cm; yellowish brown (10YR 5/4 m) silty clay loam to clay loam; weak to moderate, fine subangular blocky; friable; few, fine roots; very stony; diffuse, smooth boundary.

Bt_1 29 to 51 cm; yellowish brown (10YR 5/4 m) clay loam; moderate, fine subangular blocky; firm; few, fine roots; very stony; clear, wavy boundary.

Bt_2 51 to 87 cm; yellowish brown (10YR 5/4 m) clay loam; moderate, medium subangular blocky; firm to very firm; few, fine roots; very to exceedingly stony; gradual, wavy boundary.

BC 87 to 108 cm; dark grayish brown (10YR 4/2 m) clay loam; massive; very firm; very few, fine roots; very to exceedingly stony; diffuse, wavy boundary.

Ck 108 to 125 cm; dark grayish brown (10YR 4/2 m) clay loam; massive; very firm; no roots; very stony.

Analyses of a Mayberne Soil Profile (MBN 4)

Horizon	Depth (cm)	Particle Size Analysis				pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g)				Cation Exchange Capacity (me/100g)
		Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)							Na	K	Ca	Mg	
L-H	6-0	-	-	-	-	5.7	1.29	45.04	35	-	-	0.02	2.98	45.8	4.1	68.4
Ae_1	0-8	33	59	8	1	5.2	0.06	0.60	10	-	-	0.00	0.25	3.1	0.7	6.0
Ae_2	8-21	24	45	31	11	4.9	0.08	0.92	12	-	-	0.01	0.57	7.7	1.9	16.3
AB	21-29	20	41	39	19	4.8	0.08	0.76	10	-	-	0.02	0.53	10.6	2.7	20.1
Bt_1	29-51	24	41	35	17	4.8	0.06	0.76	13	-	-	0.03	0.60	11.0	2.8	19.3
Bt_2	51-87	26	41	33	16	4.8	0.07	1.15	16	-	-	0.07	0.50	13.0	3.3	21.0
BC	87-108	31	38	31	14	5.6	-	-	-	-	-	0.07	0.28	17.5	3.9	21.0
Ck	108-125	25	42	33	14	7.3	-	-	-	8.5	-	0.11	0.27	41.1	3.9	16.9

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE PUTZY 1 SOIL UNIT

Soil Unit: PZY 1
Location: SW 30-59-13-W6th
Topography: strongly rolling to hilly
Elevation: 1,490 m (4,900 feet)
Vegetation: lodgepole pine, alpine fir, Engelmann spruce, rhododendron, rose, bog cranberry, blueberry, moss, lichen
Drainage: rapidly to well drained
Parent Material: Mountain till
Classification: Orthic Humo-Ferric Podzol

L — 3 to 0 cm; undecomposed conifer needles and moss; abundant, medium roots; abrupt, smooth boundary.

Ae — 0 to 21 cm; light gray (10YR 7/2 m) sandy loam; weak, fine platy breaking to single grain; very friable; few, coarse roots; very stony; abrupt, wavy boundary.

Bf_1 — 21 to 37 cm; yellowish red (5YR 5/6 m) gravelly loam; single grain; friable; few, fine and medium roots; exceedingly to excessively stony; diffuse, wavy boundary.

Bf_2 — 37 to 55 cm; strong brown (7.5YR 5/6 m) gravelly sandy loam; single grain; friable to firm; few, fine roots; exceedingly to excessively stony; gradual, irregular boundary.

BC — 55 to 87 cm; yellowish brown (10YR 5/6 m) gravelly sandy loam; single grain; firm; few, fine roots; exceedingly to excessively stony; clear, wavy boundary.

C — 87 to 110 cm; yellowish brown (10YR 5/4 m) gravelly sandy loam; single grain; firm; no roots; exceedingly to excessively stony.

Analyses of a Putzy Soil Profile (PZY 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L	3-0	-	-	-	-	3.7	0.90	43.47	48	-	-	0.01	3.64	10.9	3.1	76.1
Ae	0-21	49	49	2	0	3.8	0.02	0.65	33	-	-	0.00	0.06	0.2	0.1	4.0
Bf_1	21-37	47	41	12	3	4.8	0.04	0.99	25	-	0.97	-	0.06	0.0	0.0	10.4
Bf_2	37-55	53	38	9	1	4.9	0.02	0.50	28	-	0.72	0.02	0.06	0.0	0.0	6.9
BC	55-87	55	40	5	1	5.1	-	-	-	-	-	0.02	0.05	0.1	0.0	4.3
C	87-110	55	38	7	2	4.9	-	-	-	-	-	0.02	0.10	0.4	0.1	4.5

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE ROBB 7 SOIL UNIT

Soil Unit: RBB 7
Location: NE 19-59-8-W6th
Topography: gently rolling to moderately rolling
Elevation: 1,570 m (5,150 feet)
Vegetation: lodgepole pine, alpine fir; kinnikinnick; bunchberry, bog cranberry, crowberry, moss
Drainage: well drained
Parent Material: Cordilleran till
Classification: Eluviated Dystric Brunisol

L - F 3 to 0 cm; relatively undecomposed litter; abundant, fine and medium roots; abrupt, wavy boundary.

Ae 0 to 10 cm; brown (10YR 5/3 m) loam to clay loam; single grain; very friable; few, fine roots; moderately stony; clear, wavy boundary.

Bf_j 10 to 22 cm; yellowish brown (10YR 5/6 m) clay loam; weak, fine subangular blocky to single grain; friable; plentiful, fine roots; moderately stony; clear, wavy boundary.

Bt_j 22 to 40 cm; light yellowish brown (2.5Y 6/4 m) loam; weak to moderate, fine subangular blocky; friable; plentiful, fine roots; very stony; gradual, wavy boundary.

BC 40 to 66 cm; light yellowish brown (2.5Y 6/4 m) loam; weak, fine subangular blocky; friable; few, fine roots; very stony; diffuse, wavy boundary.

C 66+ cm; dark grayish brown (10YR 4/2 m) loam; pseudo, weak, fine angular blocky; friable; very few, fine roots; moderately stony.

Analyses of a Robb Soil Profile (RBB 7)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ae	0-10	38	35	27	-	4.3	0.10	1.83	18	-	-	0.02	0.30	1.5	0.6	18.8
Bfj	10-22	40	30	30	-	4.9	0.06	0.93	14	-	0.81	0.02	0.20	1.3	0.6	19.6
Btj	22-40	43	31	26	-	4.9	0.03	0.33	11	-	-	0.04	0.21	4.2	1.4	17.8
BC	40-66	42	32	26	-	4.8	0.03	0.32	11	-	-	0.04	0.21	6.2	1.7	18.1
C	66+	44	30	26	-	5.0	0.03	-	-	-	-	0.07	0.22	12.1	2.3	19.6

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE SHEEP 1 SOIL UNIT

Soil Unit: SHP 1
Location: SE 33-59-11-W6th
Topography: moderately to strongly rolling
Elevation: 1,400 m (4,600 feet)
Vegetation: lodgepole pine, alpine fir, Engelmann spruce, rhododendron, bunchberry, crowberry, blueberry, Labrador tea, moss
Drainage: moderately well drained
Parent Material: Mountain till
Classification: Brunisolic Gray Luvisol

L - H 5 to 0 cm; semidecomposed moss and conifer needles; abundant, fine and medium roots; abrupt, smooth boundary.

Ae 0 to 13 cm; grayish brown (10YR 5/2 m) silt loam; weak, medium platy; friable; plentiful, fine and medium roots; moderately stony; clear, smooth boundary.

Bm 13 to 18 cm; strong brown (7.5YR 5/6 m) silt loam; weak, fine granular; friable; plentiful, medium roots; very stony; clear, wavy boundary.

Bt 18 to 36 cm; dark grayish brown (2.5Y 4/2 m) silt loam; moderate, fine subangular blocky; friable; plentiful, fine and medium roots; very stony; gradual, wavy boundary.

BC 36 to 81 cm; very dark grayish brown (2.5Y 3/2 m) silt loam; moderate, medium subangular blocky; firm; few, fine roots; moderately stony; gradual, wavy boundary.

Ck 81 to 95 cm; dark olive gray (5Y 3/2 m) silt loam; massive; firm to very firm; very few, fine roots; slightly stony.

Analyses of a Sheep Soil Profile (SHP 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ae	0-13	29	54	17	5	5.2	0.08	2.15	27	-	-	0.05	0.13	5.4	1.4	11.8
Bm	13-18	24	55	21	10	5.2	0.09	2.27	25	-	0.43	0.05	0.13	6.0	1.5	10.9
Bt	18-36	21	54	25	11	5.4	0.09	2.75	31	-	-	0.03	0.11	7.3	1.7	12.6
BC	36-81	20	57	23	9	6.3	-	-	-	-	-	0.01	0.10	13.1	3.2	15.7
Ck	81-95	22	58	20	8	7.4	-	-	-	9.6	-	0.02	0.09	25.9	3.6	13.3

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE CAW SOIL UNIT

Soil Unit: CAW
Location: SE 9-59-10-W6th
Topography: moderately rolling
Elevation: 1,980 m (6,500 feet)
Vegetation: sparse cover of mountain avens, moss campion, sedge
Drainage: well drained
Parent Material: colluvium
Classification: Orthic Regosol

$H-C_1$ 0 to 22 cm; black (2.5Y 2.5/0 m) gravelly sandy loam; pseudo, medium angular blocky; very friable; plentiful, fine roots; exceedingly stony; clear, irregular boundary.

$H-C_2$ 22 to 41 cm; black (2.5Y 2.5/0 m) gravelly loam; pseudo, medium angular blocky; friable; no roots; exceedingly stony; clear, irregular boundary.

C 41+ cm; very dark gray (10YR 3/1 m) gravelly loam to sandy clay loam; pseudo, angular blocky; friable; no roots; exceedingly stony.

Analyses of a Caw Soil Profile (CAW)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
$H-C_1$	0-22	64	24	12	-	7.3	0.60	22.24	37	0.2	-	0.06	0.55	52.4	6.2	55.5
$H-C_2$	22-41	50	36	14	-	7.6	0.64	52.68	82	0.2	-	0.03	0.06	97.3	11.1	125.1
C	41+	50	26	24	-	7.4	0.31	17.18	55	0.0	-	0.03	0.10	37.4	4.1	29.4

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE ERRINGTON 3 SOIL UNIT

Soil Unit: ERR 3
Location: SE 11-61-14-W6th
Topography: hilly
Elevation: 1,520m (5,000 feet)
Vegetation: alpine fir, Engelmann spruce, buffaloberry, rhododendron, fireweed, cranberry, blueberry, bunchberry, kinnikinnick, moss, grass
Drainage; well drained
Parent Material: colluvium
Classification: Eluviated Dystric Brunisol

L - F 11 to 0 cm; relatively undecomposed moss and logs; clear, wavy boundary.

Ae_1 0 to 15 cm; light brownish gray (10YR 6/2 m) silt loam; single grain to very weak, fine platy; very friable; abundant, coarse and medium roots; moderately stony; clear, wavy boundary.

Ae_2 15 to 30 cm; brown (10YR 5/3 m) loam; single grain to very weak, fine platy; very friable; plentiful, coarse and fine roots; very stony; diffuse, irregular boundary.

Btj 30 to 42 cm; dark yellowish brown (10YR 4/4 m) loam; single grain to very weak, fine platy; very friable; plentiful, very fine roots; exceedingly stony; clear, irregular boundary.

C 42 to 76 cm; dark grayish brown (10YR 4/2 m) gravelly loam; single grain; very friable; few, coarse roots; exceedingly to excessively stony.

Analyses of an Errington Soil Profile (ERR 3)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	11-0	-	-	-	-	4.9	0.98	33.92	35	-	-	0.04	1.14	37.3	4.1	92.9
Ae_1	0-15	38	56	6	0	4.6	0.05	1.08	22	-	-	0.00	0.11	3.1	0.8	8.3
Ae_2	15-30	38	49	13	0	5.1	0.04	0.92	23	-	-	0.00	0.10	3.8	1.1	8.6
Btj	30-42	44	41	15	2	5.4	0.05	0.94	19	-	-	0.00	0.12	5.0	1.3	9.8
C	42-76	48	37	15	3	5.7	-	-	-	-	-	0.09	0.10	6.0	1.4	9.5

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE NICKERSON SOIL UNIT

Soil Unit:	NKN
Location:	NW 25-58-10-W6th
Topography:	gently to moderately rolling
Elevation:	1,950 m (6,400 feet)
Vegetation:	alpine species, moss, some grass
Drainage:	poorly drained
Parent Material:	colluvium
Classification:	Orthic Regosol

L - F	8 to 0 cm; mainly undecomposed moss; abundant, fine roots; clear, wavy boundary.
AhC	0 to 20 cm; black (10YR 2.5/1 m) sandy clay loam; weak, fine granular (fluffy); friable; plentiful, fine roots; very stony; clear, wavy boundary.
C	20+ cm; very dark gray (10YR 3/1 m) loam to sandy clay loam; pseudo, fine subangular blocky to single grain; friable; no roots; exceedingly stony.

Analyses of a Nickerson Soil Profile (NKN)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
AhC	0-20	54	20	26	-	6.5	0.44	10.4	24	-	0.41	0.03	0.05	29.3	4.5	38.6
C	20+	47	27	26	-	6.6	0.14	-	-	-	0.26	0.03	0.06	14.6	2.9	21.4

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE SMOKY 1 SOIL UNIT

Soil Unit:	SKY 1
Location:	SW 9-62-7-W6th
Topography:	undulating to gently rolling
Elevation:	1,250 m (4,200 feet)
Vegetation:	black spruce, lodgepole pine, Labrador tea, buffalo-berry, willow, rose, bog cranberry, kinnikinnick, bunchberry, moss, lichen
Drainage:	poorly drained
Parent Material:	Continental till
Classification:	Peaty Luvic Gleysol

Of 28 to 13 cm; dark brown (7.5YR 3/2 m) relatively undecomposed plant debris, mainly moss; abundant, fine and coarse roots; abrupt, smooth boundary.

Oh 13 to 0 cm; black (2.5Y 2.5/0 m) well decomposed plant debris, mainly moss; abundant, fine roots; abrupt, smooth boundary.

Aejg 0 to 5 cm; brown to dark brown (10YR 4/3 m) silt loam; common, fine and medium, faint yellowish brown (10YR 5/6 m) mottles; moderate, medium platy; firm to friable; few, fine roots; moderately to very stony; clear, smooth boundary.

ABg 5 to 28 cm; yellowish brown (10YR 5/4 m) silt loam; few, fine and medium, faint yellowish brown (10YR 5/6 m) mottles; moderate, coarse subangular blocky; firm; few, fine roots; very stony; clear, smooth boundary.

