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Soils of Southeast Vancouver Island
Duncan-Nanaimo Area

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SOILS OF SOUTHEAST VANCOUVER ISLAND DUNCAN-NANAIMO AREA

MOE Technical Report 15

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SURVEYS AND RESOURCE MAPPING BRANCH

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PREFACE

Soils of Southeast Vancouver Island, Duncan - Nanaimo Area was initiated through special Treasury Board funding and administered by the Ministry of Agriculture and Food. Surveys and Resource Mapping Branch, Ministry of Environment provided supervision, correlation, laboratory and cartographic services. The objectives included mapping soils and agriculture capability at a scale of 1:20 000 for regional and municipal planning, Agriculture Land Reserve fine tuning, corridor development and resource planning, assessment and management.

This report contains detailed information on the soil resources of part of southeastern Vancouver Island and describes the results of a detailed soil survey of the coastal plain from Nanoose Bay to Shawnigan Lake. The report also contains a general description of the area with information on history and present land use, geology, surficial deposits, climate and native vegetation.

The high priority given by the Agricultural Land Commission and the Ministry of Agriculture and Food provided strong impetus for the project.

SUMMARY

Thirty-seven individual soils are identified in the map area. In addition, twenty-two phases and/or variants of these soils were established. Soil names taken from the original soil survey (Day, 1959) were used where applicable.

The soils found within the map area are mainly classified in the Brunisolic Soil Order although soils of the Podzolic Order are also common where wetter moisture regimes occur. The area is considered a Brunisolic to Podzolic soil transition zone. Soils of the Organic, Regosolic, Gleysolic, and to very minor extent, Luvisolic orders also occur.

The map area consists of about 76 500 ha. Of this total, bedrock occupies 2730 ha, miscellaneous land types occupy 7590 ha and various water bodies encompass 1900 ha.

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A. Green, Agriculture Canada, Vancouver, is specially acknowledged for field correlation between this survey and the concurrent Gulf Islands survey.

The positive guidance provided by the editorial committee under the chairmanship of B. Louie is greatly appreciated.

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HOW TO USE THE SOIL MAPS AND REPORT

Soil descriptions including general comments, landscape cross-sectional diagrams, landscape characteristics, photographs, typical profiles, and soil characteristics form the major part of this report. The map legend relates these soils to the maps which are published separately.

The mapping is at a detailed level of intensity (survey intensity level 2) and is intended to guide planners and land users in making decisions at the level of individual land parcels and farm units. For detailed projects on any given site, more intensive field studies would be needed.

General information about the study area and its environmental characteristics is provided in Chapter 1, "General Description of the Area".

Chapter 2 explains the procedures used in collecting the information used to compile the report and maps.

Chapter 3 provides guidelines used for the soil descriptions given in Chapter 4.

Chapter 4 contains the descriptions of soils identified in the study area.

Detailed soil profile descriptions for the map area stored in the British Columbia Soil Information System (BCSIS) and soil and agriculture capability maps are available from:

MAPS-B.C.
Ministry of Environment
Parliament Buildings
Victoria, British Columbia
V8V 1X4

INTRODUCTION

The initial soil survey of the east coast of Vancouver Island was completed in 1959 (Day, 1959). A reconnaissance biophysical soil survey for all of Vancouver Island, begun in the mid-1970's, did not resurvey the coastal plain, but rather incorporated the earlier information. These small scale surveys, while valuable for broad scale planning, were not designed to meet present day requirements for solving complex land use problems. Some of these requirements are: (i) accurate agricultural capability ratings for updating or fine tuning the Agriculture Land Reserves; (ii) municipal and regional district planning; (iii) detailed technical soil information for the Ministries of Agriculture and Food, Environment, Municipal Affairs, and the British Columbia Assessment Authority.

To meet these needs a survey of te Duncan-Nanaimo area at a scale of 1:20 000 was initiated. Field work for the project was conducted during the summers of 1980, 1981, by a team of soil surveyors. Land classification was carried out in accordance with the Terrain Classification System (E.L.U.C. Secretariat, 1976), Canadian System of Soil Classification, 1978, and provisional edition of Land Capability Classification for Agriculture in British Columbia, 1983. Further details of methodology are discussed in Chapter 2.

Soils of Duncan - Nanaimo Map Area includes the coastal plain as well as isolated hills and lower slopes of adjacent mountains. The map area encompasses 76,500 ha and is bounded by Georgia Strait on the east, and the steep mountainous terrain of the Vancouver Island Mountains on the west (Figure 1.2).

Preliminary soil and agriculture capability maps (scale 1:15 840) were produced at the end of each field season. Final soil and agricultural capability maps are available at a scale of 1:20 000. Field information was collected on standardized soil description forms, as outlined in Describing Ecosystems in the Field (Resource Analysis Branch, 1980). This information, along with laboratory analyses are entered in the British Columbia Soil Information System (BCSIS).

The report is divided into four chapters. Chapter One contains general information relevant to the area and describes briefly the geology, parent materials, climate, and vegetation of the surveyed area. Chapter Two provides information on soil classification, field procedures and soil legend development. Chapter Three provides the guidelines and parameters used for describing the individual soils while Chapter Four presents the descriptions of the individual soils.

CHAPTER ONE
GENERAL DESCRIPTION OF THE AREA

1.1 LOCATION

The map area consists of approximately 76 500 ha along the southeastern coast of Vancouver Island (Figure 1.1). From the southern end of Shawnigan Lake (49° 35'N) to Nanoose Harbour (49° 15'N), the study area extends approximately 60 km with a variable width of 2 to 10 km. The area consists of part of the Nanaimo Lowlands and is bounded on the west by Vancouver Island Mountains and on the east by the Strait of Georgia.

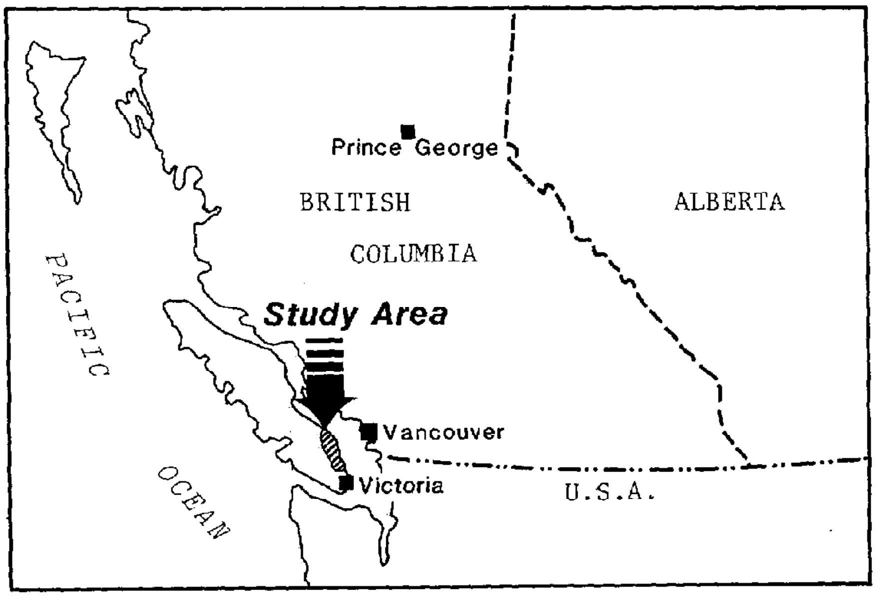


Figure 1.1 Location of the map area.

1.2 HISTORY AND PRESENT LAND USE

Nonaboriginal settlement in the survey area began during the mid-1800's. The main center developed at Nanaimo which is presently the largest city on Vancouver Island north of Victoria. It was established by the Hudson's Bay Company in 1851 to allow exploitation of the local coal resources and became a major center of coal production during the late 19th and early 20th centuries. Expansion of the industry continued between 1901 and 1921, with operations at Ladysmith. Several small settlements in the Nanaimo area were coal mining centers: East Wellington, South Wellington, Extension and Cassidy (Howatson, 1979). Peak coal production was reached in 1922, with the industry declining during the 1930's and most mines ceasing production by the early 1950's. The Duncan area near Cowichan Bay was settled in the 1860's and developed as an agricultural center. The discovery of copper and zinc deposits on nearby Mt. Sicker led to active mining (1897-1907), including construction of a narrow gauge railroad to a smelter at Crofton on Osborn Bay.

The forest industry began at Chemainus in 1862 and was further expanded by the construction of the Esquimalt and Nanaimo (E & N) Railroad in 1886. Virtually all of the study area has been logged at least once, and small scale timber harvesting from second growth forests is occurring on privately-owned lands. The large forest industry facilities at Nanaimo, Chemainus and Cowichan Bay receive their current timber supplies from elsewhere on the coast.

Present-day agricultural activities are dominated by livestock and dairy production. As a result, the largest proportion of agricultural land is used for pasture and forage crops. The largest concentration of dairy farms is in the area from Mill Bay to just north of Duncan. Vegetables and small fruits for local sale are grown on the floodplain of the Chemainus River and on the Cowichan River delta.

The map area includes most of the Cowichan Valley Regional District and part of the Regional District of Nanaimo. The estimated population is 115,000, of which over half live in the Nanaimo area. The area is serviced with a good network of paved roads and streets. Scheduled ferry service to the mainland and the Gulf Islands is available from Nanaimo. The Nanaimo Municipal Airport provides air travel facilities.

1.3 PHYSIOGRAPHY

The study area lies within the Nanaimo Lowland (Figure 1.2), a narrow coastal plain bounded by the Georgia Depression to the east and the Vancouver Island Ranges to the west (Holland, 1978).

Plate 1.1 Physiography of the map area.

The Lowland is characterized by a series of generally low, northwest trending bedrock ridges, with narrow intervening valleys created by differential erosion of softer rock types. This pattern is particularly evident in the areas east of Highway 1 between Nanaimo and Ladysmith. The Lowland is mostly overlain by various kinds of unconsolidated geologic deposits. Fine marine sediment covers large areas below 100 m asl, particularly in the Duncan area. Morainal deposits (glacial till) form the main material on the undulating and rolling landscapes above 100 m while gravelly fluvial, fluvioglacial and marine deposits are common along rivers, streams and seaward slopes.