Btg 28 to 65 cm; gray (10YR 5/1 m) clay loam; common, medium, distinct light olive brown (2.5Y 5/4 m) mottles; weak, fine subangular blocky; firm; no roots; very stony; diffuse, wavy boundary.

Ckg 65 to 88 cm; gray (10YR 5/1 m) silt loam; common, medium, distinct light olive brown (2.5Y 5/6 m) mottles; pseudo, weak, fine angular blocky; firm; no roots; very stony.

Analyses of a Smoky Soil Profile (SKY)

		Particle Size Analysis										Exchangeable Cations (me/100g)				
Horizon	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Of	28-13	-	-	-	-	5.9	1.10	45.01	41	-	-	0.20	4.63	78.6	15.9	152.2
Oh	13-0	-	-	-	-	6.3	1.47	36.10	25	-	-	0.11	0.32	178.1	27.0	255.6
Aejg	0-5	28	57	15	5	6.5	0.09	3.97	44	-	-	0.05	0.10	12.1	2.5	20.9
ABg	5-28	32	54	14	5	6.6	0.06	0.89	15	-	-	0.03	0.11	9.0	2.0	14.9
Btg	28-65	23	47	30	12	7.2	-	-	-	0.8	-	0.07	0.20	23.9	4.7	31.5
Ckg	65-88	24	56	20	1	7.6	-	-	-	12.9	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE DONNELLY 1 SOIL UNIT

Soil Unit:	DON 1
Location:	SW 7-69-11-W6th
Topography:	gently undulating
Elevation:	750 m (2,470 feet)
Vegetation:	aspen poplar, willow, balsam poplar, rose, raspberry, grass
Drainage:	moderately well to imperfectly drained
Parent Material:	lacustro-till
Classification:	Gleyed Solonetzic Gray Luvisol

L - H 5 to 0 cm; semidecomposed grass, deciduous leaves and root debris; abrupt, smooth boundary.

Ahe 0 to 8 cm; dark grayish brown (10YR 4/2 m) silt loam; weak to moderate, fine platy; friable; abundant, fine roots; slightly stony; abrupt, smooth boundary.

Ae 8 to 25 cm; light brownish gray (10YR 6/2 m) loam; moderate to strong, coarse platy; friable; few, fine roots; moderately stony; clear, smooth boundary.

ABgj 25 to 38 cm; yellowish brown (10YR 5/6 m) clay loam; few, fine, faint brownish yellow (10YR 6/6 m) mottles; moderate, medium subangular blocky; firm; few, fine roots; slightly stony; clear, wavy boundary.

Btnjgj 38 to 70 cm; dark yellowish brown (10YR 4/4 m) clay; few, fine, faint brownish yellow (10YR 6/6 m) mottles; strong, medium to coarse subangular blocky; firm to very firm; very few, fine roots; slightly stony; gradual, wavy boundary.

Csagj 70 to 105 cm; dark grayish brown (10YR 4/2 m) clay loam; few, fine, distinct brownish yellow (10YR 6/6 m) mottles; pseudo, fine to moderate angular blocky; stratified; friable to firm; no roots; slightly stony; gradual, irregular boundary.

Cskgj 105+ cm; brownish yellow (10YR 6/6 m) clay loam; few, fine, faint strong brown (7.5 YR 5/6 m) mottles; stratified; friable to firm; no roots; slightly stony.

Analyses of a Donnelly Soil Profile (DON 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	5-0	-	-	-	-	5.8	-	-	-	-	-	0.06	1.30	16.2	8.2	56.8
Ahe	0-8	26	53	21	7	5.7	0.17	2.77	16	-	-	0.09	0.51	3.9	3.2	17.3
Ae	8-25	35	45	20	5	5.5	0.04	0.51	13	-	-	0.02	0.13	1.1	1.7	7.9
ABgj	25-38	34	36	30	13	5.0	0.06	0.64	11	-	-	0.03	0.20	2.7	4.7	15.8
Btnjgj	38-70	28	31	41	24	5.5	0.05	0.88	18	-	-	0.02	0.21	7.0	8.4	24.0
Csagj	70-105	34	30	36	18	7.5	-	-	-	0.2	-	-	-	-	-	-
Cskgj	105+	30	34	36	17	7.7	-	-	-	6.2	-	-	-	-	-	-

Horizon	Depth (cm)	Sand	Silt	Clay	Fine Clay	pH	N	Organic C	C/N	$CaCO_3$	Electrical Conductivity	Soluble Salts (me/L): Na	K	Ca	Mg	Total
Csagj	70-105	-	-	-	-	-	-	-	-	-	4.1	13.0	0.0	28.1	34.3	75.4
Cskgj	105+	-	-	-	-	-	-	-	-	-	2.8	1.1	0.1	32.2	6.5	39.9

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE NAMPA 1 SOIL UNIT

Soil Unit: NMP 1
Location: NW 15-69-8-W6th
Topography: gently undulating
Elevation: 730 m (2,380 feet)
Vegetation: aspen poplar, willow, rose, raspberry, bog cranberry, bunchberry, blueberry, grass
Drainage: moderately well to imperfectly drained
Parent Material: lacustrine
Classification: Orthic Gray Luvisol

Ah 0 to 5 cm; dark grayish brown (10YR 4/2 m) silt loam; weak, fine subangular blocky to granular; very friable; abundant, fine and medium roots; non-stony; clear, broken boundary.

Aegj 5 to 13 cm; light yellowish brown (10YR 6/4 m) silt loam; common, medium, prominent brownish yellow (10YR 6/8 m) mottles; moderate, medium platy; very friable; plentiful, fine roots; non-stony; clear, wavy boundary.

AB 13 to 18 cm; brown (10YR 5/3 m) clay; moderate, medium subangular blocky; friable to firm; few to plentiful, fine and medium roots; non-stony; clear, irregular boundary.

Bt 18 to 43 cm; dark brown to brown (10YR 4/3 m) clay; weak to moderate, medium subangular blocky; firm; few, fine roots; non-stony; gradual, irregular boundary.

Ck 43 to 118 cm; olive brown (2.5Y 4/4 m) clay; pseudo, fine subangular blocky and stratified; friable; few, fine roots; non-stony.

Analyses of a Nampa Soil Profile (NMP 1)

Horizon	Depth (cm)	Particle Size Analysis Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ah	0-5	18	61	21	11	7.0	0.49	7.17	15	-	-	0.21	0.55	19.1	5.2	38.1
Aegj	5-13	20	66	14	5	7.1	0.05	0.53	11	-	-	0.10	0.06	2.3	1.4	7.2
AB	13-18	17	36	47	27	7.1	0.07	0.71	10	0.2	-	0.08	0.35	8.1	5.8	20.0
Bt	18-43	26	24	50	28	7.5	0.08	0.84	11	0.2	-	0.04	0.26	9.5	6.9	22.2
Ck	43-118	25	25	50	22	7.8	-	-	-	16.0	-	-	-	-	-	-
											Electrical Conductivity	Soluble Salts (me/L) Na	K	Ca	Mg	Total
Ck	43-118	-	-	-	-	-	-	-	-	-	0.4	1.1	0.0	2.1	1.6	4.8

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE SNIPE 1 SOIL UNIT

Soil Unit: SIP 1
Location: NE 11-68-7-W6th
Topography: gently undulating
Elevation: 720 m (2,350 feet)
Vegetation: aspen poplar, willow, rose, fireweed, golden rod, strawberry, grass
Drainage: poorly drained
Parent Material: lacustro-till
Classification: Orthic Luvic Gleysol

L - H 10 to 0 cm; semidecomposed deciduous leaves and other plant debris; abundant, fine and coarse roots; clear, wavy boundary.

Ahg 0 to 5 cm; very dark gray (10YR 3/1 m) silty clay to clay; common, medium, distinct yellowish brown (10YR 5/4 m) mottles; moderate, fine subangular blocky to granular; friable; abundant, fine and coarse roots; non-stony; clear, wavy boundary.

Aeg 5 to 13 cm; pale brown (10YR 6/3 m) silty clay loam; many, medium, prominent yellowish brown (10YR 5/6 m) mottles; moderate, fine subangular blocky and weak, medium platy; friable; abundant, fine roots; non-stony; clear, wavy boundary.

Btg_1 13 to 35 cm; very dark grayish brown (10YR 3/2 m) silty clay; many, medium, prominent yellowish brown (10YR 5/6 m) mottles; strong, medium to coarse subangular blocky; firm to very firm; plentiful, medium and fine roots; non-stony; gradual, wavy boundary.

Btg_2 35 to 50 cm; very dark gray (10YR 3/1 m) heavy clay; few, fine, faint yellowish brown (10YR 5/4 m) mottles; shotty; friable; few, fine roots; non-stony; diffuse, wavy boundary.

Ckg 50 to 88 cm; black (10YR 2.5/1 m) silty clay to clay; few, medium, distinct yellowish brown (10YR 5/4 m) mottles; shotty and stratified; friable; very few, fine roots; slightly stony.

Analyses of a Snipe Soil Profile (SIP 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	10-0	-	-	-	-	5.2	2.08	39.44	19	-	-	0.50	3.80	51.6	15.4	164.9
Ahg	0-5	5	40	55	23	5.7	0.49	5.41	11	-	-	0.12	2.74	15.9	9.2	54.7
Aeg	5-13	10	59	31	10	6.2	0.19	1.51	8	-	-	0.07	0.72	7.9	4.2	20.9
Btg_1	13-35	8	45	47	22	6.3	0.13	1.12	9	-	-	0.07	0.83	12.3	8.2	30.3
Btg_2	35-50	1	26	73	38	7.6	-	-	-	1.7	-	-	-	-	-	-
Ckg	50-88	8	38	54	22	7.9	-	-	-	12.4	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE TRI-CREEK 3 SOIL UNIT

Soil Unit:	TRC 3
Location:	SW 27-60-9-W6th
Topography:	gently undulating
Elevation:	1,150 m (3,770 feet)
Vegetation:	aspen poplar, white spruce, willow, Labrador tea, rose, blueberry, bog cranberry, kinnikinnick, lichen, moss
Drainage:	moderately well drained
Parent Material:	lacustrine
Classification:	Orthic Gray Luvisol

L - H 8 to 0 cm; semidecomposed moss and root debris; clear, wavy boundary.

Ael 0 to 3 cm; grayish brown (10YR 5/2 m) loam; weak, fine platy; friable; plentiful, fine roots; non-stony; clear, irregular boundary.

Ae2 3 to 25 cm; pale brown (10YR 6/3 m) silt loam; moderate, medium platy; friable to firm; few, medium roots; non-stony; clear, irregular boundary.

Bt 25 to 46 cm; dark grayish brown (10YR 4/2) silty clay loam; strong, coarse subangular blocky; very firm; few, medium roots; non-stony; diffuse, broken boundary.

BC 46 to 62 cm; very dark grayish brown (10YR 3/2 m) silt loam to silty clay loam; stratified breaking to moderate, medium subangular blocky; firm; no roots; non-stony; diffuse, irregular boundary.

C 62 to 82 cm; very dark grayish brown (10YR 3/2 m) silt loam; stratified breaking to pseudo, fine angular blocky; firm; no roots; non-stony.

Analyses of a Tri-Creek Soil Profile (TRC 3)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	8-0	-	-	-	-	4.6	0.42	40.22	96	-	-	0.09	3.14	27.2	6.9	90.2
Ae1	0-3	44	44	12	3	4.7	0.07	1.72	25	-	-	0.02	0.22	1.5	0.6	13.6
Ae2	3-25	10	76	14	2	5.3	0.05	1.41	28	-	-	0.03	0.12	1.3	0.5	7.3
Bt	25-46	1	62	37	20	5.2	0.09	1.97	22	-	-	0.03	0.23	9.6	4.7	17.7
BC	46-62	1	71	28	14	5.8	-	-	-	-	-	0.05	0.17	10.5	4.6	14.2
C	62-82	1	79	20	9	7.4	-	-	-	0.0	-	0.05	0.13	12.0	4.8	12.2

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE IOSEGUN 1 SOIL UNIT

Soil Unit: IOS 1
Location: SW 31-67-4-W6th
Topography: gently undulating
Elevation: 580 m (1,900 feet)
Vegetation: aspen poplar, balsam poplar, rose, cranberry, grass
Drainage: well drained
Parent Material: modern fluvial
Classification: Cumulic Regosol

Ckl 0 to 8 cm; brown to dark brown (10YR 4/3 d) sandy loam; single grain; very friable; no roots; non-stony; clear, wavy boundary.

L - Hbk 8 to 13 cm; very dark grayish brown (10YR 3/2 d) semidecomposed plant remains; very friable; plentiful, coarse and medium roots; non-stony; abrupt, wavy boundary.

Ck2 13 to 38 cm; grayish brown (10YR 5/2 d) loam; single grain and stratified; friable; plentiful, medium and coarse roots; non-stony; abrupt, smooth boundary.

Ahb 38 to 47 cm; very dark grayish brown (10YR 3/2 d) silty clay; single grain; firm; few, medium roots; non-stony; gradual, smooth boundary.

Ck3 47 to 56 cm; brown (10YR 5/3 d) silty clay loam to silty clay; pseudo, moderate, fine subangular blocky; firm; very few, fine roots; non-stony; abrupt, smooth boundary.

Ck4 56 to 90 cm; brown to dark brown (10YR 4/3 d) sandy loam; single grain; very friable; very few, fine roots; non-stony.

Analyses of an Iosegun Soil Profile (IOS 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ck1	0-8	56	32	12	3	7.9	-	1.32	-	7.5	-	-	-	-	-	-
L-Hbk	8-13	-	-	-	-	7.6	1.20	19.20	16	4.0	-	-	-	-	-	-
Ck2	13-38	42	44	14	4	7.6	0.06	3.07	51	9.0	-	-	-	-	-	-
Ahb	38-47	5	49	46	19	7.6	0.46	6.27	14	1.7	-	-	-	-	-	-
Ck3	47-56	6	54	40	19	7.6	-	-	-	0.3	-	-	-	-	-	-
Ck4	56-90	59	39	12	4	7.7	-	-	-	6.8	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE BLACKMUD 6 SOIL UNIT

Soil Unit: BKM 6
Location: NW 22-69-8-W6th
Topography: gently undulating
Elevation: 710 m (2,230 feet)
Vegetation: aspen poplar, willow, rose, raspberry, bunchberry, cranberry, grass
Drainage: well to moderately well drained
Parent Material: glaciofluvial sand
Classification: Orthic Gray Luvisol

L - H 5 to 0 cm; semidecomposed deciduous leaf litter, roots and grass remains; clear, smooth boundary.

Ae1 0 to 8 cm; light brownish gray (10YR 6/2 m) very fine sandy loam; single grain; very friable; plentiful, fine roots; non-stony; abrupt, smooth boundary.

Ae2 8 to 25 cm; light yellowish brown (10YR 6/4 m) to brownish yellow (10YR 6/6 m) loamy fine sand; single grain; very friable; plentiful, fine and medium roots; non-stony; clear, irregular boundary.

Btgj 25 to 40 cm; yellowish brown (10YR 5/6 m) fine sandy clay loam; few, fine, distinct brownish yellow (10YR 6/8 m) mottles; moderate, medium subangular blocky and stratified; friable; few to plentiful, fine roots; non-stony; abrupt, wavy boundary.

Cca 40 to 55 cm; light gray (10YR 7/2 m) very fine sandy loam to very fine sandy clay loam; single grain; very friable; few, fine roots; non-stony; gradual, irregular boundary.

Ck 55+ cm; yellowish brown (10YR 5/4 m) very fine sandy loam; single grain; very friable; few, fine roots; non-stony.

Analyses of a Blackmud Soil Profile (BKM 6)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	5-0	-	-	-	-	7.3	-	-	-	0.1	-	0.17	2.81	49.2	10.5	94.2
Ae1	0-8	56	38	6	2	5.4	0.09	1.35	15	-	-	0.05	0.12	1.7	0.6	7.5
Ae2	8-25	78	15	7	3	6.2	0.04	0.41	10	-	-	0.08	0.06	1.7	0.6	5.4
Btgj	25-40	62	9	29	22	7.3	0.07	0.75	11	0.2	-	0.09	0.20	8.8	2.5	17.2
Cca	40-55	59	20	21	11	8.1	-	-	-	30.8	-	-	-	-	-	-
Ck	55+	76	14	10	6	8.2	-	-	-	12.4	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE BLACKMUD 8 SOIL UNIT

Soil Unit:	BKM 8
Location:	SW 25-68-5-W6th
Topography:	gently rolling
Elevation:	670 m (2,200 feet)
Vegetation:	aspen poplar, lodgepole pine, white spruce, willow, alder, rose, honeysuckle, blueberry, bunchberry, moss, grass
Drainage:	rapidly drained
Parent Material:	glaciofluvial sand
Classification:	Eluviated Eutric Brunisol

L - H 5 to 0 cm; semidecomposed deciduous leaves and conifer needles; abundant, fine and medium roots; gradual, wavy boundary.

Ae 0 to 7 cm; light brown (7.5YR 6/4 m) sandy loam; single grain; very friable; abundant, fine roots; slightly stony; clear, wavy boundary.

Bm1 7 to 25 cm; strong brown (7.5YR 5/6 m) sandy loam; single grain to very weak, fine subangular blocky; very friable; plentiful, very fine and coarse roots; slightly stony; gradual, wavy boundary.

Bm2 25 to 49 cm; yellowish brown (10YR 5/6 m) loamy sand; single grain; very friable; plentiful, fine and very fine roots; slightly stony; diffuse, broken boundary.

BC 49 to 112 cm; brown to dark brown (10YR 4/3 m) loamy sand; single grain; very friable; few, fine roots; slightly stony; abrupt, smooth boundary.

Ck 112+ cm; grayish brown (10YR 5/2 m) sand; single grain; very friable; very few, very fine roots; slightly stony.

Analyses of a Blackmud Soil Profile (BKM 8)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	5-0	-	-	-	-	5.8	0.68	17.11	25	-	-	0.14	1.84	29.7	3.3	52.8
Ae	0-7	70	28	2	-	6.2	0.02	0.40	20	-	-	0.04	0.12	2.3	0.4	4.5
Bm1	7-25	73	19	8	-	5.6	0.02	0.31	16	-	0.37	0.01	0.25	1.6	0.4	6.3
Bm2	25-49	84	9	7	-	6.0	0.02	0.14	7	-	0.26	0.03	0.21	2.7	1.0	5.8
BC	49-112	84	10	6	-	6.2	-	-	-	-	-	0.01	0.17	3.9	0.6	5.8
Ck	112+	87	9	4	-	7.8	-	-	-	9.6	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE DAVIS 1 SOIL UNIT

Soil Unit: DVS 1
Location: NW 10-68-5-W6th
Topography: gently undulating
Elevation: 670 m (2,200 feet)
Vegetation: aspen poplar, white spruce, raspberry, rose, strawberry, bunchberry, vetch, moss, grass
Drainage: well drained
Parent Material: glaciofluvial silts
Classification: Orthic Gray Luvisol

L - H 5 to 0 cm; semidecomposed deciduous leaves, roots, shrubs and grasses; abundant, medium and coarse roots; abrupt, wavy boundary.

Ae 0 to 17 cm; brownish yellow (10YR 6/6 m) silt loam; weak, fine and medium platy; very friable; abundant, fine roots; non-stony; clear, wavy boundary.

AB 17 to 24 cm; yellowish brown (10YR 5/4 m) silt loam; moderate, medium subangular blocky; very friable to friable; plentiful, medium and fine roots; non-stony; gradual, wavy boundary.

Bt 24 to 40 cm; dark yellowish brown (10YR 4/4 m) silt loam; moderate, fine subangular blocky; friable; plentiful, fine and very fine roots; non-stony; clear, wavy boundary.

BCk 40 to 49 cm; dark yellowish brown (10YR 4/4 m) silt loam; pseudo platy or stratified; friable; few, very fine roots; non-stony; abrupt, smooth boundary.

Cca 49+ cm; brown (10YR 5/3 m) silt loam; stratified; very friable; very few, fine and medium roots; non-stony.

Analyses of a Davis Soil Profile (DVS 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	5-0	-	-	-	-	6.2	1.35	32.12	24	-	-	0.09	3.12	72.7	8.2	95.4
Ae	0-17	15	77	8	-	5.5	0.03	0.41	14	-	-	0.02	0.18	3.3	0.5	5.8
AB	17-24	10	72	18	-	6.9	0.04	0.60	15	-	-	0.03	0.15	5.2	1.3	10.2
Bt	24-40	12	64	24	-	6.0	0.05	0.71	14	-	-	0.06	0.24	12.5	2.9	17.7
BCk	40-49	18	60	22	-	7.4	-	-	-	1.3	-	-	-	-	-	-
Cca	49+	16	71	13	-	8.4	-	-	-	20.8	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE GUNDERSON 1 SOIL UNIT

Soil Unit:	GUN 1
Location:	NE 20-65-2-W6th
Topography:	undulating
Elevation:	820 m (2,700 feet)
Vegetation:	alpine fir, white spruce, birch, willow, black spruce, fireweed, rose, raspberry, moss, grass
Drainage:	poorly to very poorly drained
Parent Material:	glaciofluvial sands
Classification:	Peaty Rego Gleysol

H 25 to 0 cm; well decomposed plant remains; plentiful, coarse roots; abrupt, irregular boundary.

Ckg 0 to 5 cm; grayish brown (10YR 5/2 m) silt loam; few, fine, faint dark yellowish brown (10YR 4/4 m) mottles; silt loam; pseudo, strong, coarse platy; friable; no roots; non-stony; gradual, irregular boundary.

IICkg 5 to 55 cm; light brownish gray (10YR 6/2 m) fine sandy loam; many medium, prominent yellowish brown (10YR 5/6 m) mottles; stratified and single grain; friable; no roots; non-stony; abrupt, smooth boundary.

IIICkg 55 to 60 cm; very dark grayish brown (10YR 3/2 m) coarse sandy loam; indiscernible mottles; single grain; very friable; no roots; moderately stony; abrupt, smooth boundary.

IVCkg 60 to 75 cm; light brownish gray (10YR 6/2 m) silty clay loam; common, medium, prominent yellowish brown (10YR 5/6 m) mottles; stratified; friable; no roots, non-stony.

Analyses of a Gunderson Soil Profile (GUN 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
H	25-0	-	-	-	-	7.3	0.96	18.82	20	0.3	-	0.11	0.13	88.5	14.2	129.9
Ckg	0-5	20	63	17	8	7.6	0.09	1.13	13	1.1	-	-	-	-	-	-
IICkg	5-55	55	27	18	7	7.8	-	-	-	9.1	-	-	-	-	-	-
IIICkg	55-60	73	16	11	5	7.6	-	-	-	3.2	-	-	-	-	-	-
IVCkg	60-75	9	62	29	15	7.6	-	-	-	3.2	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE JARVIS 4 SOIL UNIT

Soil Unit: JRV 4
Location: NE 22-61-13-W6th
Topography: undulating
Elevation: 1,100 m (3,600 feet)
Vegetation: lodgepole pine, white spruce, aspen poplar, alpine fir, buffalo-berry, Labrador tea, cranberry, bunchberry, blueberry, grass, moss, lichen
Drainage: rapidly drained
Parent Material: glaciofluvial outwash gravels
Classification: Brunisolic Gray Luvisol

L - F 8 to 0 cm; relatively undecomposed moss, pine needles, roots and grass; abundant, medium and coarse roots; abrupt, wavy boundary.

Ae 0 to 8 cm; light brownish gray (10YR 6/2 m) loam to sandy loam; weak, fine platy to single grain; very friable; plentiful, fine and medium roots; very to exceedingly stony; clear, irregular boundary.

Bm 8 to 23 cm; yellowish brown (10 YR 5/6 m) gravelly loam; very weak, fine subangular blocky to single grain; very friable; plentiful, fine and medium roots; excessively stony; gradual, irregular boundary.

Bt 23 to 40 cm; dark yellowish brown (10YR 4/4 m) gravelly loam to sandy loam; weak, fine subangular blocky; friable; plentiful to few, fine and medium roots; excessively stony; clear, wavy boundary.

Ck 40 to 60 cm; dark grayish brown (10YR 4/2 m) gravelly sandy loam; single grain; very friable; few, fine roots; excessively stony.

Analyses of a Jarvis Soil Profile (JRV 4)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	8-0	-	-	-	-	4.8	-	-	-	-	-	0.09	1.79	12.5	4.1	80.2
Ae	0-8	49	44	7	2	4.6	0.07	1.37	20	-	0.05	0.04	0.09	1.4	0.5	7.6
Bm	8-23	46	37	17	6	6.0	0.08	1.54	19	-	0.28	0.04	0.08	3.3	1.2	12.7
Bt	23-40	52	31	17	7	7.4	0.09	1.70	19	1.0	-	0.06	0.06	7.7	1.7	13.7
Ck	40-60	60	30	10	4	7.5	-	-	-	9.0	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE WANHAM 1 SOIL UNIT

Soil Unit: WHM 1
Location: SE 23-68-9-W6th
Topography: undulating
Elevation: 770 m (2,550 feet)
Vegetation: aspen poplar, willow, white spruce, black spruce, birch, raspberry, buffalo-berry, bunchberry, strawberry, moss, grass
Drainage: poorly drained
Parent Material: glaciofluvial silts
Classification: Orthic Luvic Gleysol

L - H 5 to 0 cm; semidecomposed deciduous leaves and some grass remains; abundant, coarse roots; abrupt, wavy boundary.

Ah 0 to 5 cm; very dark gray (10YR 3/1 m) silt loam; weak, fine granular to weak, fine shotty; very friable; abundant, fine and medium roots; non-stony; clear, wavy boundary.

Aeg 5 to 13 cm; brown (10YR 5/3 m) silt loam; common, medium, distinct yellowish brown (10YR 5/6 m) mottles; moderate, medium platy; very friable; plentiful, fine and medium roots; non-stony; clear, wavy boundary.

ABg 13 to 22 cm; grayish brown (10YR 5/2 m) silt loam; common, fine, distinct yellowish brown (10YR 5/6 m) mottles; very weak, fine subangular blocky; very friable; plentiful, fine and medium roots; non-stony; gradual, irregular boundary.

Btkg 22 to 44 cm; dark gray (5Y 4/1 m) silt loam; many, medium, distinct dark yellowish brown (10YR 4/4 m) mottles; weak, fine subangular blocky; friable; few, fine roots; non-stony; clear, irregular boundary.

Ckg 44 to 92 cm; gray (5Y 5/1 m) silt loam; common, medium, distinct dark yellowish brown (10YR 4/4 m) mottles; pseudo, weak angular blocky; friable; few, very fine roots; non-stony.

Analyses of a Wanham Soil Profile (WHM 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	5-0	-	-	-	-	6.3	2.17	32.08	16	-	-	0.48	3.57	121.4	13.5	133.2
Ah	0-5	14	64	22	-	6.4	0.36	5.02	14	-	-	0.01	0.61	27.1	3.3	31.8
Aeg	5-13	18	69	13	-	6.8	0.04	0.63	16	-	-	0.01	0.17	6.4	1.1	7.3
ABg	13-22	14	61	25	-	6.8	0.05	0.70	14	-	-	0.01	0.31	9.8	2.4	12.8
Btkg	22-44	11	67	22	-	8.0	0.04	0.63	15	16.7	-	-	-	-	-	-
Ckg	44-92	12	68	20	-	7.4	-	-	-	25.1	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE LODGE 6 SOIL UNIT

Soil Unit: LDG 6
Location: NE 32-67-4-W6th
Topography: gently rolling
Elevation: 700 m (2,300 feet)
Vegetation: aspen poplar, balsam poplar, willow, rose, high bush cranberry, strawberry, fireweed, vetch, grass
Drainage: well drained
Parent Material: glaciofluvial or eolian sands overlying lacustro-till
Classification: Orthic Gray Luvisol

L - H 8 to 0 cm; semidecomposed deciduous leaves and other plant remains; clear, wavy boundary.

Ae1 0 to 8 cm; light gray (10YR 7/2 m) sandy loam; single grain; very friable; few, coarse roots; non-stony; gradual, wavy boundary.

Ae2 8 to 27 cm; yellowish brown (10YR 5/4 m) sandy loam; single grain; very friable; few, coarse and fine roots; non-stony; gradual, wavy boundary.

Ae3 27 to 44 cm; pale brown (10YR 6/3 m) sandy loam; weak, medium platy breaking easily to single grain; very friable; few, coarse and fine roots; non-stony; abrupt, smooth boundary.

Bt 44 to 52 cm; brown to dark brown (10YR 4/3 m) sandy clay loam; moderate, medium subangular blocky; firm; plentiful, coarse and fine roots; non-stony; clear, smooth boundary.

IICk 52 to 91 cm; grayish brown (10YR 5/2 m) silty clay; moderate, coarse angular blocky; firm; few, fine and coarse roots; slightly stony.