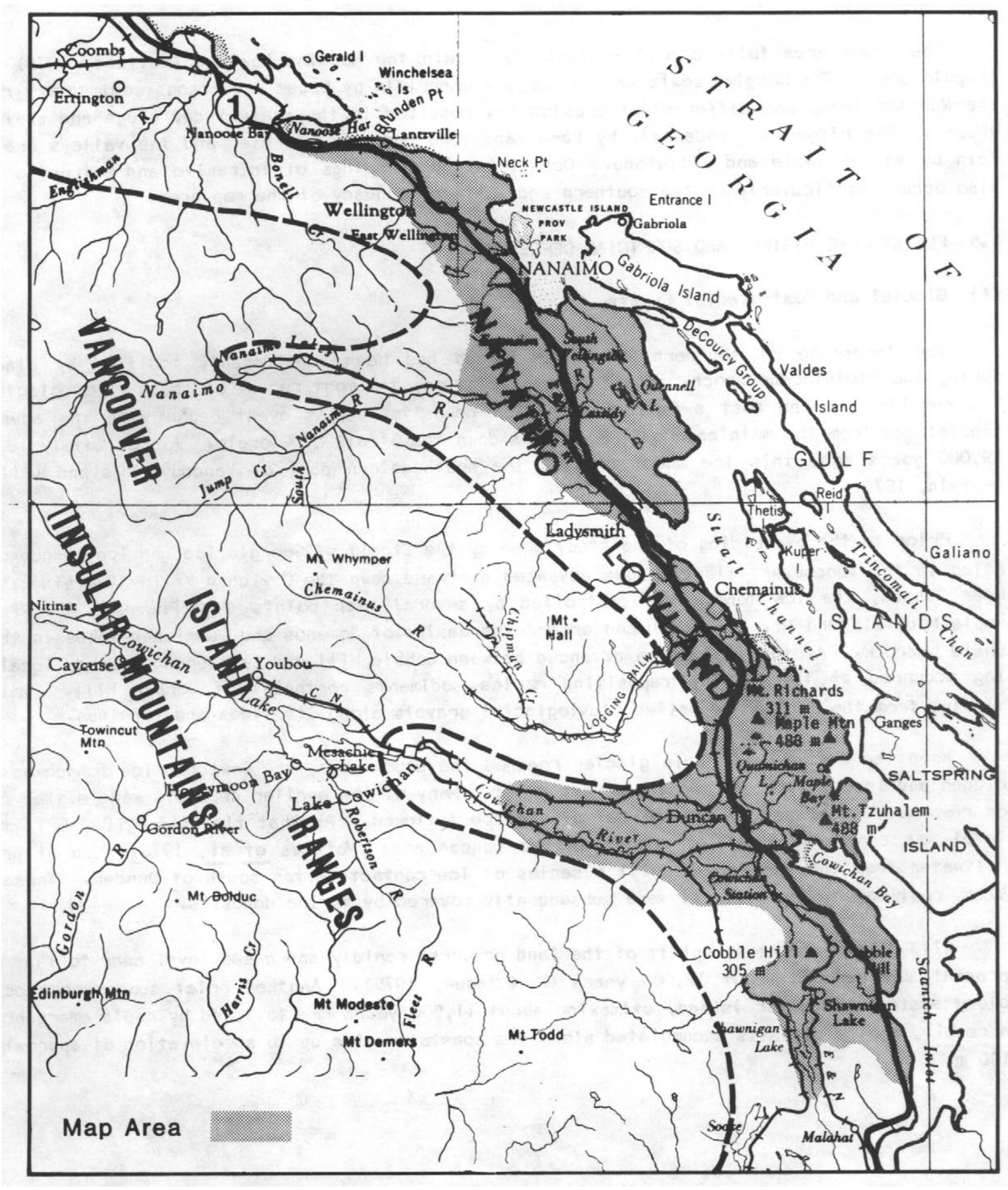


Figure 1.2 Physiography.

Most of the map area lies below 150 m asl. Notable high points are the Woodley Ranges (217 m) east of Ladysmith, Mt. Richards (311 m), Maple Mountain (488 m), Mt. Tzuhalem (488 m) and Cobble Hill (305 m) in the Duncan area.

The principal rivers draining the map area are the Cowichan, Chemainus and Nanaimo Rivers, all of which have extensive floodplains, deltas and estuaries along their lower reaches.

1.4 GEOLOGY

The study area falls almost exclusively within the Nanaimo Lowland (Holland, 1978) physiographic area. The Nanaimo Lowlands are largely underlain by Upper Cretaceous sedimentary rocks of the Nanaimo Group and differential erosion has resulted in the present day ridge and swale topography. The ridges are underlain by hard sandstone and conglomerate, and the valleys are underlain by softer shale and siltstone. Occasional outcroppings of intrusive and extrusive bedrock also occur, particularly on the southern and western boundary of the map area.

1.5 PLEISTOCENE HISTORY AND SURFICIAL DEPOSITS

(A) Glacial and Post-glacial Events

The landscape of southern Vancouver Island has been considerably modified by glaciation during the Pleistocene epoch. The Fraser glaciation, the most recent of these major glaciations, has resulted in the most extensive surficial deposits. This event began with the advance of glacial ice from the mainland Coast Mountains down the Strait of Georgia. Approximately 18,000 to 19,000 years ago, this ice sheet crossed the southeastern part of Vancouver Island (Alley and Chatwin, 1979).

Prior to the overriding of the study area by the Strait of Georgia ice, an ice tongue originating in the Vancouver Island ranges advanced eastward down the Cowichan Valley (Halstead, 1968). Near Duncan, the ice tongue was controlled by several high points (Mt. Prevost, Mt. Richards, Maple Mountain and Mt. Tzuhalem) and eroded the basins of Somenos and Quamichan lakes in the soft shale bedrock. As the ice tongue advanced between Cobble Hill and Saltspring Island, local ponding occurred at its margin, depositing marine sediments northeast of Cobble Hill. Meltwater flowing from the glacier deposited fluvioglacial gravels along its sides and terminus.

When the Strait of Georgia glacier reached the study area, the Cowichan ice tongue was overridden and incorporated in the larger ice sheet. Many of the earlier deposits were either removed or reworked. Downwasting and retreat of the ice followed. At that time (13-12,000 BP), the sea level was approximately 90 m higher in the Duncan area (Mathews <u>et al</u>, 1970) than at present. Meltwater from the ice tongue built a series of ice-contact deltas south of Duncan. These deposits, resting on glacial till, were subsequently covered by marine deposits.

With glacial retreat, uplift of the land occurred rapidly and a sea level near to that of the present was reached about 12,000 years BP (Clague, 1975). Another brief submergence occurred along eastern Vancouver Island, climaxing about 11,500 years BP, followed by rapid emergence. As a result, marine deposits accumulated along the coastal region up to an elevation of approximately 100 m.

Post-glacial erosion has entrenched numerous creeks and rivers draining the map area and large deltas have formed in the Strait of Georgia from the Nanaimo, Chemainus and Cowichan Rivers.

(B) Surficial Deposits

Virtually all soils in the map area are developed in unconsolidated surficial deposits (soil parent materials). Five major genetic types of soil parent materials occur in the study area: morainal, marine, fluvial, colluvial, and organic. These materials are defined according to the Terrain Classification System (E.L.U.C., 1978) and are briefly described in the following paragraphs.

(i) Morainal (till) materials are deposited directly from glaciers and usually are poorly sorted and have little or no bedding (Plate 1.2) and are compacted. These deposits commonly occur above 100 m elevation throughout the study area. Below 100 m, the till is often covered by marine deposits. Two types of till are found in the map area. The more common type is coarser textured (silty sand or sand) and contains 40 to 70% coarse fragments. A finer textured till (sandy fines) is associated with shale and siltstone bedrock, principally in the Cedar and Mt. Prevost areas.

(ii) Marine sediments cover significant areas within the map area and were deposited during the periods of marine submergence after deglaciation. These deposits occur most frequently between Cobble Hill and Crofton below 100 m asl.

Fine textured marine deposits (sandy silt to clayey silt) are the most common (Plate 1.3) and blanket a considerable area south and west of Duncan. The material is very hard when dry and has a low hydraulic conductivity. Perched water tables often occur during the wet winter months, particularly in depressional sites, resulting in saturated soils. At depth, black manganese stains and bedding are sometimes evident.

Coarse textured marine deposits (sand, gravelly sand) originated as beaches or coastal sand bars prior to isostatic rebound. These materials, usually occurring in small, discontinuous deposits, vary in texture, both vertically and laterally and tend to occur on east-facing slopes where exposure to wave action was greatest. They may overlie or grade laterally into finer marine deposits.

Other deposits have also been modified by marine submergence. For example, morainal deposits occurring below the limit of marine submergance sometimes have a surface lag deposit of gravel and cobbles which has been concentrated by wave action.

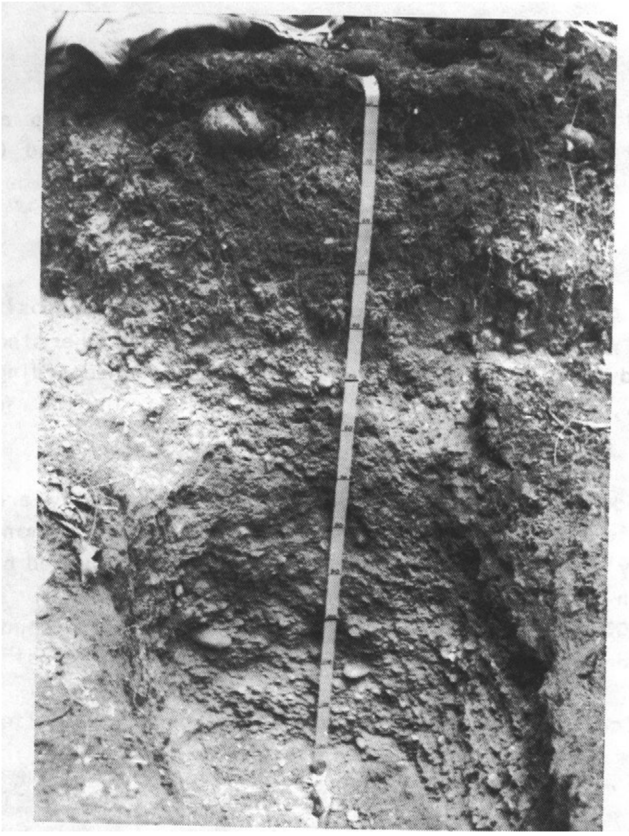


Plate 1.2 Example of morainal parent material.

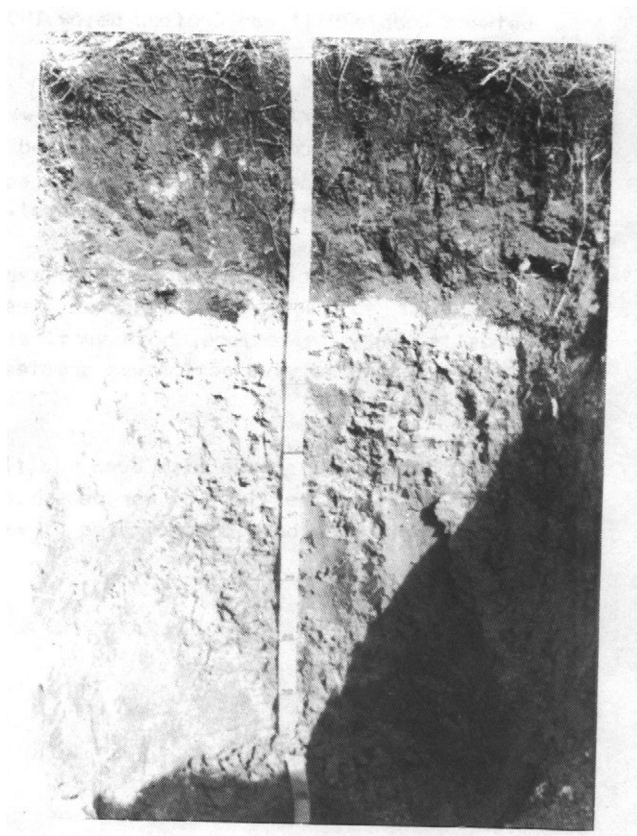


Plate 1.3 Example of marine parent material.