Analyses of a Lodge Soil Profile (LDG 6)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	8-0	-	-	-	-	5.4	0.99	32.62	33	-	-	0.10	5.72	88.1	12.6	144.8
Ae1	0-8	56	42	2	1	6.3	0.05	0.75	15	-	-	0.01	0.19	3.4	0.9	6.6
Ae2	8-27	72	24	4	1	5.9	0.03	0.33	11	-	0.18	0.03	0.12	2.4	0.4	5.0
Ae3	27-44	71	24	5	0	5.5	0.02	0.26	13	-	-	0.03	0.09	2.5	0.5	5.7
Bt	44-52	48	28	24	16	5.6	0.05	0.65	13	-	-	0.09	0.24	9.5	2.3	17.8
IICk	52-91	0	53	47	16	7.7	-	-	-	16.7	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE LODGE 8 SOIL UNIT

Soil Unit:	LDG 8
Location:	SE 31-68-8-W6th
Topography:	undulating
Elevation:	740 m (2,430 feet)
Vegetation:	aspen poplar, willow, rose, raspberry, bunchberry, clover, grass
Drainage:	well drained
Parent Material:	glaciofluvial or eolian sands overlying glaciofluvial silts
Classification:	Brunisolic Gray Luvisol

L - H 8 to 0 cm; semidecomposed deciduous leaf litter, grass and roots; abundant, coarse and medium roots; abrupt, smooth boundary.

Ae1 0 to 8 cm; pinkish gray (7.5YR 7/2 m) very fine sandy loam; single grain; very friable; plentiful, fine and medium roots; non-stony; abrupt, wavy boundary.

Bm 8 to 18 cm; strong brown (7.5YR 5/6 m) very fine loamy sand; single grain; very friable; plentiful, fine roots; non-stony; clear, wavy boundary.

Ae2 18 to 28 cm; yellowish brown (10YR 5/4 m) very fine sandy loam; single grain; very friable; plentiful, fine roots; non-stony; clear, wavy boundary.

IIBt 28 to 48 cm; yellowish brown (10YR 5/6 m) silty clay loam; weak, fine subangular blocky; friable; plentiful, fine and medium roots; non-stony; clear, wavy boundary.

IICk 48 to 75 cm; yellowish brown (10YR 5/4 m) silt loam; single grain and weakly stratified; very friable to friable; few, fine roots; non-stony.

Analyses of a Lodge Soil Profile (LDG 8)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ae1	0-8	70	27	3	1	6.5	0.04	0.57	14	-	-	0.11	0.05	1.1	0.4	3.7
Bm	8-18	80	13	7	1	6.2	0.04	0.52	13	-	0.19	0.08	0.05	1.1	0.3	3.7
Ae2	18-28	69	24	7	2	6.4	0.04	0.88	22	-	0.15	0.04	0.04	1.7	0.5	5.2
IIBt	28-48	16	47	37	23	6.8	0.07	0.80	11	-	-	0.03	0.20	7.7	3.3	17.3
IICk	48-75	11	72	17	9	8.3	-	-	-	18.5	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE JUDY 1 SOIL UNIT

Soil Unit: JUY 1
Location: SE 20-61-3-W6th
Topography: moderately rolling
Elevation: 1,340 m (4,400 feet)
Vegetation: lodgepole pine, black spruce, white spruce, mountain ash, buffalo-berry, tall bilberry, Labrador tea, cranberry, blueberry, moss
Drainage: rapidly drained
Parent Material: preglacial fluvial cobbly gravel
Classification: Brunisolic Gray Luvisol

L - H 6 to 0 cm; semidecomposed moss and root debris; few, fine roots; abrupt, wavy boundary.

Ae1 0 to 10 cm; light brownish gray (10YR 6/2 m) loam; weak, fine platy breaking to single grain; very friable; plentiful, medium roots; slightly to moderately cobbly; abrupt, wavy boundary.

Bfj 10 to 21 cm; strong brown (7.5YR 5/8 m) silt loam to clay loam; weak, medium subangular blocky; very friable; abundant, fine roots; moderately cobbly; clear, wavy boundary.

Ae2 21 to 39 cm; yellowish brown (10YR 5/6 m) cobbly sandy clay loam; single grain; very friable; plentiful, fine and medium roots; excessively cobbly; gradual, irregular boundary.

Bt 39 to 52 cm; yellowish brown (10YR 5/6 m) cobbly sandy clay loam; weak, fine subangular blocky to single grain; friable; plentiful, fine roots; excessively cobbly; gradual, irregular boundary.

C 52 to 100 cm; yellowish brown (10YR 5/4 m) cobbly loam; pseudo, weak angular blocky; very friable; plentiful, medium roots; excessively cobbly; abrupt, irregular boundary.

IIC 100 to 116 cm; dark grayish brown (10YR 4/2 m) silty clay loam; stratified and angular blocky; firm; few, medium roots; slightly stony; clear, wavy boundary.

IIIC 116 to 146 cm; brown to dark brown (10YR 4/3 m) loam; massive; friable; no roots; exceedingly cobbly.

Analyses of a Judy Soil Profile (JUY 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-H	6-0	-	-	-	-	3.8	0.06	29.60	493	-	-	0.06	2.42	12.5	2.9	64.1
Ae1	0-10	45	47	8	2	4.1	0.04	0.84	21	-	-	0.00	0.12	0.5	0.3	7.3
Bfj	10-21	37	48	15	5	5.1	0.04	1.03	26	-	0.71	0.00	0.15	1.0	0.3	10.7
Ae2	21-39	57	22	21	7	5.2	0.03	0.60	20	-	-	0.05	0.11	1.1	0.5	7.8
Bt	39-52	45	25	30	13	5.1	0.03	0.36	12	-	-	0.08	0.09	1.7	0.8	12.3
C	52-100	46	36	18	8	5.0	-	-	-	-	-	0.02	0.18	2.2	0.8	11.7
IIC	100-116	5	57	38	17	4.7	-	-	-	-	-	0.06	0.43	7.7	2.9	19.1
IIIC	116-146	32	48	20	9	4.9	-	-	-	-	-	0.02	0.22	7.2	2.5	12.8

A DESCRIPTION OF A SOIL PROFILE OF THE SIMONETTE 1 SOIL UNIT

Soil Unit: STT 1
Location: NW 4-61-2-W6th
Topography: gently undulating
Elevation: 1,300 m (4,250 feet)
Vegetation: black spruce, lodgepole pine, Labrador tea, cranberry, blueberry, kinnikinnick, moss
Drainage: poorly drained
Parent Material: preglacial fluvial cobbly gravel
Classification: Peaty Fera Gleysol

L 26 to 13 cm; relatively undecomposed moss; many, medium roots; clear, smooth boundary.

H 13 to 0 cm; black (2.5Y 2.5/0 m) well decomposed plant remains; plentiful, fine and medium roots; clear, wavy boundary.

Aeg 0 to 8 cm; brown (10YR 5/3 m) cobbly loam; many, medium, prominent yellowish brown (10YR 5/8 m) mottles; moderate, medium platy; friable; few, fine roots; excessively cobbly; clear, wavy boundary.

Bgf 8 to 17 cm; grayish brown (10YR 5/2 m) cobbly sandy loam; few, medium, prominent yellowish red (5YR 4/8 m) mottles; single grain; friable; no roots; excessively cobbly; clear, smooth boundary.

Cg1 17 to 48 cm; dark yellowish brown (10YR 4/4 m) cobbly sandy loam; few, fine, faint yellowish brown (10YR 5/4 m) mottles; single grain; friable; no roots; excessively cobbly; abrupt, smooth boundary.

Cg2 48+ cm; pale brown (10YR 6/3 m) cobbly sandy loam; common, medium, prominent strong brown (7.5YR 5/6 m) mottles; single grain; friable; no roots; excessively cobbly.

Analyses of a Simonette Soil Profile (STT 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L	26-13	-	-	-	-	3.9	0.52	12.26	24	-	-	0.18	1.88	11.0	3.8	97.8
H	13-0	-	-	-	-	4.3	1.07	41.34	39	-	-	0.04	0.34	1.5	0.4	62.2
Aeg	0-8	33	46	21	12	4.7	0.07	1.49	21	-	-	0.03	0.14	0.3	0.1	15.7
Bgf	8-17	73	14	13	7	5.0	0.04	0.78	20	-	2.48 (Fe=1.10)	0.00	0.07	0.3	0.1	10.0
Cg1	17-48	69	14	17	10	4.9	-	-	-	-	-	0.03	0.11	1.0	0.3	13.8
Cg2	48+	61	24	15	9	4.9	-	-	-	-	-	0.04	0.12	2.2	0.8	9.5

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE HEART 1 SOIL UNIT

Soil Unit: HRT 1
Location: NE 36-64-2-W6th
Topography: undulating
Elevation: 820 m (2,700 feet)
Vegetation: lodgepole pine, Labrador tea, bunchberry, blueberry, kinnikinnick, moss
Drainage: rapidly drained
Parent Material: eolian sand
Classification: Eluviated Eutric Brunisol

L - F 3 to 0 cm; relatively undecomposed pine needles and moss; clear, abrupt boundary.

Ae 0 to 5 cm; light gray (10YR 7/2 m) loamy sand; weak, fine platy to single grain; loose; plentiful, fine and medium roots; non-stony; abrupt, wavy boundary.

Bfj 5 to 21 cm; red (2.5YR 4/6 m) sandy loam; single grain; loose; plentiful, fine and medium roots; non-stony; clear, wavy boundary.

Bm 21 to 31 cm; yellowish red (5YR 5/6 m) loamy sand; single grain; loose; abundant, fine roots; non-stony; clear, wavy boundary.

BC 31 to 91 cm; yellowish brown (10YR 5/4 m) sand; single grain; loose; few, fine roots; non-stony.

Analyses of a Heart Soil Profile (HRT 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	3-0	-	-	-	-	6.0	-	-	-	-	-	-	-	-	-	-
Ae	0-5	83	14	3	1	6.5	0.03	0.61	20	-	0.06	-	-	-	-	-
Bfj	5-21	68	19	13	4	6.6	0.03	0.47	16	-	0.43	-	-	-	-	-
Bm	21-31	88	6	6	2	6.5	0.01	0.16	16	-	0.18	-	-	-	-	-
BC	31-91	91	8	1	0	6.5	-	-	-	-	-	-	-	-	-	

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE HEART 3 SOIL UNIT

Soil Unit: HRT 3
Location: NW 35-67-10-W6th
Topography: gently rolling
Elevation: 740 m (2,450 feet)
Vegetation: lodgepole pine, white spruce, occasional aspen poplar, Labrador tea, rhododendron, buffalo-berry, cranberry, blueberry, lichen, grass, moss
Drainage: well drained
Parent Material: eolian sand
Classification: Brunisolic Gray Luvisol

L - F 3 to 0 cm; relatively undecomposed pine needles, moss, grass and other plant remains; abundant, coarse roots; clear, smooth boundary.

Ae 0 to 8 cm; gray to light gray (10YR 6/1 m) loamy sand; single grain; loose; abundant, coarse roots; non-stony; abrupt, wavy boundary.

Bfj 8 to 17 cm; strong brown (7.5YR 5/6 m) sandy loam; single grain; loose; plentiful, medium roots; non-stony; clear, wavy boundary.

Bm 17 to 35 cm; yellowish brown (10YR 5/4 m) sandy loam; single grain; loose; plentiful, fine roots; non-stony; abrupt, broken boundary.

Bt 35 to 65 cm; brown to dark brown (10YR 4/3 m) sandy loam to sandy clay loam; weak, fine sun-angular blocky; friable; few, fine and medium roots; non-stony; abrupt, broken boundary.

Ck 65 to 120 cm; dark grayish brown (10YR 4/2 m) sandy loam; single grain; loose; very few, fine roots; non-stony.

Analyses of a Heart Soil Profile (HRT 3)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	3-0	-	-	-	-	5.2	-	-	-	-	-	0.06	1.35	16.8	2.4	26.9
Ae	0-8	75	23	2	0	5.4	0.02	0.19	10	-	-	0.01	0.08	1.6	0.2	2.5
Bfj	8-17	72	18	10	3	5.6	0.03	0.30	10	-	0.45	0.01	0.17	2.7	0.4	6.3
Bm	17-35	73	18	9	4	5.8	0.02	0.18	9	-	-	0.12	0.14	3.4	0.6	4.7
Bt	35-65	69	11	20	13	6.0	0.03	0.34	11	-	-	0.02	0.25	5.2	1.4	9.9
Ck	65-120	73	13	14	7	7.6	-	-	-	15.3	-	-	-	-	-	-

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE COPTON 1 SOIL UNIT

Soil Unit: COP 1
Location: NE 23-59-9-W6th
Topography: moderately rolling
Elevation: 1,670 m (5,500 feet)
Vegetation: lodgepole pine, alpine fir, Labrador tea, bunchberry, cranberry, rhododendron, moss
Drainage: well to moderately well drained
Parent Material: unconsolidated sandstone bedrock overlying consolidated sandstone
Classification: Eluviated Dystric Brunisol

L - F 2 to 0 cm; relatively undecomposed conifer needles and moss; abundant, fine and medium roots; abrupt, smooth boundary.

Ae 0 to 13 cm; brown (7.5YR 5/2 m) loam to sandy clay loam; weak, fine platy; very friable; abundant, coarse and fine roots; some soft sandstone (S1); clear, wavy boundary.

Bfj 13 to 23 cm; strong brown (7.5YR 5/6 m) loam to sandy clay loam; weak, fine subangular blocky; very friable; plentiful, coarse roots; some soft sandstones (S1); clear, wavy boundary.

Bm 23 to 47 cm; light olive brown (2.5Y 5/4 m) loam to sandy clay loam; moderate, fine subangular blocky; friable; plentiful, medium and fine roots; some soft sandstones (S1-2); clear, irregular boundary.

C 47 to 64 cm; brown to dark brown (10YR 4/3 m) sandy loam to sandy clay loam; single grain; very friable; few, fine roots, some soft sandstones (S2); clear, irregular boundary.

R 64+ cm; brown to dark brown (10YR 4/3 m) consolidated sandstone slabs; no roots.

Analyses of a Copton Soil Profile (COP 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Ae	0-13	46	26	28	-	4.7	0.10	2.38	24	-	-	0.03	0.34	1.7	0.6	21.8
Bfj	13-23	48	24	28	-	5.0	0.05	0.89	18	-	0.75	0.03	0.18	1.5	0.6	21.4
Bm	23-47	50	26	24	-	5.0	0.04	0.54	14	-	-	0.03	0.18	2.2	0.9	21.4
C	47-64	54	26	20	-	4.9	0.04	-	-	-	-	0.03	0.15	4.2	1.7	21.8

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE COPTON 3 SOIL UNIT

Soil Unit:	COP 3
Location:	NE 10-58-9-W6th
Topography:	strongly rolling
Elevation:	1,370m (4,500 feet)
Vegetation:	lodgepole pine, alpine fir, Labrador tea, bunchberry, cranberry, kinnikinnick, moss
Drainage:	well drained
Parent Material:	thin unconsolidated sandstone bedrock overlying consolidated sandstone slabs
Classification:	Lithic Eluviated Dystric Brunisol

L - F — 15 to 0 cm; relatively undecomposed moss and conifer needles; plentiful, medium roots; abrupt, smooth boundary.