(iii) Fluvial materials have been deposited by flowing water (Plate 1.4). In the map area, many such materials were deposited by glacial meltwaters and are designated as fluvioglacial. Coarse textured fluvioglacial sediments (sand to sandy gravel) have a variety of surface expressions, in the form of old terraces, estuaries and deltas. The deltas are usually found at or below the limit of marine submergence and have characteristic foreset and topset bedding. Finer textured fluvioglacial materials (sandy silt to silty sand) are not common and occur only as a veneer or blanket over coarser textured deltaic deposits.

Deposits of contemporary rivers and creeks also have a wide range of textures, varying from sandy silt to gravelly sand. Floodplains, low lying fluvial terraces, fans and active deltas are characteristic landforms of recent fluvial origin. Generally finer textures (sandy silt, silty sand) occur in the surface sediments of currently active deltas and estuaries (e.g. Cowichan River delta).

Plate 1.4 Example of fluvial parent material.

(iv) Colluvial deposits result from mass wastage and have reached their present position by gravity-induced movement (e.g. rockfalls, soil creep) (Plate 1.5). Such deposits are found only in the steepest parts of the map area and are of minor significance. Colluvium may occur in association with morainal deposits, however colluvium can usually be distinguished by a predominance of angular coarse fragments.

Plate 1.5 Example of colluvial parent material.

(v) Organic materials result from the accumulation and decay of vegetative growth (Plate 1.6). Most organic deposits in the study area resulted from vegetative succession which caused infilling of shallow lake basins (e.g. Dougan Lake, Somenos Lake) and vary greatly in depth. Generally, the organic materials are at an intermediate stage of decomposition. The most common botanical origin of the organic material is from sedges, rushes and reeds, with aquatic peats of algal and animal origin occurring above the mineral contact. Domed islands of bog peat (*Sphagnum* moss) often occur on the predominantly sedge-derived organic deposits.

Plate 1.6 Example of organic parent material.

1.6 CLIMATE

A distinct climatic zone characterized by cool wet winters and mild, dry summers occurs over the southeastern lowlands of Vancouver Island, The Gulf Islands in the Strait of Georgia, and the Fraser River Estuary (Shaefer, 1978). While the Pacific Ocean plays the dominant role in determining the climates of the province (Shaefer, 1978), orographic effects are of prime importance in controlling precipitation distribution (Tuller, 1979). This is especially true for the climate of southeast Vancouver Island Lowlands where the climate is affected by the close proximity of the Pacific Ocean, Olympic Peninsula and Vancouver Island Mountains.

During the winter the climate is controlled by moist maritime air masses originating in the north Pacific and flowing onto Vancouver Island. This easterly flow brings the frequent cyclonic storms responsible for the cloud and rain that dominate the area during the winter. Peak precipitation occurs in December and January (Figure 4.1); 80 to 85% of the mean annual precipitation falls during the period October through April. January mean daily air temperatures are about 2°C to 4°C. Given the prolonged periods of cloud cover and cool temperatures, little energy is available to the vegetation for evapotranspiration. This results in a climatic moisture surplus (precipitation minus potential evapotranspiration) for the period October through April, and consequently at the onset of the growing season most of the soils are either saturated, or at field capacity.

Occasionally during winter, intense high pressure ridges build over British Columbia, block the easterly flow, and allow out-flow of cold Arctic air from the major inlets of the mainland o spill onto Vancouver Island, bringing snow and freezing temperatures. Freezing temperatures do not persist for long however, for with the return of the moist maritime westerlies, temperatures rise above 0°C.

Unlike the cloudy, wet winters, the summers are mild and dry. A weak easterly flow during summer allows the North Pacific high pressure cell to influence southwestern British Columbia, bringing warm, dry and cloudless weather to the area. In particular, the months of July and August are dominated by high pressure systems, resulting in mean monthly precipitation of only 22 mm and mean maximum temperatures of 25°C.

During May through September, empirically estimated potential evapotranspiration is 461 mm at Duncan (Baier and Robertson, 1965), while precipitation is 157 mm. This results in an estimated climatic moisture deficit of 304 mm during the growing season. Therefore, in an average growing season, droughty conditions are experienced on most moderately well to rapidly drained soils. The resulting moisture stress is most evident during July and August.

Topographic changes and proximity to the Strait of Georgia are the major influences on mesoscale climatic variation within the map area. Precipitation increases westwardly and also with increasing elevation. Lake Cowichan, at 163 m asl and approximately 35 km from the Strait of Georgia, receives approximately 75% more precipitation than Duncan which is located at 10 m asl and only 7 km from the Strait of Georgia. The average annual precipitation at Duncan is 1042 mm. The temperature regime of the map area is fairly uniform, (Figure 4.1), with minor variations mainly attributable to the moderating influence of the Strait of Georgia.

The west and southeast coasts of Vancouver Island have the longest freeze-free periods in Canada (Tuller, 1979). East coastal locations such as Cowichan Bay and Departure Bay may expect over 200 frost-free days from mid April to mid-November, while inland locations such as Duncan and Nanaimo airport may expect a frost free period of approximately 160 days from May to October.

The long freeze-free periods of the area result in substantial accumulations of seasonal growing degree days (GDD) (Table 4.3). These GDD may be misleading for agricultural crop growth and adjustment using a more suitable thermal criterion is necessary (Coligado, 1978). Since the GDD are mostly accumulated from temperatures at the lower end of the scale (near the base temperature of 5°C), they should not be considered as Effective Growing Degree Days (EGDD) (Coligado, 1978). Effective Growing Degree Days determined for the Duncan area are 1158, based on the period 1941-1970 while the number of GDD for the same period are 1878.

Given the long freeze-free period, abundant sunshine of approximately 1800 hrs at Cowichan Bay and Namaimo Airport (Yorke, 1972), and warm summer temperatures, the southeast coastal plain of Vancouver Island has a very favorable climate for agriculture. Low precipitation during summer is the major climatic limitation. However, provided that water is available for irrigation, the area has a high climatic capability for agriculture.

1.7 NATIVE VEGETATION

Almost all of the map area lies within the Coastal Grand Fir - Western Red Cedar Zone of southeastern Vancouver Island (Harcombe, 1982). This zone has a climatic climax forest of grand fir (Abies grandis) and western red cedar (Thuja plicata) on mesic sites. Coast Douglas-fir (Pseudotsuga menziesii var. menziesii) is a persistent early successional species, dominating most second-growth stands, and may be a climax species on drier sites. Shrubs, such as salal (Gaultheria shallon) and Oregon grape (Mahonia nervosa), are abundant.

In the driest part of this zone which lies within a few km of the coast, particularly on coarse textured soils or where bedrock is close to the surface, open grassy areas occur with occasional stands of Pacific madrone (Arbutus menziesii) and Garry oak (Quercus garryana). More moist sites such as floodplains and creek valleys are often dominated by deciduous species, notably bigleaf maple (Acer macrophyllum), red alder (Alnus rubra), and black cottonwood (Populus balsamifera subsp. trichocarpa). Characteristic herb species on such sites include western sword fern (Polystichum munitum) and skunk cabbage (Lysichitum americanum).

The western boundary of the study area coincides with a transition to the Coastal Western Hemlock Zone. Although coast Douglas-fir dominates during early succession and on drier sites, western hemlock (Tsuga heterophylla) is the climatic climax species within this zone.

CHAPTER 2
SOIL CLASSIFICATION AND MAPPING METHODOLOGY

2.1 SOIL CLASSIFICATION

Soil is the naturally occurring unconsolidated mineral or organic material at the earth's surface which is able to support plant growth. The type of soil at a given location is the result of climate, organisms and topography acting on the parent material over time. Soils display a continuum of properties, reflecting the variation of these soil-forming factors.

Each soil is a three-dimensional, naturally occurring body having length, width and depth. The objective of a soil survey is to identify the different kinds of soil, to separate or classify them by means of a classification system and to delineate their areal distribution on a map. Soils are classified on morphological characteristics observed in a vertical section (soil profile) and on the physical and chemical characteristics obtained by analysis of samples taken from representative basic soil units (pedons). Individual soil profiles are grouped (classified) according to categories of the soil classification employed. The resultant groups are then delineated on a soil map by boundaries which encompass areas of soil in the same group. The kinds of morphologic characteristics considered are discussed in the following section dealing with field methods.

During the process of developing a legend two taxonomic entities were used for naming soils; the soil family and the soil series. A soil family is a taxonomic entity within which from one to large number of series may be established. A soil series is a conceptual class that consists of a group of related pedons that have similar kinds and arrangements of horizons whose color, texture, structure, and consistance, thickness, reaction, and composition fall within a narrow range. Soil series names are usually place names occurring in the locality where the series is orginally classified. The series however is not restricted to that locality.

Because of the complexity of soil characteristics within fluvial terrain units it was not always possible to separately delineate individual soil series. Therefore, the soil family was also used as a category for mapping.

Some soils are so intermixed that it was not possible to describe them using one soil name. In these cases, the map unit is a complex of two or three individual soils. In all such cases, the intermingling of the series and/or families is too intricate to be separated at the map scale used.

In addition to the soil series and families, phases, variants, and several miscellaneous land types are also recognized. The miscellaneous land types consist of non-soil areas and include coastal beaches, eroded scarps, recent alluvium, rock outcrop and man-made land.

Soil phases are variations within a soil series or other hierarchial category due to differences in stoniness, topography, depth of profile or other features which effect land use.

Soil variants are employed when differing soils are identified but occupy such small areas that definition of a new soil is not warranted. These are usually classified as a variant of the established soil series or family which has most characteristics in common with the variant.

The first level of generalization above the soil series is the soil family. A soil family consists of a group of related soil series which fall within a range of differentiating criteria that is broader than that for soil series. The differentiating criteria include particle size distribution, drainage, permeability reaction and consistence as well as others that have implications for land use.

The next level of generalization is the soil subgroup. A soil subgroup consists of a group of soils which have defined common soil horizons which reflect the environmental conditions under which the soils developed. Soil subgroups may be grouped into soil great groups. Soil great groups consist of soils which have major soil horizons in common which reflect the strengh of the dominant soil forming process or processes. The broadest level of generalization is the soil order. A soil order is composed of groups of soils that have developed under broadly similar environmental conditions as expressed by the presence or absence of major, diagnostic soil horizons.