Ae — 0 to 18 cm; light brownish gray (10YR 6/2 m) loam; moderate, medium platy; very friable; plentiful, fine and medium roots; non-stony; clear, wavy boundary.

Bm — 18 to 33 cm; yellowish brown (10YR 5/4 m) loam; weak, medium subangular blocky; very friable; plentiful, fine and medium roots; non-stony; abrupt, smooth boundary.

R — 33+ cm; dark brown (10YR 3/3 m) consolidated sandstone; no roots.

Analyses of a Copton Soil Profile (COP 3)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	15-0	-	-	-	-	3.5	1.05	47.48	45	-	-	0.07	1.87	19.3	3.3	139.2
Ae	0-18	40	46	14	-	4.2	0.05	0.94	19	-	-	0.01	0.17	2.1	0.8	10.7
Bm	18-33	39	45	16	-	5.2	0.05	0.94	19	-	0.21	0.01	0.10	3.3	1.1	9.4

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE TORRENS 1 SOIL UNIT

Soil Unit: TOR 1
Location: NW 35-64-11-W6th
Topography: gently rolling
Elevation: 1,420 m (4,650 feet)
Vegetation: lodgepole pine, Engelmann spruce, white spruce, alpine fir, willow, alder, cranberry, blueberry, Labrador tea, moss, some grass
Drainage: moderately well drained
Parent Material: unconsolidated mudstone
Classification: Orthic Gray Luvisol

L - F 8 to 0 cm; relatively undecomposed moss, roots, conifer needles and other plant remains; abrupt, wavy boundary.

Ae1 0 to 13 cm; light brownish gray (10YR 6/2 m) silt loam; moderate, fine to medium platy; very friable; abundant, fine roots; non-stony; clear, wavy boundary.

Ae2 13 to 23 cm; yellowish brown (10YR 5/6 m) silty clay loam to clay loam; weak, fine platy; friable; abundant, fine roots; slightly stony; gradual, irregular boundary.

Bt 23 to 33 cm; light olive brown (2.5Y 5/4 m) silty clay loam to silty clay; moderate, fine to medium subangular blocky; friable; plentiful, fine roots; slightly stony; gradual, irregular boundary.

BC 33 to 50 cm; olive brown (2.5Y 4/4 m) silty clay; pseudo, weak, fine subangular blocky; friable; few, fine roots; slightly stony; diffuse, broken boundary.

C 50 to 90 cm; brown to dark brown (10YR 4/3 m) silty clay; pseudo, weak, fine subangular blocky to massive; friable to firm; few, fine roots; non-stony.

Analyses of a Torrens Soil Profile (TOR 1)

Horizon	Depth (cm)	Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g): Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
L-F	8-0	-	-	-	-	4.7	-	-	-	-	-	0.25	0.92	5.6	1.8	41.2
Ae1	0-13	28	57	15	3	5.0	0.10	1.39	14	-	-	0.16	0.12	0.8	0.4	10.9
Ae2	13-23	19	51	30	9	4.9	0.08	0.82	10	-	-	0.03	0.16	1.4	0.8	15.4
Bt	23-33	16	45	39	18	4.8	0.09	1.51	17	-	-	0.03	0.22	2.3	1.3	21.3
BC	33-50	15	40	45	18	4.8	-	-	-	-	-	0.07	0.24	3.6	1.8	24.6
C	50-90	16	41	43	22	5.4	-	-	-	-	-	0.12	0.23	9.7	4.0	25.1

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE EAGLESHAM SOIL UNIT

Soil Unit: EGL
Location: NW 19-66-11-W6th
Topography: depressional
Elevation: 910 m (3,000 feet)
Vegetation: willow, sedge, reeds, rushes, grass
Drainage: very poorly drained
Parent Material: fen peat
Classification: Terric Mesic Fibrisol

Of1 0 to 10 cm; brown (10YR 5/3 m) 74 percent unrubbed fiber and 48 percent rubbed fiber; strongly layered with some mineral washed in; compact; non-woody; abundant, fine and coarse roots; predominantly reeds, sedges and rushes; clear, smooth boundary.

Om1 10 to 20 cm; very dark grayish brown (10YR 3/2 m) 77 percent unrubbed fiber and 21 percent rubbed fiber; moderately layered with some mineral washed in; compact; non-woody; abundant, fine and medium roots; mainly sedges, rushes and reeds, some moss; abrupt, smooth boundary.

Of2 20 to 48 cm; dark brown (7.5YR 4/4 m) 79 percent unrubbed fiber and 52 percent rubbed fiber; weakly layered; compact; non-woody; plentiful, fine and medium roots; mainly sedges and reeds; clear, smooth boundary.

Om2 48 to 60 cm; dark brown (7.5YR 3/2 m) 75 percent unrubbed fiber and 30 percent rubbed fiber; weakly layered; compact; non-woody; few, fine and medium roots; mainly sedges and reeds; clear, smooth boundary.

Of3 60 to 90 cm; dark brown (7.5YR 4/4 m) 93 percent unrubbed fiber and 52 percent rubbed fiber; strongly layered; very compact; non-woody; few, fine and medium roots; mainly sedges and reeds; abrupt, smooth boundary.

Cg 90 to 102 cm; dark grayish brown (10YR 4/2 m) silty clay loam; amorphous; very friable; very few, fine roots; non-stony.

Analyses of an Eaglesham Soil Profile (EGL)

Horizon	Depth (cm)	Unrubbed Fiber (%)	Rubbed Fiber (%)	Ash (%)	Pyrophosphate Color (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Of1	0-10	74	48	37.8	10YR 8/2	4.9	1.54	30.53	20	-	-	0.36	4.02	22.2	7.2	91.4
Om1	10-20	77	21	15.7	10YR 8/2	5.2	3.15	38.43	12	-	-	0.34	2.92	22.8	4.8	94.4
Of2	20-48	79	52	4.0	10YR 7/1	5.1	3.02	50.79	17	-	-	0.17	0.38	24.5	3.1	91.4
Om2	48-60	75	30	4.8	10YR 7/1	4.9	3.15	47.69	15	-	-	0.30	0.32	29.7	3.6	103.2
Of3	60-90	93	52	8.8	10YR 6/1	5.0	3.02	50.96	17	-	-	0.43	0.33	19.4	3.1	76.8
		Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)											
Cg	90-102	18	53	29	13	5.1	0.83	9.38	11	-	-	0.04	0.99	7.5	1.9	39.6

A DESCRIPTION OF A SOIL PROFILE COMMON TO THE KENZIE SOIL UNIT

Soil Unit: KNZ
Location: SW 20-69-6-W6th
Topography: level to gently undulating
Elevation: 670 m (2,200 feet)
Vegetation: black spruce, tamarack, Labrador tea, moss
Drainage: very poorly drained
Parent Material: moss peat
Classification: Terric Mesic Fibrisol

Of1 0 to 30 cm; reddish brown (5YR 4/4 m) 92 percent unrubbed fiber and 82 percent rubbed fiber; weakly layered; spongy; non-woody; abundant, medium roots; predominantly sphagnum and feathermoss peat; clear, wavy boundary.

Of2 30 to 68 cm; dusky red (2.5YR 3/2 m) and dark reddish brown (2.5YR 3/4 m) 92 percent unrubbed fiber and 80 percent rubbed fiber; moderately to strongly layered; compacted to feltlike; moderately woody; plentiful, medium roots; predominantly feathermoss peat; diffuse, wavy boundary.

Om1 68 to 93 cm; yellowish red (5YR 5/6 m) and dark reddish brown (5YR 3/2 m) 72 percent unrubbed fiber and 31 percent rubbed fiber; very weakly layered; compacted to feltlike; very slightly woody; few, fine roots; slightly discernible feathermoss; abrupt, smooth boundary.

Cg 93 to 103 cm; gray (5Y 5/1 m) silt loam to silty clay loam; few, fine distinct yellowish brown (10YR 5/6 m) mottles; massive and somewhat stratified; firm; very few, fine roots; non-stony.

Analyses of a Kenzie Soil Profile (KNZ)

Horizon	Depth (cm)	Un-rubbed Fiber (%)	Rubbed Fiber (%)	Ash (%)	Pyrophosphate Color (%)	pH (H_2O)	N (%)	Organic C (%)	C/N	$CaCO_3$ Equivalent (%)	Pyrophosphate Extractable Fe + Al (%)	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Cation Exchange Capacity (me/100g)
Of1	0-30	92	82	2.2	10YR 7/1	3.6	0.62	42.36	68	-	-	0.41	1.08	16.3	11.8	182.8
Of2	30-68	92	80	-	-	4.1	0.65	40.41	62	-	-	0.04	0.26	35.0	17.8	202.3
Om1	68-93	72	31	13.5	-	5.2	0.98	45.66	46	-	-	0.30	0.07	67.2	28.2	212.0
		Particle Size Analysis: Sand (%)	Silt (%)	Clay (%)	Fine Clay (%)											
Cg	93-103	10	62	28	1.3	5.9	-	-	-	-	-	0.12	0.57	7.9	4.4	19.2

APPENDIX B

FOREST VEGETATION CLASSIFICATION

CLASSIFICATION OF THE FOREST VEGETATION

The forest vegetation of map area 83L was classified into 15 forest types on the basis of the dominant tree species, floristic composition, and environment as inferred from soils. The concepts of the forest types were developed both during field investigations and after the plots were sampled and the data analyzed. No attempt was made to restrict sampling to certain forest types nor to exclude certain forest types from sampling, though some forest types are not well represented, particularly those at high elevations. A table giving species composition of the 137 plots comprising the 15 forest types can be found in Corns (1978). The plant species representative of the plant communities in the Wapiti map area are given in Table 11.

1. Aspen/Low-bush cranberry/Dewberry
(Populus tremuloides/Viburnum edule/Rubus pubescens)

This type represents the aspen forests in the northern sectors of map area 83L (Plate 33). These forests are found at low elevations (610 to 960 m) on gentle north slopes (Classes b to e; CSSC 1974). They are young (45 to 125 years), have lush shrub and herb understorys, and often have plentiful white spruce regeneration. Constant species (over 80 percent presence in plots within type) which comprise most of the total plant cover, are *Viburnum edule, Lonicera involucrata, Rosa acicularis, Petasites palmatus, Rubus pubescens, Epilobium angustifolium, Pyrola asarifolia, Aster conspicuus, Maianthemum canadense, Cornus canadensis and Linnaea borealis.* No species have mean cover greater than 7 percent. *Aralia nudicaulis* and *Spiraea lucida* are locally abundant. The moss layer has generally low cover. Scientific and common names of species characteristic of the vegetation of the Wapiti map area are in Table 11.

The anticipated climax is the *Picea glauca/Rubus pubescens/Maianthemum canadense* type. The abundant white spruce regeneration and maturing white spruce trees in the understory suggest probable eventual dominance by white spruce. Forest productivity is variable in the aspen forests ranging from Canada Land Inventory (CLI) classes 3 to 5 (Table 12) as determined from the plot data.

Soils are well to imperfectly drained and include in order of decreasing abundance, Gleyed Gray Luvisols, Orthic Gray Luvisols, Solonetzic Gray Luvisols and Eluviated Eutric Brunisols on fine-textured lacustro-till, lacustrine deposits, and alluvium overlying lacustro-till parent materials. Lodge and Donnelly are the predominant soil groups.

2. Balsam poplar/Prickly rose/Veiny meadow rue
(Populus balsamifera/Rosa acicularis/Thalictrum venulosum)

Balsam poplar forests grow sporadically at low elevations (690 m) on alluvial floodplains which are still subject to periodic flooding. The herb understory is dense but moss cover is sparse. Constant species are *Rosa acicularis, Rubus strigosus, Lonicera involucrata, Thalictrum venulosum, Equisetum arvense, Aster conspicuus, Mertensia paniculata, Calamagrostis canadensis* and *Vicia americana.* Stands of this type are young (about 70 years) and appear to be succeeding towards the *Picea glauca/Rubus pubescens/Maianthemum canadense* type. This trend is suggested by the many understory species in common to the two types and the presence of white spruce seedlings and maturing white spruce trees in the understory. Balsam poplar productivity is fairly high (class 3), but heart-rot in this species develops at an early age. Iosegun is the predominant soil group.

Plate 33. A typical aspen poplar forest.