Soil classifications seek to group (similar soils) in order to organize our knowledge of soils and enable prediction of their behaviour. In The System of Soil Classification for Canada (1978), soil groupings are based on properties that indicate a similar mode of origin. The soil order is the highest level of generalization in this system. Of the nine orders, five occur in the study area:

(1) Soils of the humid forested regions containing significant amounts of amorphorus aluminum, iron, and/or organic matter (Podzolic order);
(2) Soils with weakly developed horizons (Brunisolic order);
(3) Young soils with little or no horizon development (Regosolic order);
(4) Soils which are influenced by periodic or long-term water saturation (Gleysolic order); and,
(5) Soils developed primarily from plant residues (Organic order).

Each soil order is subdivided into two to four Great Soil Groups according to the differing strengths of dominant soil-forming processes. Further subdivision into Soil Subgroups is on the basis of the kind and arrangement of soil horizons.

The following paragraphs generally describes the soil orders occurring in the map area, along with the great soil groups and soil subgroups within each soil order. (Also see Table 2.1).

Brunisolic Order

Brunisolic soils are the dominant soil order in the map area, occurring on virtually all parent materials. These soils have drainage classes ranging from imperfectly to rapidly drained, reflecting both topographic position and parent material texture. Soils of the Brunisolic order have sufficient development to exclude them from the Regosolic order, but they lack the degree or kind of horizon development specified for soils of other orders. Their B horizons have insufficient accumulation of Fe, and Al, and organic matter to qualify as Podzolic B horizons.

Two Brunisolic great groups are represented in the map area: Dystric and Sombric. Both are acidic and the latter has a dark, organic matter-enriched surface (Ah) horizon 10 cm or more in thickness. Such Ah horizons may form naturally under grassy, open forests or under long term cultivation.

Three subgroups occur in both great groups. Duric Dystric and Duric Sombric Brunisol soils contain cemented (duric) subsoil horizons and occur mostly on coarse textured glacial till and some fluvioglacial deposits. Gleyed Dystric and Gleyed Sombric Brunisols are imperfectly drained, contain subsurface mottling and are most common on medium textured parent materials with a seasonally perched water table. In some areas small amounts of clay has accumulated in the lower B horizon by illuviation. Orthic Dystric and Orthic Sombric Brunisols occur on moderately well to rapidly drained parent materials.

Gleysolic Order

Gleysolic soils develop in the presence of excessive moisture that results in permanent or periodic reducing conditions. As a result, the gleyed subsoil is bluish-gray to greenish-gray and reddish-brown mottles usually occur in the profile. These soils occur where the watertable is high because of proximity to bodies of water (e.g. floodplains) or in depressional sites, or on materials with low hydraulic conductivity.

Humic Gleysol, Luvic Gleysol, and Gleysol great groups occur in the map area. Humic Gleysols are usually found in depressional sites on medium to fine textured parent materials. Organic matter accumulates in the Ah horizon and occasionally a surface veneer of peat is found. Luvic Gleysols are associated with Humic Gleysol soils but differ by having substantial clay accummulation in the B horizon. Two subgroups of the Gleysol Great Group are significant. The Orthic Gleysols have a mottled and gleyed B horizon, but lack a dark surface horizon. These soils are usually found on fine marine deposits and differ from the Gleyed Dystric Brunisols only in the decreased depth to distinct or prominent mottling. Rego Gleysols occur only on active floodplains or estuaries where continuing sedimentation restricts soil development to a juvenile stage.

Podzolic Order

Podzolic soils have acidic, yellowish red, illuvial B horizons in which amorphous material composed of humified organic matter combined with aluminum (Al) and iron (Fe) has accumulated. Formation of podzolic soils is promoted by cool temperatures, high precipitation, and coniferous vegetation which produces acidic organic matter accumulations on the soil surface.

In general, Podzolic soils occur along the western edge of the map area at higher elevations. In practice, Podzolic soils are difficult to distinguish in the field from Brunisolic soils for both have similar colour. Some profiles tentatively designated as Brunisolic have, after chemical analysis, met the requirements of the Podzolic Order because of high levels of extractable Al which has no effect on soil colour.

All Podzolic soils in the map area belong to the Humo-Ferric Great Group which is characterized by a Bf horizon in which Fe and Al, but little organic matter have accumulated. Distinct eluvial (Ae) horizons are not common in Podzolic soils in the study area, apparently because organic matter and Fe and Al released by weathering mask their appearance. Well defined Ae horizons occur mainly on coarse, rapidly drained fluvioglacial materials and seldom on glacial till.

The most common Podzolic subgroup is Duric Humo-Ferric Podzol, characterized by a strongly cemented to indurated (duric) horizon below the Bf horizon. Duric horizons resemble the underlying parent material in colour and are most common on glacial till (Plate 1.2). The cementing agents are believed to be Al, Fe, and Si (McKeague & Sprout, 1975). Three other Podzolic subgroups occur in the study area. These are Orthic Humo-Ferric Podzols which are well drained, without a duric horizon, Sombric Humo-Ferric Podzols which have dark, organic matter-enriched A horizon and have developed under open, grassy forests, and Gleyed Humo-Ferric Podzols which are imperfectly to poorly drained and have mottling in the subsoil.

Regosolic Order

Regosolic soils exist wherever active deposition or erosion interrupt soil development. These conditions occur on active floodplains or on steep, eroding slopes. Regosolic soils on recent fluvial deposits are of much greater extent and have a wide range of textures (silt loam to very gravelly sand). The largest areas of Regosolic soils are on the floodplains and deltas of the Nanaimo, Chemainus, and Cowichan Rivers.

Both Regosolic great groups occur in the map area. Humic Regosols have an organic matter enriched Ah horizon; Regosols do not. Four subgroups are recognized in both great groups. These are Orthic Regosols which depict the central characteristics of the order and great groups, Cumulic (formed by repeated additions of fresh sediment), Gleyed (imperfectly drained) and Gleyed Cumulic.

Organic Order

Organic soils are the least extensive of the five orders found in the map area. These soils occur in poorly or very poorly drained depressions where organic matter accumulates faster than it can decompose. Most of these Organic soils are at an intermediate or advanced degree of decomposition and respectively belong to the Mesisol and Humisol great groups.

Table 2.1
Relationship Between Named Soils, Soil Orders, Great Groups, Subgroups, and Parent Material

ORDER	GREAT GROUP	DOMINANT SUBGROUP	PARENT MATERIAL	SOIL NAME	(Symbol)
Brunisolic	Dystric Brunisol	Orthic	marine, fluvial	Beddis	(BD)
Brunisolic	Dystric Brunisol	Orthic	fluvial	Chemainus	(CH)
Brunisolic	Dystric Brunisol	Orthic	marine	Dougan	(DN)
Brunisolic	Dystric Brunisol	Orthic	fluvial	Flewett	(FT)
Brunisolic	Dystric Brunisol	Orthic	morainal over bedrock	Galiano	(GA)
Brunisolic	Dystric Brunisol	Orthic	morainal over fluvial	Hollings	(HO)
Brunisolic	Dystric Brunisol	Orthic	marine	Hillbank	(HT)
Brunisolic	Dystric Brunisol	Orthic	morainal	Mexicana	(ME)
Brunisolic	Dystric Brunisol	Orthic	marine over bedrock	Maple Bay	(MY)
Brunisolic	Dystric Brunisol	Orthic	fluvial, marine	Qualicum	(QL)
Brunisolic	Dystric Brunisol	Orthic	morainal, colluvial over bed-rock	Rumsley	(RY)
Brunisolic	Dystric Brunisol	Orthic	morainal, colluvial over bed-rock	Salalakim	(SL)
Brunisolic	Dystric Brunisol	Orthic	morainal, colluvial over bed-rock	Saturna	(ST)
Brunisolic	Dystric Brunisol	Duric	marine, fluvial over morainal	Dashwood	(DW)
Brunisolic	Dystric Brunisol	Duric	marine over morainal	Mill Bay	(MB)
Brunisolic	Dystric Brunisol	Duric	morainal	Shawnigan	(SH)
Brunisolic	Dystric Brunisol	Duric	marine, fluvial over morainal	Deerholme	(DE)
Brunisolic	Dystric Brunisol	Gleyed	marine, fluvial	Brigantine	(BE)
Brunisolic	Dystric Brunisol	Gleyed Eluviated	marine	Fairbridge	(FB)
Brunisolic	Dystric Brunisol	Gleyed	marine	Kulleet	(KT)
Brunisolic	Dystric Brunisol	Gleyed	morainal	Royston	(RN)
Gleysolic	Humic Gleysol	Orthic	marine, fluvial	Denman Island	(DA)
Gleysolic	Humic Gleysol	Orthic	morainal	Koksilah	(KH)
Gleysolic	Humic Gleysol	Orthic	fluvial, marine	Kaptara	(KP)
Gleysolic	Humic Gleysol	Orthic	marine	Parksville	(PA)
Gleysolic	Humic Gleysol	Orthic	marine	Tolmie	(TL)
Gleysolic	Luvic Gleysol	Humic	marine	Cowichan	(CO)
Gleysolic	Humic Gleysol	Rego	fluvial	Crofton	(CF)
Gleysolic	Humic Gleysol	Rego	fluvial	Corydon	(CR)
Organic	Mesisol	Typic	organic	Arrowsmith	(AR)
Organic	Humisol	Typic	organic	Metchosin	(MT)
Podzolic	Humo-Ferric Podzol	Orthic	fluvial	Quennell	(QL)

Table 2.1 (Continued)

ORDER	GREAT GROUP	DOMINANT SUBGROUP	PARENT MATERIAL	SOIL NAME	(Symbol)
Podzolic	Humo-Ferric Podzol	Duric	morainal	Quinsam	(QN)
Podzolic	Humo-Ferric Podzol	Sombric	morainal, colluvial over bedrock	Bellhouse	(BH)
Podzolic	Humo-Ferric Podzol	Gleyed	marine	Bowser	(BO)
Regosolic	Regosol	Cumulic	fluvial	Cassidy	(CA)
Regosolic	Regosol	Cumulic	fluvial	Comiaken	(CN)

2.2 FIELD PROCEDURES AND MAP COMPILATION

The intensity of the survey is Level 2, according to the guidelines of the Mapping Systems Working Group (1981). The publication map scale of 1:20 000 is typical for a survey at this intensity level. Field work involved at least one soil inspection in over 90% of map delineations, with boundaries frequently checked in open country, or less frequently in forested areas. Boundary delineation was determined by aerial photograph interpretation, using landform characteristics, variation in slopes, tone and vegetation patterns. Ground truthing was used to improve accuracy of delineations on the pretyped aerial photographs and to determine boundaries that were not discernible through stereoscopic examination. Soil boundaries and thematic information were compiled on 1:15 000 and 1:20 000 scale aerial photographs.

Field observations recorded at inspection sites included: site position, terrain type, elevation, soil horizons and thickness, texture, drainage, coarse fragment content, and agriculture capability rating. Standardization of site information was made possible by using site and soil description forms as outlined in Describing Ecosystems in the Field (Resource Analysis Branch, 1980). Approximately 4800 inspections at this level of detail were conducted. Eighty representative soil profiles were described in detail and sampled for laboratory analysis. All these descriptions, along with supporting analytical data, are stored on computer file (British Columbia Soil Information System) and are available on request from the Surveys and Resource Mapping Branch, Ministry of Environment.

At all inspection sites, the agricultural capability rating was determined, according to methodology in Land Capability Classification For Agriculture in British Columbia, Draft Technical Paper (Kenk and Cotic, 1982). Soil and landscape observations made between inspection sites on foot traverses were also used in deriving agricultural capability ratings for individual map delineations.

Soil inspection pits were dug with a shovel, usually to a depth of 100 cm. In materials with few coarse fragments a hand auger was often used. To enable more consistent estimates of coarse fragment content, a 2 mm mesh sieve was used to separate gravel and cobbles from the finer fraction. For organic soils, a specialized peat auger was used so that the entire control section (160 cm) could be observed.

A number of practical problems, some of which are peculiar to the study area, influenced the rate of progress and accuracy of the mapping. First, the inherent complexity of the soil landscape was particularly great below the limit of marine submergence. Abrupt and unpredictable changes in soil texture occur as a result of past marine sedimentation and wave action and are not easily identified on aerial photographs. Second, although road access was generally good, dense forest cover in some areas caused uncertainties in accurately plotting inspection site locations and delineating boundaries. Third, the highly fragmented pattern of land use and property sizes influenced the rate of progress. In order to assist the rate of mapping progress, parcels of less than two hectares were usually not visited unless an inferred soil boundary crossing the parcel required checking.

After completion of field mapping, delineations were transferred from the working aerial photographs to a 1:20 000 scale base map. Boundaries appearing on the soil maps were deleted on the corresponding agricultural capability maps if the ratings of adjacent soil polygons were the same.

2.3 SOIL LEGEND DEVELOPMENT

Soils occur in intricate patterns across the landscapes. Each piece of the pattern, with a unique set of soil properties represents a mappable entity. This entity, which may consist of one or more soils, is presented on a soils map as a soil mapping individual. Each unique soil is discussed in an accompaning soil report. Prior to the survey it is not possible to determine the exact soil property ranges that will be used to define and delineate a particular soil (Mapping System Working Group 1981). This must be left to the correlator and surveyors as they gain more data during the soil survey. This process is known as soil legend development.

The initial information used for developing the legend was obtained from "Soil Survey of Southwest Vancouver Island and Gulf Islands, British Columbia" (Day et al., 1959), (mapping scale 1:63 360), and report "Soil Resources of Southern Vancouver Island" (in progress), (mapping scale 1:50 000).

These surveys provided sufficient information on groups of related soils and their associated landscape characteristics to develop a preliminary working legend. As the survey progressed repetitive types of soil sequences on similiar parent materials were observed and described.

In total, thirty seven soils, each with unique combinations of properties and which differed significantly with respect to their physical behavior and chemical composition, were identified and described in detail.

Specifically, the soils differ with respect to one or more of the following characteristics: genetic material, texture, drainage, classification, and type of bedrock if it occurs at depths less than one metre. Each soil is given a local geographical name - that name represents a soil with a unique set of properties. Whenever possible, previously established names were used (Table 2.2). For example, Soil Survey Report No. 6 (Day et al., 1959), which used a 1:63 360 mapping scale, described the Shawnigan soils as having a relatively wide range of soil properties, suitable for that scale of mapping. This soil survey report, which uses a 1:20 000 mapping scale identified four separate groups of soil within the original Shawnigan soil. Each new soil has sufficient differentiating characteristics and interpretive differences to warrant separation and each can be delineated at the new larger map scale.

Since the main objective of the soil maps is to provide as much interpretive value as possible, an "uncontrolled soil legend" was perceived to best provide that flexibility. This type of legend allows the soil surveyor the opportunity to describe each soil mapping individual in as much useful detail as required and also allows additions of new soils, if warranted.

Table 2.2
Relationships Between Soils Identified in Day *et al.* 1959 and Current Soil Survey

Soil Name (1959 Survey)	Current Soil Names*
Arrowsmith	Arrowsmith
Bowser	Brigantine, Bowser, Denman Island
Cassidy	Cassidy
Chemainus	Chemainus, Crofton, Corydon, Comiaken, Flewett
Cowichan	Cowichan
Dashwood	Dashwood
Fairbridge	Fairbridge, Hillbank, Mill Bay, Maple Bay, Dougan, Kulleet
Metchosin	Metchosin
Kye	Beddis, Deerholme
Parksville	Parksville
Qualicum	Qualicum, Quennell, Kaptura
Quinsam	Quinsam, Koksilah
Royston	Royston
Shawnigan	Shawnigan, Mexicana, Koksilah, Hollings
Tolmie	Tolmie
Unnamed, shallow to bedrock soils	Bellhouse, Saturna, Salalakim, Rumsley, Galiano

*Many of the soils identified by Day *et al.* 1959 are more narrowly defined by the current survey. The original Bowser soil, for example, has been subdivided into three unique soils which are named Brigantine, Denman Island and Bowser. The name Bowser has been retained in the current survey for continuity but the soil it now identifies has limits on its characteristics than are more restrictive than those originally defined by Day *et al.* 1959.

CHAPTER THREE
GUIDELINES FOR SOIL DESCRIPTIONS

3.1 INTRODUCTION

The guidelines provided in this chapter describe in detail the criteria and parameters used for describing the soils in Chapter 4.

3.2 GUIDELINES TO SOIL DESCRIPTIONS

3.2.1 Landscape Picture and General Comments

Where available, landscape photographs are used to illustrate a typical setting in which each soil occurs. The general comments include a description of the main soil characteristics, topography, drainage, parent materials, and the typical location of the soil in the landscape. Also included are brief comments on the soils suitability (or limitations) for agricultural, urban and other uses.

3.2.2 Soil Landscape Cross Section

These diagrams depict the usual landscape position of each soil in relation to other soils and parent materials. The symbols used for the latter are described in Table 3.1 and are extracted from Terrain Classification System, Environment and Land Use Committee Secretariat, 1976.

3.2.3 Landscape Characteristics

Parent Material - defined according to the Terrain Classification System (E.L.U.C., 1976).

Topography - given as a description of slope classes as defined in Canadian System of Soil Classification, 1978. The classes are defined as follows:

Description	Percent slope
depressional or nearly level	0 to 0.5
very gently sloping or gently undulating	0.5 to 2
gently sloping or undulating	2+ to 5
moderately sloping or gently rolling	5+ to 9
strongly sloping or moderately rolling	9+ to 15
steeply sloping or strongly rolling	15+ to 30
very steeply sloping or hilly	30+ to 60
extremely sloping or very hilly	over 60

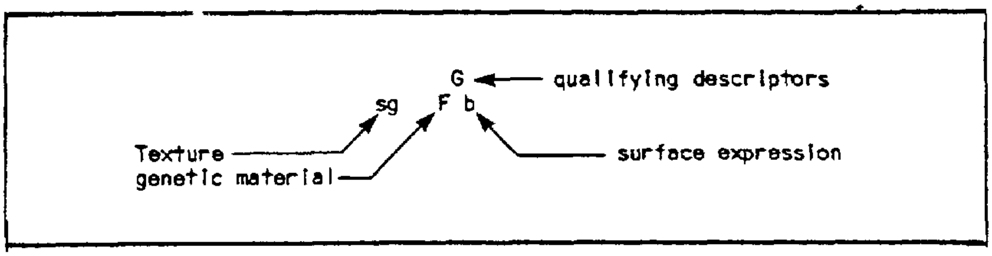
Elevation Range - given in meters above sea level.

Aspect - typical orientation of slopes on which the soil occurs.

Flood Hazard - described according to classes (no hazard, rare, may be expected, frequent, and frequent and irregular) as defined in Describing Ecosystems in the Field, R.A.B., 1980.

Table 3.1
Terrain Classification

Explanation of Letter Notation



Texture

Letter Symbol	Name
b	bouldery
k	cobbly
p	pebbly
s	sandy
s	silty
c	clayey
a	blocky
r	rubbly
g	gravelly
f	fine
m	mesic
h	humic

Genetic Material

Letter Symbol	Name
A	anthropogenic
C	colluvial
E	eolian
F	fluvial
L	lacustrine
M	morainal
O	organic
R	bedrock
W	marine
U	undifferentiated

Surface Expression

Letter Symbol	Name
b	blanket
f	fan
h	hummocky
l	level
m	subdued
v	ridged
s	steep
t	terraced
v	veneer

Qualifying Descriptors

Letter Symbol	Name
G	glacial
B	bog
F	fen
S	swamp

Flooding relates to river and stream overflow and not surface accumulation via high watertables, seepage, and runoff. They are referred to as ponding and are not considered in this assessment.

Vegetation - describes broadly some of the most typical native trees, shrubs and grasses. Mention is made of whether the soils are mostly in their native state or are cultivated.

3.2.4 Typical Soil Profile

A generalized soil profile diagram is provided for each soil, with major horizons indicated and briefly described according to CanSIS, 1978 and C.S.S.C., 1978.

3.2.5 Soil Characteristics

These tables summarize data obtained from field observations and laboratory analyses. Data for physical and chemical properties are presented as unweighted means, along with the range of values measured and the number of samples analysed. The laboratory data are usually from the analyses of two or more representative profiles, often supplemented by additional samples from selected soil horizons or depths. If laboratory data are unavailable, estimated values are usually provided. Definitions for the soil characteristics described are as follows:

Depth to Bedrock - this term refers to the estimated average depth to solid bedrock. Where bedrock is greater than 100 cm from the surface the symbol N/A (non applicable) is used.

Humus Form - this indicates the type of humus form that most commonly occurs under natural conditions defined as follows (R.A.B., 1980).

MOR - A nonzoogenous forest humus form distinguished by a matted F layer and an organic H layer with a sharp delineation from the A horizon. It is generally acid, has a high organic carbon content of 52% or more, and a high C:N ratio of 25 to 35, or sometimes higher. Various subgroups can be recognized by the morphology, and chemical and biological properties. Commonly occurs in coniferous forests.

MODER - A zoogenous forest humus form made up of plant remains partly disintegrated by the soil fauna (F layer), but not matted as in raw humus. It is transitional to a zone of spherical or cylindrical microejections of arthropods that are permeated by loose mineral particles in its lower part and often throughout. Although incorporation of organic matter is intense, it is shallow, because none of the organisms concerned with moder formation have important burrowing activity. The mixing of organic and mineral particles is purely mechanical. Organic carbon content under the F layer varies from 23% to 29%, but may exceed 35%. The C:N ratio is 20 to 25 and sometimes lower. Various subgroups can be recognized by their morphology and chemical characteristics.

MULL - A zoogenous forest humus form consisting of an intimate mixture of well-humified organic matter and mineral soil that makes a gradual transition to the horizon underneath. It is distinguished by its crumb or granular structure. Due to the activity of the burrowing microfauna (mostly earthworms), partly decomposed organic debris does not accumulate as a distinct layer (F layer) as in mor and moder. The organic matter content is 5 to 20% and the C:N ratio is 10 to 15. Various subgroups can be distinguished by the morphology and chemical characteristics.