TABLE 11
Plant Species of Representative Plant Communities in the Wapiti Map Area

Species	Common Name
Trees	
Abies lasiocarpa	subalpine fir
Betula papyrifera	paperbirch
Larix laricina	tamarack
Picea engelmannii	Engelmann spruce
Picea glauca	white spruce
Picea mariana	black spruce
Pinus contorta	lodgepole pine
Populus balsamifera	balsam poplar
Populus tremuloides	aspen poplar
Shrubs	
Alnus crispa	green alder
Alnus tenuifolia	river alder
Betula glandulosa	dwarf birch
Betula pumila var glandulifera	swamp birch
Cornus stolonifera	red osier dogwood
Juniperus communis	common juniper
Ledum groenlandicum	Labrador tea
Lonicera involucrata	bracted honeysuckle
Menziesia glabella	false azalea
Oplopanax horridum	devil's club
Rhododendron albiflorum	white flowered rhododendron
Rosa acicularis	prickly rose
Rubus parviflorus	thimbleberry
Salix spp.	willow
Sorbus scopulina	mountain ash
Spiraea lucida	white meadowsweet
Vaccinium membranaceum	tall bilberry
Viburnum edule	low-bush cranberry
Herbs and dwarf shrubs	
Aralia nudicaulis	wild sarsaparilla
Arctostaphylos uva-ursi	bearberry
Arnica cordifolia	heartleaf arnica
Arnica latifolia	mountain arnica
Artemisia norvegica	wormwood
Aster conspicuus	showy aster
Calamagrostis canadensis	marsh reed grass
Carex capillaris	hair sedge
Carex nardina	spikenard sedge
Cassiope mertensiana	white mountain heather
Cassiope tetragona	white mountain heather
Castilleja spp.	indian paintbrush
Cornus canadensis	bunchberry
Dryas integrifolia	white mountain avens
Dryas octopetala	white mountain avens
Elymus innovatus	hairy wild rye
Equisetum arvense	common horsetail
Epilobium angustifolium	fireweed
Fragaria virginiana	wild strawberry
Gymnocarpium dryopteris	oak fern
Kobresia myosuroides	Kobresia
Linnaea borealis	twinflower
Lycopodium annotinum	stiff clubmoss
Lycopodium complanatum	ground cedar
Lupinus nootkatensis	lupine
Maianthemum canadense	wild lily of the valley
Mertensia paniculata	tall mertensia
Mitella nuda	bishop's cap
Oxycoccus microcarpus	small bog cranberry
Pedicularis bracteosa	bracted lousewort
Petasites palmatus	palmate leaf coltsfoot
Phyllodoce empetriformis	red or purple heather
Phyllodoce glanduliflora	yellow heather
Polygonum viviparum	bistort
Pyrola asarifolia	common pink wintergreen

TABLE 11 (continued)

Species	Common Name
Herbs and dwarf shrubs (continued)	
Pyrola secunda	one sided wintergreen
Ranunculus eschscholtzii	buttercup
Rubus chamaemorus	cloudberry
Rubus pedatus	five leaved bramble
Rubus pubescens	dewberry
Salix arctica	arctic willow
Salix nivalis	snow willow
Saxifraga tricuspidata	saxifrage
Silene acaulis	moss campion
Thalictrum venulosum	veiny meadow rue
Tiarella trifoliata	false mitrewort
Vaccinium caespitosum	dwarf bilberry
Vaccinium myrtilloides	blueberry
Vaccinium vitis-idaea	bog cranberry
Vicia americana	wild vetch
Mosses and lichens	
Cladonia spp.	reindeer lichen and others
Peltigera aphthosa	lichen
Pleurozium schreberi	feathermoss
Ptilium crista-castrensis	knight's plume , feathermoss
Hylocomium splendens	stair-step moss, feathermoss
Sphagnum spp.	sphagnum moss

TABLE 12

Canada Land Inventory Mean Annual Total Volume Increment Classes

Canada Land Inventory Class	Mean Annual Increment (ft^3 $acre^{-1}$ yr^{-1})	Mean Annual Increment (m^3 ha^{-1} yr^{-1})
1	greater than 111	greater than 7.8
2	91 - 110	6.4 - 7.8
3	71 - 90	5.0 - 6.3
4	51 - 70	3.6 - 4.9
5	31 - 50	2.2 - 3.5
6	11 - 30	0.8 - 2.1
7	less than 10	less than 0.8

3. White spruce/Dewberry-Wild lily of the valley
(Picea glaucus/Rubus pubescens-maianthemum canadense)

These white spruce forests (Plate 34) are found at low to medium elevations (670 to 1220 m) on generally north-sloping (classes b to f) sites. They are generally young (70 to 140 years) and have well developed shrub and herb understorys. Constant species are *Lonicera involucrata, Rosa acicularis, Viburnum edule, Rubus pubescens, Maianthemum canadense, Mitella nuda, Cornus canadensis, Linnaea borealis,* and *Petasites palmatus. Cornus stolonifera, Alnus crispa, Alnus tenuifolia,* and *Aralia nudicaulis* are often evident in this type but are seldom seen in the other white spruce types. *Hylocomium splendens* is the predominant moss. This type can commonly be seen on depressional sites within aspen forest, suggesting that succession advances faster on these sites. The abundance of white and black spruce seedlings and fir seedlings in some stands of this type should ensure perpetuation of this type as well as increased abundance of black spruce and subalpine fir in some stands. Forest productivity is good (classes 3 and 4) but appears to be lower in the older forests. It is distinguished from the wetter *Picea glauca/Equisetum arvense/Hylocomium splendens* type by the presence of *Maianthemum canadense,* lower *Equisetum arvense* cover, the absence of *Carex capillaris,* less moss cover and by generally better drained soils.

Soils are moderately well to imperfectly drained Orthic Gray Luvisols, Gleyed Gray Luvisols and Luvic Gleysols developed on lacustrotill, and Continental and Cordilleran till. Donnelly, Snipe, and Edson are the predominant soil groups.

4. White spruce/Horsetail/Feathermoss
(Picea glauca/Equisetum arvense/Hylocomium splendens)

The white spruce/horsetail forests are found at low to moderately high elevations (670 to 1450 m) on gentle (classes a to d) generally north-facing slopes. They are young to moderately old (80 to 220+ years). White spruce and subalpine fir regeneration is common in many of the stands. The understory is herb-dominated and a dense *Hylocomium splendens* cover is present with lesser amounts of *Ptilium crista-castrensis* and *Pleurozium schreberi.* Constant species include *Rosa acicularis, Lonicera involucrata, Equisetum arvense, Petasites palmatus, Mertensia paniculata, Mitella nuda, Cornus canadensis, Linnaea borealis,* and *Rubus pubescens. Carex capillaris,* an indicator of the moist conditions of this type, is found in approximately one-half of the plots of this type. Forest productivity is variable (class 2 to 5) and appears to be less in the older forests.

Plate 34. A typical white spruce forest.

Soils are poorly to imperfectly drained peaty Orthic Gleysols, peaty Luvic Gleysols and Orthic, Luvic, and Rego Gleysols on Continental till, alluvial sand, and lacustrotill parent materials. Snipe, Smoky, and Gunderson are the predominant soil groups.

5. White spruce/Feathermoss
(Picea glauca/Hylocomium splendens)

The white spruce/feathermoss forests (Plate 35) grow at low to moderately high elevations (610 to 1280 m), often along valleys of major rivers on old river terraces, on generally north sloping (classes b to f) sites. They are young to moderately old (70 to 170 years), have sparse shrub understorys, a herb-dwarf shrub stratum dominated by *Cornus canadensis* and *Linnaea borealis* and a dense cover of *Hylocomium splendens* and *Pleurozium schreberi.* Lodgepole pine forms a large proportion of the basal area in some stands but is being replaced by white spruce. Subalpine fir regeneration is abundant in most of the stands, suggesting eventual co-dominance of subalpine fir with white spruce. Constant species are *Cornus canadensis, Linnaea borealis, Pyrola secunda, Hylocomium splendens,* and *Pleurozium schreberi.* This type is stable and has moderate forest productivity (class 4 to 5). Hybrids of white and Engelmann spruce are found at higher elevations within this type where productivity is lower.

Soils are rapidly to well-drained Orthic and Cumulic Regosols, Brunisolic Gray Luvisols, and Orthic Gray Luvisols on generally coarse-textured alluvial sands and gravels, outwash gravels, and coarse-textured Cordilleran till. Jarvis and Robb are the predominant soil groups.

6. Black spruce/Labrador tea/Horsetail
(Picea mariana/Ledum groenlandicum/Equisetum arvense)

The black spruce forests are found at low to mid-elevations (840 to 1220 m) on gently sloping (classes b to d) sites with a northerly aspect, and may occur in association with the *Picea mariana/Ledum groenlandicum/Rubus chamaemorus* type (Plate 36). The slight slope of stands of this type probably allows more oxygen to move through the peaty soil than in the black spruce/Labrador tea/cloudberry type. The stands are young to fairly old (75 to 180 years) and are usually in climax condition, with abundant black spruce regeneration. The herb understory is often species rich. Constant species are *Ledum groenlandicum, Vaccinium vitis-idaea, Equisetum arvense, Petasites palmatus, Carex capillaris* and *Cornus canadensis.* The moss stratum is dominated by *Hylocomium splendens, Pleurozium schreberi,* and lesser amounts of *Ptilium crista-castrensis* and *Sphagnum* spp. Although individual trees often attain merchantable size (such as occasional white spruce) in this type, overall productivity is rather low (classes 5 and 6).

Soils are poorly drained Terric Mesisols, peaty Rego Gleysols, and Humic Luvic Gleysols on organic and occasionally till parent materials. Kenzie and, to a lesser extent, Smoky are the predominant soil groups.

Plate 35. A typical white spruce feathermoss vegetation type.

Plate 36. A stand of black spruce.

7. Black spruce/Labrador tea/Cloudberry
(Picea mariana/Ledum groenlandicum/Rubus chamaemorus)

This type represents the black spruce bog vegetation (Plate 36). The bogs are found at low to mid-elevations (915 to 1070 m) in depressions with impeded drainage on level sites with hummocky microtopography. These open forests are often over 200 years old and can be considered climax. The well developed shrub layer is dominated by *Ledum groenlandicum.* The herb-dwarf shrub understory is dominated by *Vaccinium vitis-idaea, Rubus chamaemorus,* and *Oxycoccus microcarpus. Sphagnum* spp. are abundant. Tree cover is sparse and productivity is very low (class 7); the trees can be considered non-merchantable.

Soils are poorly drained Typic Mesisols and Fibrisols on moss peat parent materials. Kenzie is the predominant soil unit.

8. Lodgepole pine/Low-bush cranberry/Dewberry
(Pinus contorta/Viburnum edule/Rubus pubescens)

This is a relatively common forest type in 83L on north-sloping (classes b to f) sites at mid-elevations (880 to 1040m). It is characterized by young (80 to 90 years) lodgepole pine stands developed in areas previously decimated by fires; white spruce, black spruce, subalpine fir and paper birch regeneration is common, indicating possible eventual dominance of these species. The occasional occurrence of *Oplopanax horridum* in this type and the lush herb understory seem to indicate high precipitation. Constant species include *Viburnum edule, Lonicera involucrata, Rosa acicularis, Rubus pubescens, Cornus canadensis, Linnaea borealis, Pyrola asarifolia,* and *Epilobium angustifolium. Pleurozium schreberi* dominates the moss layer. Though not restricted to this type, *Sorbus scopulina, Spiraea lucida, Maianthemum canadense,* and *Gymnocarpium dryopteris* may be considered to be indicators of these forests. This type is similar to the *Pinus contorta/Spiraea lucida/Cornus canadensis* type but appears to be more moist as indicated by the higher cover of *Viburnum, Sorbus, Rubus,* and *Gymnocarpium.* This type also has affinities with the *Picea glauca/Rubus pubescens-Maianthemum canadense* type towards which it might be expected to succeed. Forest productivity is good (classes 3 and 4).

Soils are rapidly to imperfectly drained and include Gleyed Gray Luvisols, Eluviated and Orthic Eutric Brunisols, "bleached" Gray Luvisols (Brunisolic Gray Luvisols with Ae1 horizon of high color value above a darker Ae2 horizon) and Orthic Gray Luvisols on Continental till, sandstone and shale bedrock and aeolian sand parent materials. Edson, Torrens, and Copton are the predominant soil groups.

9. Lodgepole pine/White meadowsweet/Bunchberry
(Pinus contorta/Spiraea lucida/Cornus canadensis)

This type is not common and grows at low elevations (915 to 1265 m) on sloping topography (classes d to g) in association with the *Pinus contorta/Viburnum edule/Rubus pubescens* type. It is characterized by young (less than 125 years) lodgepole pine stands developed in the wake of forest fires with a lush herb-dominated understory and regenerating aspen, paper birch, and some black spruce. Constant species include *Betula papyrifera, Rosa acicularis, Spiraea lucida, Cornus canadensis, Linnaea borealis, Arnica cordifolia, Lycopodium annotinum, Lycopodium complanatum, Pyrola asarifolia,* and *Pleurozium schreberi,* the dominant moss. Forest productivity is moderate (classes 4 and 5).

Soils are well to moderately well drained Orthic Gray Luvisols and Brunisolic Gray Luvisols on Continental till, Cordilleran till, and alluvial sand over bedrock parent materials. Soil groups include Mayberne, Edson, Robb, and Lodge over unconsolidated sandstone bedrock.

10. Lodgepole pine/Green alder/Bunchberry
(Pinus contorta/Alnus crispa/Cornus canadensis)

This type is fairly common and is characterized by young (less than 100 years) lodgepole pine stands developed after the spread of forest fires at moderate elevations (840 to 1280 m). Well developed shrub and herb understorys are present and many stands have abundant white spruce regeneration. Constant species include *Alnus crispa, Vaccinium caespitosum, Cornus canadensis, Linnaea borealis, Arnica cordifolia, Petasites palmatus, Calamagrostis canadensis, Pyrola asarifolia, Equisetum arvense,* and *Pleurozium schreberi,* the dominant moss. The shrub *Rubus parviflorus* is present sporadically in this type.

Soils are moderately well to imperfectly drained Orthic and Gleyed Gray Luvisols, Brunisolic Gray Luvisols, and "bleached" Gray Luvisols on Cordilleran or Continental till and shale and sandstone bedrock. Edson, Marlboro, and Torrens are the predominant soil groups.

11. Lodgepole pine/Labrador tea/Feathermoss
(Pinus contorta/Ledum groenlandicum/Pleurozium schreberi)

The Lodgepole pine/Labrador tea/Feathermoss forests are common at moderate elevations (745 to 1220 m) and are characterized by young to fairly old (80 to 180 years) lodgepole pine stands developed after decimation by forest fires on sloping topography (classes b to e). Black spruce is often present and may eventually assume dominance. Labrador tea is usually abundant but dwarf shrub and herb cover is usually sparse. The moss layer is dominated by a dense cover of *Pleurozium schreberi, Hylocomium splendens,* and *Ptilium crista-castrensis* with lesser amounts of the lichen, *Peltigera aphthosa* which reaches its highest cover in this type. Constant species include *Ledum groenlandicum, Vaccinium vitis-idaea, Cornus canadensis, Linnaea borealis, Pleurozium schreberi,* and *Peltigera aphthosa.* This type is similar to the Lodgepole pine/Black spruce/Labrador tea/Tall bilberry type but seems to occur in areas of lower precipitation at generally lower elevations. It lacks the tall bilberry which is often replaced by the blueberry (*Vaccinium myrtilloides*). Forest productivity is moderate (classes 4 and 5).

Soils are moderately well to imperfectly drained Orthic Gray Luvisols, Brunisolic Gray Luvisols, and "bleached" Gray

Plate 37. A forest of lodgepole pine and black spruce typical of the Lodgepole pine - Black spruce - Labrador tea - Tall Bilberry vegetation type.

Luvisols on Continental and Cordilleran till, lacustro-till, and bedrock parent materials. Soil groups include Edson, Snipe, Torrens, Copton, Lodge, and Heart.

12. Lodgepole pine/Black spruce/Labrador tea/Tall bilberry
(Pinus contorta/Picea mariana/Ledum groenlandicum/Vaccinium membranaceum)

The Lodgepole pine/Black spruce/Labrador tea/Tall bilberry forest type (Plate 37) covers more area than any other type in the 83L area, and is found on sloping (classes b to e) sites of variable aspect from low to relatively high elevations (840 to 1465 m). It is characterized by young to fairly old (65 to 190 years) lodgepole pine and black spruce stands originating after the passage of forest fires. Black spruce forms a tree understory layer of approximately the same age as the pine. Black spruce and subalpine fir regeneration is often abundant, indicating probable eventual succession to these species. *Ledum* often forms a dense low shrub understory, and herb cover is moderate. Constant species include *Ledum groenlandicum, Vaccinium membranaceum, Vaccinium vitis-idaea, Cornus canadensis,* and *Linnaea borealis.* A dense feathermoss cover of *Pleurozium schreberi* and *Hylocomium splendens* is usual. This type is transitional to the *Pinus contorta/Ledum groenlandicum/Pleurozium schreberi* type at lower elevations. At the upper limits of type 12, *Rubus pedatus* is common, and *Menziesia glabella, Rhododendron albiflorum, Tiarella trifoliata,* and *Arnica latifolia* are present sporadically. Forest productivity is moderate (class 5 with a few exceptions).

Soils are moderately well to imperfectly drained Orthic Gray Luvisols, Brunisolic Gray Luvisols and "bleached" Gray Luvisols. Edson, Mayberne, Copton, Marlboro, and Sheep are the predominant soil units.

13. Lodgepole pine/False azalea/Five-leaved bramble
(Pinus contorta/Menziesia glabella/Rubus pedatus)

The lodgepole pine/false azalea type is a subalpine forest type restricted to the south and west portions of 83L at high elevations (1220 to 1555 m) and is characterized by young to fairly old (70 to 180 years) lodgepole pine stands of fire origin. Black and white spruce and subalpine fir regeneration is common in the older stands indicating probable eventual succession to these species. A shrub understory of *Menziesia glabella* and often *Rhododendron albiflorum,* another characteristic species of subalpine forests, is present. Herb cover is moderate. The subalpine herb *Veratrum eschscholtzii* grows sporadically within this type. The predominantly shrub understory could compete with tree seedlings following clearcutting on this type. Constant species include *Menziesia glabella, Ledum groenlandicum, Vaccinium membranaceum, Vaccinium vitis-idaea, Rubus pedatus, Cornus canadensis, Linnaea borealis, Lycopodium annotinum, Pleurozium schreberi, Ptilium crista-castrensis,* and *Hylocomium splendens.* Forest productivity is low (classes 5 and 6).

Soils are well to moderately well drained Brunisolic Gray Luvisols and "bleached" Gray Luvisols on Continental till and thin Cordilleran till over bedrock parent materials. Putzy, Robb and Mayberne are the predominant soil groups, although this type also grows on small areas of Marlboro, Torrens, and Sheep soils.

14. Lodgepole pine/Blueberry/Lichen
(Pinus contorta/Vaccinium myrtilloides/Cladonia spp)

The Lodgepole pine/Blueberry/Lichen type was not common and was only sampled twice. It is restricted to well drained, coarse textured soils. The tree canopy is open, and black spruce regeneration is common. This type is closely related to the Lodgepole pine/Labrador tea/Feathermoss type, and is characterized by a similar climate and elevational range. Herb and moss cover is sparse but lichen cover may exceed 30 percent. Constant species include *Ledum groenlandicum, Vaccinium myrtilloides, Vaccinium vitis-idaea, Arctostaphylos uva-ursi, Cornus canadensis, Pleur-*

ozium schreberi, and *Cladonia* spp. Forest productivity is low (class 6), probably due to the soil's limited capacity to hold water.

Soils are well drained Orthic Humo-Ferric Podzols and Eluviated Eutric Brunisols on outwash sand and alluvial sand parent materials. Blackmud is the predominant soil group.

15. Engelmann spruce/Subalpine fir/False azalea
(Picea engelmanii/Abies lasiocarpa/Menziezia glabella)

The Engelmann spruce/Subalpine fir/False azalea forests are a climax type which grows on steep (classes e to g) north-facing slopes at high elevations (above 1670 m) in the south-west corner of the Wapiti map area. *Menziesia* may form a fairly dense shrub understory but herb and low shrub cover is generally sparse. Constant species include *Menziesia glabella, Phyllodoce empetriformis, Vaccinium membranaceum, Rubus pedatus, Pedicularis bracteosa, Cornus canadensis, Lycopodium annotinum,* and *Arnica latifolia.* Tree growth is slow (classes 5 and 6), and stands are usually not suitable for commercial use. The type is species poor and would show a slow recovery after disturbance.

Soils are moderately well to imperfectly drained Orthic Gray Luvisols on Cordilleran till. Robb and Copton are the predominant soil groups.

APPENDIX C

TABLES OF GUIDELINES FOR EVALUATING SOIL LIMITATIONS FOR SPECIFIC USES

TABLE 13
Guidelines for Evaluating Soil Limitations for Single Family Dwellings

Properties Affecting Use	Degree of Limitation		
	None to Slight	Moderate	Severe
Flooding	None	None	Subject to Flooding
Wetness (soil drainage)	WITH BASEMENTS: Very rapidly, rapidly and well drained soils. Water-table below 150 cm	WITH BASEMENTS: Moderately well drained soils, Water-table below 75 cm	WITH BASEMENTS: Imperfectly, poor and very poorly drained soils. Water-table above 75 cm one month or more during year
	WITHOUT BASEMENTS: Very rapidly, rapidly, well and moderately well drained soils. Water-table below 75 cm	WITHOUT BASEMENTS: Imperfectly drained soils. Water-table below 50 cm	WITHOUT BASEMENTS: Poorly and very poorly drained soils. Water-table above 50 cm 1 month or more during year
Slope	0 to 9%	9+ to 15%	Greater than 15%
Shrink-Swell potential	Low-Unified Groups[1] GW, GP, SW, SP, GM, GC, SM, SC, and CL with *P.I. less than 15	Moderate-Unified Groups ML, and CL with *P.I. more than or equal to 15	High-Unified Groups CH, MH, OL, OH and Peat
Depth to consolidated bedrock	WITH BASEMENTS: More than 150 cm WITHOUT BASEMENTS: More than 100 cm	WITH BASEMENTS: 100 cm to 150 cm WITHOUT BASEMENTS: 50 to 100 cm	WITH BASEMENTS: Less than 100 cm WITHOUT BASEMENTS: Less than 50 cm
Potential sulphate attack on concrete	0 to 1000 ppm	1000 to 2000 ppm	Greater than 2000 ppm
Surface stoniness	0 to 2	3	4 and 5
Potential frost action	Low-Unified Groups[1] GW, GP, SW, SP	Moderate-Unified Groups GM, GC, SC, CH, OH	High-Unified Groups ML, CL, OL, MH, SM
AASHO group index[2]	0 to 6	6 to 12	More than 12

*P.I. - Plasticity Index

[1] - See page 69 for description of Unified Groups

[2] - See page 69 for description of AASHO Index

TABLE 14
Guidelines for Evaluating Soil Limitations for On-Site Sewage Disposal

Properties Affecting Use	Degree of Limitation		
	None to Slight	Moderate	Severe
Flooding	Not subject to flooding	Not subject to flooding	Subject to flooding
Wetness (soil drainage)	Very rapidly, rapidly, well and moderately well drained soils not subject to ponding or seepage. Water-table below 180 cm	Well and moderately well drained soils subject to occasional ponding or seepage. Imperfectly drained soils not subject to ponding. Water-table 120 to 180 cm	Imperfectly drained soils subject to ponding. Poorly and very poorly drained soils. Very rapidly and rapidly drained soils if groundwater contamination hazard. Water-table less than 120 cm
Slope	0 to 9%	9+ to 15%	Greater than 15%
Permeability	Very rapid to moderate inclusive (greater than 1.8 cm/hour)	Moderately slow (0.5 to 1.8 cm/hour)	Slow and very slow (less than 0.5 cm/hour) Very rapid and rapid if groundwater contamination hazard
Depth to consolidated bedrock	More than 178 cm	120 to 178 cm	Less than 120 cm
Depth to sand or gravel	More than 180 cm	If less than 180 cm and a groundwater contamination hazard exists, limitation is severe	Less than 180 cm if groundwater contamination hazard exists

TABLE 15

Guidelines for Evaluating Corrosivity Potential of Soils to Underground Pipe Installations

Properties Affecting Use	Degree of Limitation		
	None to Slight	Moderate	Severe
Texture and wetness	Coarse textured soils that are rapidly and well drained	Medium textured soils that are well and moderately well drained. Coarse textured soils that are imperfectly drained. All poorly and very poorly drained and organic soils with water table at the surface at all times	Fine textured soils that are well and moderately well drained. Medium textured soils that are imperfectly drained. All poorly and very poorly drained and organics with fluctuating water table within one foot of the surface
Permeability	Rapid and moderately rapid	Moderately slow and slow	Very slow
Salinity	*EC <0.2 mmhos/cm	EC 0.2 to 0.4 mmhos/cm	EC >0.4 mmhos/cm

*EC - Electrical Conductivity

TABLE 16

Guidelines for Evaluating Soil Limitations for Road Location

Properties Affecting Use	Degree of Limitation		
	None to Slight	Moderate	Severe
Flooding	None	Once in 5 years	More than once in 5 years
Wetness (soil drainage)	Very rapidly, rapidly, well and moderately well drained	Imperfectly drained	Poorly and very poorly drained
Slope	0 to 9%	9+ to 15%	Greater than 15%
Shrink-swell potential	Low - Unified groups[1] GW, GP, SW, SP, GM, GC, SM, SC	Moderate - Unified groups CL and ML with *P.I. less than 15	High - CL with P.I. 15 or more. CH, MH, OH, OL, Peat
AASHO group index[2]	0 to 4	5 to 8	More than 8
Depth to consolidated bedrock	More than 100 cm	50 to 100 cm	Less than 50 cm
Potential frost action	Low - Unified groups GW, GP, SW, SP	Moderate - Unified groups GM, GC, SC, CH, OH	High - Unified groups ML, CL, OL, MH, SM

[1] See page 69 for explanation of Unified classification

[2] See page 69 for explanation of AASHO classification

*P.I. - Plasticity Index

TABLE 17
Guidelines for Evaluating the Suitability of Soils as a Source of Road Subgrade Material

Item Affecting Use	Degree of Suitability		
	GOOD	FAIR	POOR
Wetness	Rapidly to moderately well drained	Imperfectly drained	Poorly and very poorly drained
ENGINEERING GROUPS			
Unified group[1]	GW, GP, GC, SW, SP, SM, SC	ML, CL with *P.I. less than 15	CH, MH, OL, OH, Pt, and CL with P.I. more than 15
AASHO			
Group index[2]	0 - 4	5 - 8	greater than 8
Slope	0 - 15%	15 - 30%	more than 30%

*P.I: - Plasticity Index
[1] See page 69 for explanation of Unified classification
[2] See page 69 for explanation of AASHO classification

TABLE 18
Guidelines for Evaluating the Suitability of Soils as a Source of Sand and Gravel

Properties Affecting Use	Degree of Suitability		
	GOOD	FAIR	POOR
Unified soil* group	SW, SP, GW, GP	SW-SM, SP-SM, GW-GM, GP-GM	SM, SW-SC, SP-SC, GM, GW-GC, GP-GC, (all other groups unsuitable)
Thickness of overburden	Less than 60 cm	60 to 150 cm	More than 150 cm
Wetness (soil drainage)	Drainage class not determining factor if better than poorly drained		Poorly and very poorly drained
Flooding	None	May flood occasionally for short periods	Frequent flooding or constantly flooded

* See page 69 for explanation of Unified classification

APPENDIX D

DEFINITIONS OF TERMS

SUMMARY OF CANADIAN SYSTEM OF SOIL CLASSIFICATION (1976)

Throughout this report descriptive terms are used repeatedly to describe features of significance within the map area. The following are definitions of some of these descriptive terms.

Soil Texture

Soil Separates (Particle Size) on which Textural Classes are Based

Separates		Diameter in millimetres
Very Coarse Sand (V.C.S.)		2.0 - 1.0
Coarse Sand (C.S.)		1.0 - 0.5
Medium Sand (M.S.)	Sand (S.)	0.5 - 0.25
Fine Sand (F.S.)		0.25 - 0.10
Very Fine Sand (V.F.S.)		0.10 - 0.05
Silt (Si.)		0.05 - 0.002
Clay (C.)		less than 0.002
Fine Clay (F.C.)		less than 0.0002

Proportions of Soils Separates in Various Soil Textural Classes

From: Toogood, J.A. (1958): A simplified textural classification diagram; Canadian Journal of Soil Science, vol. 38, p. 54-55.

Sands are further divided according to the prevalence of differently sized sand fractions. Medium and coarse sands may contain over 25 percent coarse sand but not over 50 percent fine sands. Fine and very fine sands must contain over 50 percent of the respective fine sand fractions.

The soil textural classes are grouped according to the National Soil Survey Committee of Canada as follows:

(a) *coarse textured* sands, loamy sands
(b) *moderately coarse textured* sandy loam, fine sandy loam
(c) *medium textured* very fine sandy loam, loam, silt loam, silt
(d) *moderately fine textured* sandy clay loam, clay loam, silty clay loam
(e) *fine textured* sandy clay, silty clay, clay (40 - 60 percent)
(f) *very fine textured* heavy clay (more than 60 percent clay).

Soil Structure and Consistence

Soil structure refers to the aggregation of the primary soil particles into compound particles, or clusters of primary particles, which are separated from adjoining aggregates by surfaces of weakness. The aggregates differ in grade of development (degree of distinctness) and this distinctness is classed as: weak, moderate, and strong. The aggregates vary in size and are classed as: very fine, fine, medium, coarse, and very coarse. They also vary in kind, that is, in the character of their faces and edges. The kinds mentioned in this report are: *single grain*-loose, incoherent mass of individual particles as in sands; *blocky*-faces rectangular and flattened, vertices sharply angular; *subangular blocky*-faces subrectangular, vertices mostly oblique, or subrounded; *columnar*-vertical edges near top of columns are not sharp (columns may be flat-topped, round-topped, or irregular); *granular*-spheroidal, characterized by rounded vertices; *platy*-horizontal planes more or less developed.

Soil *consistence* comprises the attributes of soil materials that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation and rupture. Consistence reflects the strength and nature of the forces of attraction within a soil mass. The terms used in describing soils in this report are: *loose*-noncoherent; *friable* (specifies friable when moist) - soil material crushes easily under gentle to moderate pressure between thumb and forefinger, and coheres when pressed together; *firm* (specifies firm when moist) - soil material crushes under moderate pressure between thumb and forefinger but resistance is distinctly noticeable; *hard* (species hard when dry) - moderately resistant to pressure, can be broken in the hands without difficulty but rarely breakable between thumb and forefinger; *compact*-term denotes a combination of firm consistence and a close packing or arrangement of particles; *plastic* (specifies plastic when wet) - soil material can be formed into wires by rolling between the thumb and forefinger and moderate pressure is required for deformation of the soil mass.