Solum Depth - the total thickness of upper horizons in which soil forming processes are active and in which most plant roots occur. It usually consists of A and B horizons.

Depth to, Thickness, and Type of Restricting Layer - the depth of soil to a root restricting layer; the thickness of the restricting layer; type of restricting layer includes cemented or other layers acting as barriers to plant roots (for example, duric horizons, Bt horizons, or compacted glacial till).

Rooting Depth - depth of soil available for plant rooting.

Coarse Fragment Class - a measure by volume of the content of coarse fragments 2.5 cm in diameter or greater in the upper 25 cm of mineral soil. These classes indicate the abundance of coarse gravels, cobbles and stones present. These are considered a hindrance to cultivation, decrease available water holding capacity and decrease the volume of soil available for rooting and nutrient uptake. Fine gravels <2.5 cm in diameter are not included. The classes are defined in Table 3.2.

Table 3.2
Coarse Fragment Classes

Class	Description
0	Coarse fragments greater than 2.5 cm in diameter are essentially absent.
1	Coarse fragments offer a only slight hinderance to cultivation. The total content of coarse fragments greater than 2.5 cm in diameter is less than 10% and/or the content of cobbles and stones is less than 1%.
2	Coarse fragments cause a significant interference with cultivation. The total content of coarse fragments greater than 2.5 cm in diameter varies from 11 to 20% and/or the content of cobbles and stones varies from 2 to 5%.
3	Coarse fragments are a serious handicap to cultivation. The total content of coarse fragments greater than 2.5 cm in diameter varies from 21 to 40% and/or the content of cobbles and stones varies from 6 to 15%.
4	Coarse fragments prevent cultivation until considerable picking has been done. The total content of coarse fragments greater than 2.5 cm in diameter varies from 41 to 60% and/or the content of cobbles and stones varies from 16 to 30%.
5	The abundance of coarse fragments makes impractical the application of improvement practices. The total content of coarse fragments is greater than 60% and/or the content of cobbles and stones is greater than 30%.

Depth to and Type of Watertable - the depth to the upper zone of free water as indicated by matrix colours of low chroma or distint to prominent mottles of high chroma. Watertables are described according to their persistence, i.e. seasonal (usually during winter) or year-round, and their origin, i.e. whether perched (resulting from an underlying impermeable layer) or apparent (representing the true surface of the unconfined groundwater). For some soils the presence of a water table is unknown since soil pits were generally only dug about 1 m deep. In these cases the watertables are described as >1 m deep and of unknown type.

Soil perviousness - Soil perviousness refers to the soils ability to transmit water internally, and is inferred from soil characteristics such as structure, texture, porosity, cracks, organic matter content, and shrink-swell properties. It is closely related to measures of permeability, percolation rate, and infiltration rate, but these are reserved for actual measurements using standard techniques. Perviousness applies to the whole soil profile. Because of this, it is determined by the least permeable layer in the soil "control section". It is important to distinguish between soil drainage and perviousness. For example, a rapidly pervious soil could be receiving excessive seepage and thus be poorly drained. Three perviousness classes are defined (from Resource Analysis Branch, 1980):

a. Rapidly pervious - The capacity to transmit water vertically is so great that the soil will remain wet for no more than a few hours after thorough wetting. The horizons and soils have large and continuous or connecting pores and cracks that do not close with wetting.
b. Moderately pervious - The capacity to transmit water vertically is great enough that the soil will remain saturated for no more than a few days after thorough saturation. Most moderately pervious soils hold relatively large amounts of water against the force of gravity, and are considered to have good physical structure for rooting and supplying water to plants. Soil horizons may be single grained, granular, blocky, weakly platy or massive (but porous if continuous conducting pores or cracks are present which do not close with wetting).
c. Slowly pervious - The potential to transmit water vertically is so slow that the horizon or the soil will remain saturated for periods of a week or more after thorough wetting. The soil may be massive, blocky or platy, but connecting pores that conduct water when the soil is wet are few, and cracks or spaces among peds that may be present when the soil is dry, close with wetting. Even in positions accessible to plant roots, roots are usually few or absent and if present, they are localized along cracks when the soil is wet.

Soil Drainage - Defined in terms of (i) the actual moisture content in excess of field moisture capacity, and (ii) the extent of the period during which such excess water is present in the plant-root zone. It is recognized that permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot be used generally as criteria for drainage classes.

Soil profile morphology, particularly mottling and gleying, normally, but not always, reflects soil drainage. Topographic position and vegetation as well as other soil characteristics, are useful field criteria for assessing soil drainage classes.

The definitions of the soil drainage classes are underlined. As a guide to surveyors, additional comments under each class indicate some of the pertinent soil morphological features that are commonly, but not necessarily found.

a. Rapidly drained - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions. Soils are free from any evidence of gleying or mottling throughout the profile. Rapidly drained soils often occur on steep slopes.

b. Well drained - The soil moisture content does not normally exceed field capacity in a horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 1 m, but may be mottled below this depth.

c. Moderately well drained - The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are often faintly mottled in the lower B and C horizons or below a depth of 0.7 m. The Ae horizon, if present, may be faintly mottled in fine-textured soils and in medium-textured soils that have a slowly permeable layer below the A and B horizons. In grassland soils the B and C horizons may be only faintly mottled and the A horizon may be relatively thick and dark.

d. Imperfectly drained - The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are often distinctly mottled in the B and C horizons; the Ae horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well drained soil on similar parent material. Soils are generally gleyed subgroups of mineral soil orders.

e. Poorly drained - The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually strongly gleyed. Except in high chroma parent materials, the B, if present, and upper C horizons usually have matrix chromas of 3 or less; prominent mottling may occur throughout. Soils are generally in the Gleysolic or Organic order.

f. Very poorly drained - Free water remains at or within 30 cm of the surface most of the year. The soils are usually strongly gleyed. Subsurface horizons usually are of low chroma and yellowish to blueish hues. Mottling may be present within 30 cm or at depth in the profile. Soils are generally in the Gleysolic or Organic order; mineral soils are usually a peaty phase.

Depth to Salts - The depth to saline horizons indicated by electrical conductivity measurements. Soil is usually considered saline when electrical conductivity is 4 mS/cm or higher.

Soil Texture - Soil texture is an important physical property and is defined in terms of the size distribution of primary mineral particles (2 mm diameter or less) as determined by sieve and sedimentation analysis, or field estimation. Particle size separates consist of clay (<0.002 mm), silt (0.002-0.05 mm) and sand (0.05-2.0 mm). The texture classes are illustrated in Figure 3.1.

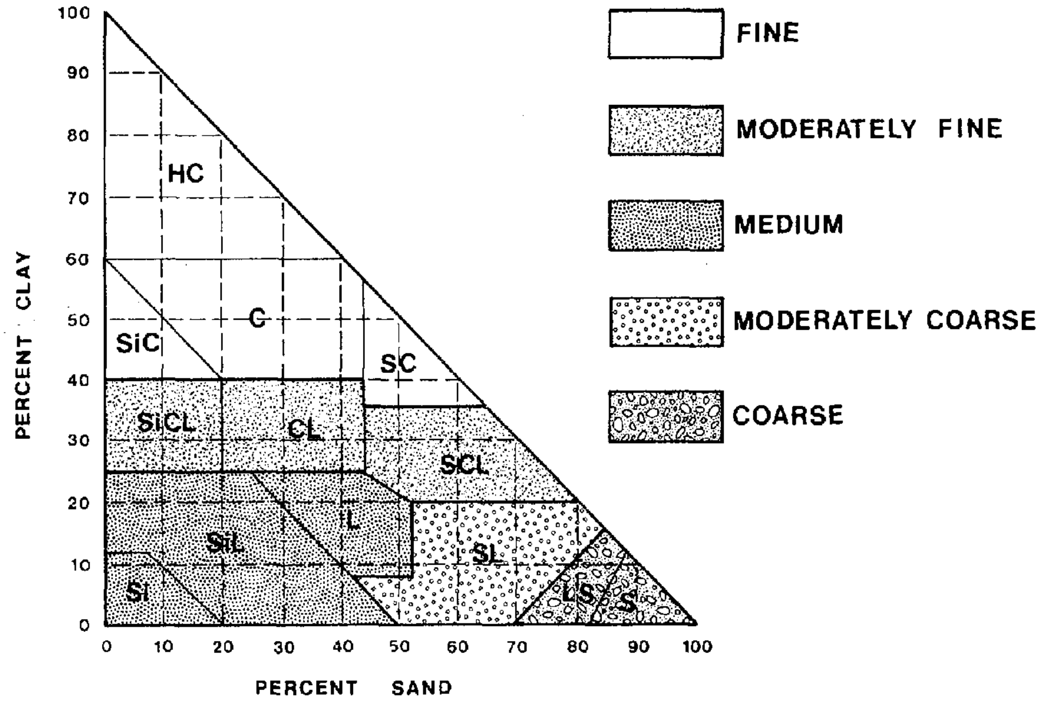


Figure 3.1 Soil texture classes. Percentages of clay and sand in the main textural classes of soil; the remainder of each class is silt.

The relative proportions of the particle size separates for various soil textures is as shown in Figure 3.1. Texture classes can be modified by the prefix "gravelly", if 20 to 50% gravels by volume or "very gravelly" if gravels occupy 50 to 90% of the soil volume, with gravels defined as the coarse fragments less than 7.5 cm in diameter. Sand, loamy sand, and sandy loam textures can be further subdivided on the basis of the proportions of the various sand separates present.

The limits of the various textural classes and subclasses are:

Sand - *Sand is a soil material that contains 85% or more sand; the percentage of silt plus 1.5* times the percentage of clay does not exceed 15.

coarse sand - Coarse sand is a soil material that contains 25% or more very coarse and coarse sand, and less than 50% any other one grade of sand.

medium sand - Medium sand is a soil material that contains 25% or more very coarse, coarse, and medium sand, and less than 50% fine or very fine sand.

fine sand - Fine sand is a soil material that contains 50% or more fine sand or less than 25% very coarse, coarse, and medium sand and less than 50% very fine sand.

very fine sand - Very fine sand is a soil material that contains 50% or more very fine sand.

Loamy Sand - Loamy sand is a soil material that contains at the upper limit 85 to 90% sand, and the percentage of silt plus 1.5 times the percentage of clay is not less than 15; at the lower limit it contains not less than 70 to 85% sand, and the percentage of silt plus twice the percentage of clay does not exceed 30.

loamy coarse sand - Loamy coarse sand is a soil material that contains 25% or more very coarse and coarse sand and less than 50% any other one grade of sand.

loamy (medium) sand - Loamy sand is a soil material that contains 25% or more very coarse, coarse, and medium sand and less than 50% fine or very fine sand.

loamy fine sand - Loamy fine sand is a soil material that contains 50% or more fine sand or less than 25% very coarse, coarse, and medium sand and less than 50% very fine sand.

loamy very fine sand - Loamy very fine sand is a soil material that contains 50% or more very fine sand.