Soil Moisture Classes

Soil moisture classes are defined according to: (1) actual moisture content in excess of field moisture capacity, and (2) the extent of the period during which such excess water is present in the plant root zone. The classes are:

(a) *rapidly drained*-soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions;
(b) *well-drained*-soil moisture content does not normally exceed field capacity in any horizon, except possibly the C, for a significant part of the year;
(c) *moderately well-drained*-soil moisture in excess of field capacity remains for a small but significant period of the year;
(d) *imperfectly drained*-soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year;
(e) *poorly drained*-soil moisture in excess of field capacity remains in all horizons for a large part of the year;
(f) *very poorly drained*-free water remains at or within 12 inches of the surface most of the year.

Special reference to surface drainage may be designated in terms of runoff and described as high, medium, low, or ponded. Similarly, specific reference to the characteristics of horizons within the profile may be designated in terms of permeability or percolation and described as rapid, moderate, slow, very slow, and none.

Calcareous Classes

The Canada Soil Survey Committee (1974) has set the following nomenclature and limits for calcareous grades:

(a) *weakly calcareous:* 1 to 5 percent calcium carbonate equivalent
(b) *moderately calcareous:* 6 to 15 percent calcium carbonate equivalent
(c) *strongly calcareous:* 16 to 25 percent calcium carbonate equivalent
(d) *very strongly calcareous:* 26 to 40 percent calcium carbonate equivalent
(e) *extremely calcareous:* greater than 40 percent calcium carbonate equivalent.

Reaction Classes

The reaction classes and terminology adopted by the Canada Soil Survey Committee (1974) are:

Class	$pH(H_2O)$
(a) *Extremely acid*	less than 4.5
(b) *Very strongly acid*	4.6 to 5.0
(c) *Strongly acid*	5.1 to 5.5
(d) *Medium acid*	5.6 to 6.0
(e) *Slightly acid*	6.1 to 6.5
(f) *Neutral*	6.6 to 7.3
(g) *Mildly alkaline*	7.4 to 7.8
(h) *Moderately alkaline*	7.9 to 8.4
(i) *Strongly alkaline*	8.5 to 9.0
(j) *Very strongly alkaline*	9.0

Stoniness

The classes of stoniness are:

(a) *Stones 1 (slightly stony land):* some stones, offering slight to no hindrance to cultivation;
(b) *Stones 2 (moderately stony land):* enough stones to interfere somewhat with cultivation;
(c) *Stones 3 (very stony land):* enough stones to constitute a serious handicap to cultivation and some clearing is required;
(d) *Stones 4 (exceedingly stony land):* enough stones to prevent cultivation until considerable clearing is done (50 to 90 percent stones by volume);
(e) *Stones 5 (excessively stony land):* the land is a boulder or stone pavement, too stony to permit any cultivation (greater than 90 percent stones by volume).

Horizon Boundaries

The lower boundary of each horizon is described by indicating its distinctness and form as suggested in the USDA Soil Survey Manual (United States Department of Agriculture, 1951). The classes of distinctness are:

(a) *abrupt*	less than 1 inch wide
(b) *clear*	1 to 2.5 inches wide
(c) *gradual*	2.5 to 5 inches wide
(d) *diffuse*	more than 5 inches wide.

The categories for form are:

(a) *smooth*	nearly a plane
(b) *wavy*	pockets are wider than deep
(c) *irregular*	pockets are deeper than wide
(d) *broken*	parts of the horizon are unconnected with other parts

Roots

The terminology for describing roots is that adopted by the Canada Soil Survey Committee (1974). In this system both the abundance and diameter of roots are described. The classes of abundance are:

	Number per unit area (1 $inch^2$) of surface
(a) *very few*	less than 1
(b) *few*	1 to 3
(c) *plentiful*	4 to 14
(d) *abundant*	more than 14

The diameter categories are:

(a) *micro*	less than 0.075 mm
(b) *very fine*	0.075 to 1 mm
(c) *fine*	1 to 2 mm
(d) *medium*	2 to 5 mm
(e) *coarse*	more than 5 mm

GLOSSARY OF TERMS

(This is included to define terms commonly used in the report; it is not a comprehensive soil glossary.)

Acid soil A soil having a pH of less than 7.0.

Aeration The process by which air in the soil is replaced by air from the atmosphere.

Aggregate A group of soil particles cohering so as to behave mechanically as a unit.

Alkali soil A soil having a pH greater than 8.5 or an exchangeable sodium percentage of greater than 15.

Alkaline soil A soil having a pH greater than 7.0.

Alluvial deposit (alluvium) Material deposited by moving water.

Aspect Orientation of the land surface with respect to compass direction.

Atterberg limits Various moisture contents of a soil at which it changes from one major physical state to another. The Atterberg limits which are most useful for engineering purposes are liquid limit and plastic limit.
The *liquid limit* is the moisture content at which a soil passes from a plastic to a liquid state.
The *plastic limit* is the moisture content at which a soil changes from a semi-solid to a plastic state.
Plasticity index (P.I.) is defined as the numerical difference between liquid limit and plastic limit.

Available plant nutrients That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

Basal area The stump area of a forested area expressed as units of area per specified unit of land area (for example m^2/ha).

Bearing capacity The average load per unit area that is required to rupture a supporting soil mass.

Bedrock The solid rock and the unconsolidated mantle of weathered rock that underlies the soil or that is exposed at the surface.

Bulk density, soil The mass of dry soil per unit bulk volume.

Cation An ion carrying a positive charge of electricity; the common soil cations are calcium, magnesium, sodium, potassium, and hydrogen.

Cation exchange capacity (C.E.C.) A measure of the total amount of exchangeable cations that can be held by the soil; it is expressed in terms of milliequivalents per 100 g of soil.

Coarse fragments Rock or mineral particles greater than 2 mm in diameter.

Climax vegetation Stable, self-perpetuating plant communities that are the end products of plant succession.

Clod A compact, coherent mass of soil produced by digging or plowing.

Colluvium A heterogeneous mixture of material that has been deposited mainly by gravitational action.

Compressibility The susceptibility of a soil to decreasing in volume when subjected to a load.

Concretion A local concentration of a chemical compound, such as calcium carbonate or iron oxide, in the form of a grain or nodule of varying size, shape, hardness and color.

Consistence (a) The resistance of a material to deformation or rupture; (b) the degree of cohesion or adhesion of the soil mass.

Constant species A species that occurs in more than 80 percent of the plots within a forest type.

Control section The vertical section upon which soil classification is based.

Creep Slow mass movement of soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and alternate freezing and thawing.

Cretaceous See Geological Time Scale.

Drift All material moved by glaciers and by the action of meltwater streams and associated lakes.

Droughty soil Sandy or very rapidly drained soil.

Eluviation The removal of soil material in suspension or in solution from a layer or layers of the soil.

End moraine Ridge-like accumulations of material constructed at the margin of an active glacier.

Engineering tests Laboratory tests made to determine the physical properties of soils that affect their uses for various types of engineering construction.

Eolian deposit Material deposited by wind, including both loess and dune sand.

Erosion The wearing away of the land surface by running water, wind, or other erosive agents; it includes both normal and accelerated soil erosion. The latter is brought about by changes in the natural cover or ground conditions, including those due to human activity.

Erratic A transported rock fragment different from the bedrock beneath it.

Fertility The status of a soil in relation to the amount and availability to plants of elements necessary for plant growth.

Floodplain The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Forest type An assemblage of sample plots with similar floristic composition, forest productivity, and site properties.

Forb Broad-leaved herbs.

Frost-free period Season of the year between the last frost of spring and first frost of fall.

Frost heave, in soil The raising of a surface caused by ice formation in the underlying soil.

Fluvial deposits All sediments, past and present, deposited by flowing water, including glaciofluvial deposits.

Geological Time Scale (see next page)

Gley Gleying is a reduction process that takes place in soils that are saturated with water for long periods of time. The horizon of most intense reduction is characterized by a gray, commonly mottled appearance, which on drying shows numerous rusty brown iron stains or streaks. Those horizons in which gleying is intense are designated with the subscript "g".

Gleysolic soil Soil developed under wet conditions resulting in reduction of iron and other elements and in gray colors and mottles.

Glaciofluvial Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may be in the form of outwash plains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine Lacustrine deposits laid down in glacial times.

Ground moraine Unsorted mixture of rocks, boulders, sand, silt, and clay deposited by glacial ice, but predominantly till with some stratified drift. Ground moraine is usually in the form of undulating plains having gently sloping swells, sags, and enclosed depressions.

Groundwater That portion of the total precipitation which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

Herb Non-woody vascular plants with above-ground parts that live for only one growing season.

Horizon A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes. Soil horizons may be organic or mineral.

Humus That more or less stable fraction of the soil organic matter remaining after the major portion of added plant and animal residues have decomposed; usually it is dark colored.

Hummocky dead-ice moraine A till deposit composed of knobs and depressions with local relief generally in excess of 40 feet; may also include stratified drift.

Illuviation The process of deposition of soil material removed from one horizon to another in the soil, usually from an upper to a lower horizon in the soil profile. Illuviated compounds include silicate clay, iron and aluminum hydrous oxides, and organic matter.

Immature soil A soil having weakly developed horizons.

Infiltration The downward entry of water into the soil.

Jurassic See Geological Time Scale.

Lacustrine deposit Material deposited in lake water and later exposed either by a lowering of the water or by uplift of the land.

Lacustrotill Glacial deposits which have the characteristics of both lacustrine deposits and till. In the Wapiti area, this material is usually closer texturally to the lacustrine materials but commonly contains considerable amounts of stones; the material shows some distortion of the strata similar to a lacustrine deposit; occasionally a slickenside can be observed. Lacustrotill is found on a fairly wide range of slopes and the exact mechanism of deposition is not clear. In some cases, ice-rafting of materials may be involved; in other cases, it might be a minor local readvancement of the glacier over lacustrine deposits, or merely the result of calving action on the shallow regions of ice-marginal lakes.

GEOLOGICAL TIME SCALE

ERA	PERIOD	EPOCH	Absolute age in years before present
CENOZOIC (Recent Life)	QUATERNARY	HOLOCENE	10,000
		PLEISTOCENE	1,000,000
	TERTIARY	PLIOCENE	13,000,000
		MIOCENE	25,000,000
		OLIGOCENE	36,000,000
		EOCENE	58,000,000
		PALEOCENE	63,000,000
MESOZOIC (Middle Life)	CRETACEOUS		135,000,000
	JURASSIC		180,000,000
	TRIASSIC		230,000,000
PALEOZOIC (Ancient Life)	PERMIAN		280,000,000
	CARBONIFEROUS – PENNSYLVANIAN		310,000,000
	CARBONIFEROUS – MISSISSIPPIAN		345,000,000
	DEVONIAN		405,000,000
	SILURIAN		425,000,000
	ORDOVICIAN		500,000,000
	CAMBRIAN		600,000,000
PRECAMBRIAN	PROTEROZOIC		2,500,000,000
	ARCHEAN		Age goes back to over four billion years

Lateral moraine An elongated body of drift deposited at or near the lateral margin of a glacier.

Liquid limit See Atterberg limits.

Lithic A feature of a soil subgroup which indicates a bedrock contact within 50 cm (20 inches) of the soil surface.

Mass-wasting A variety of processes by which large masses of earth material are moved either slowly or quickly by gravity.

Mesozoic See Geological Time Scale.

Morphology, soil The makeup of the soil, including the texture, structure, consistence, color, and other physical, mineralogical, and biological properties of the various horizons of the soil profile.

Mottles Spots or blotches of different color or shades of color interspersed with the dominant color. Mottling in soils usually indicates poor aeration and drainage.

Mulch Any material, such as straw, that is spread on the surface of the soil to protect the plant roots from the effects of crusting, freezing, evaporation, raindrops.

Organic matter The decomposition residues of plant material derived from: (a) plant materials deposited on the surface of the soil; and (b) roots that decay beneath the surface of the soil.

Outwash gravel Bodies of chiefly gravelly stratified drift deposited by meltwater streams issuing from and discharging beyond the glacier ice.

Oxidation The process and conditions by which the iron in the soil is oxidized.

Paleocene See Geological Time Scale.

Parent Material Unconsolidated mineral material or peat from which the soil profile develops.

Plasticity index See Atterberg limits.

Plastic limit See Atterberg limits.

Pleistocene See Geological Time Scale.

Regeneration, plant All young trees less than 2 m tall or having stem diameters less than 1 cm at 1.5 m above the ground. The process by which a new forest is established.

Seepage (groundwater) The emergence of water from the soil over an extensive area in contrast to a spring where it emerges from a local spot.

Shrink-swell potential The tendency of soils to undergo volume changes with changes in water content.

Soil reaction The degree of acidity or alkalinity of a soil, usually expressed as a pH value.

Soil structure The combination or arrangement of primary soil particles into secondary particles, units, or peds. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types and grades.

Solifluction A type of creep that takes place in regions where the ground freezes to a considerable depth and as it thaws during the warm seasons the upper thawed portion creeps downhill over the frozen material.

Solum (plural - sola) The part of the soil profile that is above the parent material and in which the processes of soil formation are active. It comprises the A and B horizons.

Stratified Composed of or arranged in strata or layers as applied to parent material.

Subsoil Technically, the B horizon; broadly, the part of the profile below plow depth.

Succession The process of continual change occurring within plant communities as the vegetation approaches the climax or stable condition.

Tertiary See Geological Time Scale.

Texture, soil The relative proportions of the various sized soil separates in a soil as described by the textural class name.

Till Unstratified glacial drift deposited directly by ice and consisting of non-sorted clay, silt, sand, and boulders.

Tilth The physical condition of a soil as related to its ease of tillage, fitness as a seedbed, and impedance to seedling emergence and root penetration.

Topsoil (a) the layer of soil moved in cultivation; (b) the A horizon; (c) the Ah horizon; (d) presumably fertile soil material used to topdress roadbanks, gardens and lawns.

Trafficability The capacity of a soil to withstand traffic by people, horses, or vehicles.

Triassic See Geological Time Scale.

Understory Plants that grow beneath taller plants.

Water-holding capacity The ability of soil to hold water. The water-holding capacity of sandy soils is usually considered to be low while that of clayey soils is high. Often expressed in inches of water per foot depth of soil.

Watertable The upper limit of the part of the soil or underlying rock material that is wholly saturated with water.

Weathering The physical and chemical disintegration, alteration, and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.