Sandy Loam - Sandy loam is a soil material that contains either 20% or less clay, with a percentage of silt plus twice the percentage of clay that exceeds 30, and 52% or more sand; or less than 7% clay, less than 50% silt, and between 43% and 52% sand.

coarse sandy loam - Coarse sandy loam is a soil material that contains 25% or more very coarse and coarse sand and less than 50% any other one grade of sand.

sandy loam (medium) - Sandy loam consists of 30% or more very coarse, coarse and medium sand, but less than 25% very coarse sand, and less than 30% very fine or fine sand.

fine sandy loam - Fine sandy loam is a soil material that contains 30% or more fine sand and less than 30% very fine sand or between 15 and 30% very coarse, coarse and medium sand.

very fine sandy loam - Very fine sandy loam is a soil material that contains 30% or more very fine sand or more than 40% fine and very fine sand, at least half of which is very fine sand, and less than 15% 15% very coarse, coarse, and medium sand.

Loam - Loam is a soil material that contains 7 to 27% clay, 28 to 50% silt, and less than 52% sand.

Silt loam - Silt loam is a soil material that contains 50% or more silt and 12 to 27% clay, or 50 to 80% silt and less than 12% clay.

Sandy clay loam - Sandy clay loam is a soil material that contains 20 to 35% clay, less than 28% silt, and 45% or more sand.

Clay loam - Clay loam is a soil material that contains 27 to 40% clay and 20 to 45% sand.

Silty clay loam - Silty clay loam is a soil material that contains 27 to 40% clay and less than 20% sand.

Sandy clay - Sandy clay is a soil material that contains 35% or more clay and 45% or more sand.

Silty clay - Silty clay is a soil material that contains 40% or more clay and 40% or more silt.

Clay - Clay is a soil material that contains 40% or more clay, less than 45% sand, and less than 40% silt.

Heavy clay - Heavy clay is a soil material that contains more than 60% clay.

3.2.5.1 Soil Physical Properties

These properties relate to the mechanical behavior of the soil. The physical data is presented as simple, unweighted means, along with the range of values found and the number of samples analysed for each property.

Permeability - Is a measure of downward rate of water movement through a saturated soil. Since laboratory determinations of permeability were not performed, estimates were made based on the following soil characteristics and guidelines. The soil characteristics were mainly texture and to a lesser degree, soil structure, organic matter, coarse fragment content, porosity, and bulk density.

Very Slow - The soil has very little if any water transmission. Generally fine-textured soils dominate. Permeability is less than 0.125 cm/hr.

Slow - The soil has very little water transmission. Generally moderately fine-textured soils such as clay loams and silty clay loams dominate. Permeability is 0.125 cm/hr to 2.5 cm/hr.

Moderate - There is good water transmission. Generally medium-textured soils such as loams and silt loams dominate. Permeability is 2.5 cm/hr to 12.5 cm/hr.

Rapid - The soil water transmission is too great for optimum growth. Generally moderately coarse-textured soils such as sandy loams and gravelly loams dominate. Permeability is 12.5 cm/hr to 25 cm/hr.

Very Rapid - Excessive water transmission throughout the soil. Porous, coarse-textured soils such as sands and gravels dominate. Permeability is greater than 25 cm/hr.

Bulk Density - Bulk density is the mass of a unit volume of dry soil and includes both pores and soil solids. Bulk density depends largely on texture, structure and degree of compaction. Generally, with higher bulk densities there is less pore space and development of structure. The addition of organic matter enhances soil structure development and decreases bulk density while compacting soils by traffic or tillage increases bulk density. For most soils, surface layers are likely to be less compact than subsoil layers.

Table 3.3 shows the approximate relationship between bulk density and soil texture. The type of taxonomic soil development, organic matter content and presence of coarse fragments can greatly change this relationship. For example, a loamy sand Bf horizon may have a bulk density much lower than 1.5-1.6 g/cm^3 due to well developed structure while if a large amount of coarse fragments are present, the bulk density will likely be substantially higher.

Table 3.3
Generalized Relationship Between Bulk Density and Soil Texture

Bulk Density	Soil Texture	Class
0.1-0.4 g/cm^3	peat	very low
<1.1 g/cm^3	heavy clay, clay	very low
1.1-1.2 g/cm^3	silty clay, clay, sandy clay	low
1.2-1.3 g/cm^3	clay loam, silty clay loam, sandy clay	moderately low
1.3-1.4 g/cm^3	loam, sandy clay loam, silt loam, silt	medium
1.4-1.5 g/cm^3	fine sandy loam, loam	medium high
1.5-1.6 g/cm^3	sandy loam, loamy sand	high
>1.6 g/cm^3	sand	very high

<u>Available Water Storage Capacity (AWSC)</u> - AWSC represents the amount of water which can be extracted from the soil by plants or is available for plant use. Quantitatively, it is the depth of water held in the soil between field capacity (1/3 atmosphere) and permanent wilting point (15 atmospheres) and is expressed in cm/m.

Table 3.4
Approximate Available Water Storage Capacity of Selected Soil Textures

Approximate AWSC (cm H_2O/m of soil)	Soil Texture*	Class
2.5	"pea" gravel	very low
4.5	very gravelly sand	
8.3	sand	low
10.0	loamy sand	
12.5	sandy loam	moderate
14.2	fine sandy loam	
17.5	loam	
20.0	clay loam	high
20.0	clay	
20.8	silt loam	
22.0	organic	

*Soil textures contain no gravels or other coarse fragments except where indicated. There presence will proportionately reduce the above AWSC values.

Type of Organic Material - The term applies to soils in the Organic Order. Three types of organic material are recognized based on the degree of decomposition: fibric (relatively undecomposed, with readily identifiable plant fragments); mesic (intermediate stage of decomposition); and, humic (advanced stage of decomposition).

Rubbed Fiber Content - This is a measure for determining the degree of decomposition of organic material. Fibric organic material contains more than 40% fiber, mesic material contains between 10 and 40% fiber and humic material contains less than 10% (McKeague, 1976).

von Post Scale - This empirical rating is a field assessment of the degree of organic material decomposition on a scale of 1 to 10: fibric (1 to 4), mesic (5 or 6), and humic (7 or greater) (The Canadian System of Soil Classification, 1978).

Pyrophosphate Index - This color test provides another measure of organic material decomposition: fibric (>5), mesic (3 to 5), and humic (<3) (The Canadian System of Soil Classification, 1978).

Coarse Fragments - These are soil particles greater than 2 mm in diameter. They are separated into two classes: those between 2 mm and 7.5 cm diameter are considered as gravels and those greater than 7.5 cm diameter are considered as cobbles and stones. Data given are average values based on visual estimates of relative volumes based on field sievings.

Percent Passing Sieves - This analysis refers to the percent of soil or gravel material which passes through specified sieve sizes and is used to determine Unified engineering soil classification system. No. 4 sieves have mesh openings of 4.76 mm meshes while No. 40 sieves have openings of 0.42 mm. Material passing the No. 200 sieve (0.074 mm mesh openings) is considered to be all silt and clay.

Percent Sand - as determined by particle size analysis.

Percent Clay - as determined by particle size analysis.

3.2.5.2 Soil Chemical Properties

The data presented are intended to give a general indication of the levels and variability of important soil chemical properties. They are suitable for general applications but are not suitable for deriving site specific recommendations such as for fertilizer application.

For determination of optimum fertilizer applications for individual farms or fields, it is advisable to have independent analyses and interpretations conducted, because of the wide variability found within the same soil, the effects of past and present management practices and the type of crop to be grown. The chemical values shown for most soils are based on analyses of undeveloped (forested) conditions. Tillage, crops and fertilizer applications can drastically alter these relationships. Soils under cultivation and cropping tend to become depleted of primary and secondary elements, phosphorous fixation occurs under acid conditions, bases and nitrates tend to be leached, as well as the tendency for acidification to occur as an on-going process. Minor elements such as boron, manganese, copper, zinc, molybdenom, and selenium have not been included in the standard chemical analyses carried out on the soils of the map area.

The chemical data are presented as simple unweighted means, along with the range of values found and the number of samples analysed for each property.

Soil Reaction (pH)

Soil reaction or pH is expressed in values from zero to 14. A value of seven indicates neutrality; decreasing values below seven indicate increasing acidity, while increasing values above seven indicate increasing alkalinity.

Soil pH was measured by two methods. The first utilized a glass electode in a 1:1 soil-water suspension for mineral soil samples and a 1:5 suspension for organic soil samples. The second method employed a 0.01M $CaCl_2$ solution instead of water. This latter method reduces the effect of varying concentrations of salts and approaches the pH of the soil solution under actual field conditions. Values by this method are usually about 0.5 pH unit less than in water determinations.

Plants vary in their ability to grow at different pH values. Nutrient availability to various plants at different pH values may vary significantly. In general, depending upon the type of crop to be grown, soils with pH (H_2O) values between 5.5 and 6.0 normally require slight amounts of lime whereas soils with pH (H_2O) values between 5.0 and 5.5 require moderate amounts of lime, and soils with values between 4.5 and 5.0 may require high amounts of lime. The actual amounts of lime required are best determined by a lime requirement test.

The pH of surface and subsurface horizons of southeastern Vancouver Island soils is affected largely by the regional climate, soil mineralogy, especially aluminum content, texture, soil water relationships, organic matter content and soil management. The reaction classes of soil parent materials in the survey area are generally slightly or medium acid. The surface soil horizons are nearly always medium or strongly acid.

Table 3.5
Soil Reaction (pH)

Reaction Class	pH Values (0.01 M $CaCl_2$)
Extremely Acid	<4.5
Very Strongly Acid	4.6-5.0
Strongly Acid	5.1-5.5
Medium Acid	5.6-6.0
Slightly Acid	6.1-6.5
Neutral	6.6-7.3
Mildly Alkaline	7.4-7.8
Moderately Alkaline	7.9-8.4
Strongly Alkaline	>8.5

Conductivity (Salinity)

Salt content is usually measured on a saturated soil extract and the resultant electrical conductivity is expressed in millisiemens per centimeter (mS/cm). Salinity is not a common problem in the study area, being restricted to areas subject to tidal flooding (modified from U.S.S.L., Riverside, California; U.S.D.A., 1971).

Table 3.6
Conductivity (Salinity)

Salinity Classes	Conductivity (mS/cm)	Plant Growth Conditions
Non saline (NS)	<2	Salinity effects negligible. Soils free of excess salts; plant growth not inhibited.
Very weakly saline (VWS)	2-4	Yields of sensitive crops restricted. Soils have very slight amounts of excess salts; sensitive plants may show growth restrictions.
Weakly saline (WS)	4-8	Yields of many crops restricted. Soils are slightly affected by excess salt; growth of sensitive plants inhibited but some salt tolerant plants may not be.
Moderately saline (MS)	8-16	Most salt-tolerant crops have lower yields. Soils are moderately affected by exccess salt. Plant growth is very inhibited and few crops do well.
Strongly saline (SS)	>16	Only a few very salt tolerant plants survive and show low yields. Soils are strongly affected by excess salt.

Crops and plants differ in their tolerance to salinity. Such crops as wheatgrass, beets and spinach are not only highly tolerant but also react to growth stimulation by salt levels that could be lethal to sensitive plants such as Alsike clover.

Organic Carbon

The amount of organic carbon in soils is a measure of soil organic matter which results from the decomposition and incorporation of leaves, twigs, roots, mosses, seeds and other organic material. The amount of organic matter that accumulates is controlled by vegetation which in turn is related to precipitation, drainage and temperature. The amount of organic matter can vary from less than 1% to almost 100%. In cultivated soils organic matter maintenance is very important as it improves soil fertility and soil structure, promotes resistance to crusting, puddling and erosion, and increases aeration and friability as well as moisture holding capacity and cation exchange capacity. Organic matter content can be estimated by multiplying the percent organic carbon by 1.7.

The organic matter in soils can be maintained by frequent incorporation of green manures, crop residues, barnyard manure or other organic material. This helps to maintain adequate levels of soil fertility for crop production. In general the carbon content of mineral soils is highest at the surface and decreases with depth. Organic soils tend to have organic carbon content that remains relatively constant throughout the soil profile or increases slightly with increasing depth. Levels of organic carbon of less than 2% are considered low, 2% to 10% moderate, while greater than 10% are high.

Nitrogen

Nitrogen is a major plant nutrient required for growth. Nitrogen is utilized by plants mainly in the nitrate form which is easily lost from the soil by leaching, and in the ammonium form which is somewhat less subject to leaching. Soil organic matter and commercial fertilizers are the major nitrogen sources.

Microorganisms play an important role in the provision of nitrogen to plants. The ammonifying and nitrifying microorganisms convert nitrogen from soil organic matter into forms available for plant uptake. The amount released is influenced by drainage, temperature, C:N ratio of added organic matter. Nitrogen-fixing bacteria, some of which are associated with roots of legumes (e.g. clover, alfalfa), convert atmospheric nitrogen into forms usable by plants.

In their undisturbed condition, forested soils in the study area have high nitrogen levels only in the surface organic layers and the uppermost mineral soil horizon. Nitrogen content decreases rapidly with depth.

For most crops, those soils having total nitrogen levels of greater than 0.40% in the surface 25 cm are not likely to need much nitrogen fertilization for a few years. As most of these values will vary widely from site to site, it is more useful to take individual soil fertility tests when devising a fertilization program. Surface soils with values of less than 0.25% total nitrogen will generally require fertilization.

Cation Exchange Capacity

The ability of soils to hold exchangeable cations is termed the cation exchange capacity which is expressed as milli-equivalents of cations required to balance the negative charge of 100 g of soil at pH 7.0. Exchange sites are mainly supplied by organic matter and clay minerals. Therefore, depending on the organic matter content and the type and amount of clay minerals present, the exchange capacities can range from less than 10 to over 100 milli-equivalents per 100 g of soil. The following values may be used as a guide to the relative levels of the exchange capacities of soils.

Table 3.7
Cation Exchange Capacity Classes

Class	Cation Exchange Capacity (Milli-equivalents/100 g)
Very Low (VL)	less than 5
Low (L)	5 - 10
Medium (M)	10 - 20
High (H)	20 - 60
Very High (VH)	more than 100

High cation exchange capacities generally occur in fine-textured soils and soils with high organic matter contents. Organic soils in the surveyed area have cation exchange capacities in the range of 160-200 milli-equivalents per 100 g, which reflect their very high organic matter content and high potential ability to hold nutrients. For mineral soils, exchange capacities are mostly high in the surface horizon, reflecting high organic matter contents, decreasing to medium and low in the subsoil. Coarse-textured, gravelly subsoils usually have very low cation exchange capacities.

Base saturation is a most important property in soils. It is defined as the percentage of total cation exchange capacity occupied by the basic calcium, magnesium, sodium and potassium cations. Aluminum and hydrogen generally occupy that portion on the exchange complex that is not satisfied by basic cations. The ease with which cations are absorbed by plants is related to the degree of base saturation. For any given soil the availability of basic cations increases with the degree of base saturation. For example, a soil with a base saturation of 80% would provide cations to growing plants far more easily than the same soil with a base saturation of 40% (Tisdale and Nelson 1966). The soils of the surveyed area normally have low base saturation, particularly in the upper strongly weathered horizons.

Exchangeable Cations

Calcium, magnesium, potassium, sodium, hydrogen, aluminum and hydroxyaluminum ions are the most abundant exchangeable cations. Their proportions vary from soil to soil depending on soil characteristics and past management practices. Aluminum and hydrogen ions are very abundant in most soils, but are not measured directly; rather, they are assumed to make up the remainder of the total cation exchange capacity that is not filled by the basic cations. For the soils of the study area, basic cations account for about half of the cation exchange capacity.

Aluminum and hydrogen cations predominate in acid soils while calcium and magnesium are the most common in near neutral soils. Sodic and saline soils may contain various proportions of exchangeable sodium, calcium and magnesium as well as minor amounts of potassium. Exchangeable calcium and magnesium, removed by crops and lost by leaching, are usually replaced by aluminum and this results in a decrease in pH.

(i) Exchangeable Calcium (Ca)

Calcium is the dominant basic cation on the exchange complex. Calcium values of surface horizons in soils in the report area are generally greater than 4 meq/100 g although subsoils often have calcium levels of less than 4 meq/100 g. Generally, the latter are coarse-textured soils with low cation exchange capacities and low organic matter contents. Exchangeable calcium levels below 2.5 meq/100 g are considered low and inadequate for many crops.

(ii) Exchangeable Magnesium (Mg)

Magnesium levels are generally greater than 0.85 meq/100g in most of the A horizons of mineral soils in the survey area. Most subsoils and coarse-textured sands and loamy sands with low organic matter have lower values. Organic soils in the survey area in general have high levels of magnesium, above 1.7 meq/100 g. Soils with high magnesium levels require little or no magnesium fertilization while those with medium to low levels (<0.85 meq/100 g) may show beneficial effects with increasing amount of magnesium fertilizer. Proper rates of fertilizer applications however, should be determined by individual soil tests and be related to the requirement of the desired crop. (H. Chuah, personal communication).

(iii) Exchangeable Sodium (Na)

Sodium is a relatively loosely held ion on the exchange complex and is readily lost and replaced by other ions in the soil solution. The presence of sodium in large quantities, expecially in fine-textured soils, is undesirable because of its detrimental effect on soil structure. Soils containing appreciable exchangeable Na cations tend to become dispersed, are less permeable to water, and have poor tilth. When Na cations occupy more than 10 to 20% of the cation exchange capacity, the soil develops a poor physical condition, especially if the soluble salt content is low. Coarse-textured soils can tolerate a higher exchangeable sodium percentage than fine-textured soils before the physical condition deteriorates. Also, soils having a high organic matter content can tolerate a higher Na cation percentage than those without it.

Sodium is not considered an essential plant nutrient and becomes toxic to many crops if exchangeable sodium exceeds 25%. In the surveyed area, Na cations are the least abundant exchangeable cations, except in soils affected by tidal flooding.

(iv) Exchangeable Potassium (K)

Exchangeable potassium exists in equilibrium with fixed forms of K in the soil. This equilibrium is disturbed when plants remove the exchangeable form and, to re-establish equilibrium, some fixed potassium is released. The maintenance of an adequate supply depends upon the reserve and rate of release.

Soils with less than 0.15 meq/100 g of exchangeable potassium are considered to have low levels, while values greater than 0.31 meq/100 g are considered high. Generally those soils with high to very high levels of potassium will require little or no potassium fertilization, whereas those with moderate to very low levels will require varying amounts as determined by individual soil tests and crop requirements.

Phosphorus

Phosphorus is a major nutrient element required for plant growth. Since plants can only utilize inorganic forms, the organic forms must be mineralized by microorganisms before plant uptake is possible. The proportion of phosphorus available for plant growth to the total present in the soil at any one time is generally small.

Available phosphorus levels below 10 ppm are low, while values over 40 ppm are considered high. Depending upon the crop to be grown, soils with moderately high to high available phosphorus levels will generally require little or no phosphorus fertilization, whereas those with medium to very low values will require varying amounts as determined by individual soil tests and crop requirements.

Sulfur

Sulfur is a minor but essential element for crop growth. Its content is generally low (<3 ppm) in most Vancouver Island mineral soils, but very high (>20 ppm) in organic soils.

Iron and Aluminum

Iron and aluminum content, as measured by the sodium pyrophosphate extraction technique, provides an important criterion in soil classification. For most of the soil textures in the study area, the Fe+Al content of the B horizon must be equal or greater than 0.6% for the soils to be classified in the Podzolic order. (Additional criteria apply; see: Canada Soil Survey Committee, 1978). Most B horizons in moderately well to rapidly drained soils in this study area have Fe+Al values of 0.4 to 1.0%.

3.2.6 Soil Phases and Variants

In addition to the 37 named soils described for the study area, phases and variants of these soils are also recognized. The complete lists of phase and variant symbols and their description are given below. Those phases and variants recognized for each soil are also indicated in each soil description in Chapter 4.

Soil Phases are variations of a defined soil and occur due to differences in stoniness, topography, depth of profile, depth to bedrock, and other features which affect the soils use and management. They are not sufficiently different from the defined soil to warrant identification of a separate soil. Table 3.8 lists all soil phases used in the report area.

Table 3.8
Description of Soil Phases

Phase Symbol	Description
co	Cobbly. Cobbles and stones occupy more than 20% of the soil volume.
dc	Moderately to strongly cemented horizon (duric) occurring between 100 and 200 cm depth.
g	Gravelly. Between 20 and 50% of the soil volume is occupied by gravels.
l2	Shallow lithic. Bedrock occurs at depths between 50 and 100 cm of the soil surface.
pt	Peaty. 15 to 40 cm of humic or mesic organic material occurs on the surface of the mineral soil.
r	Rubbly and/or blocky. More than 50% of the soil volume is occupied by coarse fragments greater than 25 cm in diameter.
l3	Very shallow lithic. Bedrock occurs at depths between 10 and 50 cm of the soil suface.
vg	Very gravelly. Between 50 and 90% of the soil volume is occupied by gravels.
w	Strongly mottled. Moisture regime of the soil is wetter than the usual conditions as evidenced by prominent mottling within 50 cm of the surface. Seasonal perched water tables present. Landscape position is not typical of Gleysolic soils.
wc	Weakly cemented horizons are present in the subsurface and/or subsoil.

Soil Variants are soils whose properties are believed to be sufficiently different from other known soils to justify identification of a new soil, but occurring over such a small area that definition of a new named soil is not justified. Exceptions were made with some Gleysolic soils (e.g. Koksilah) because of their significance to land use and management. Table 3.9 lists all variants in the report area.

Table 3.9
Description of Soil Variants

Symbol	Description
a	Sufficient Ah is present for the soil to be classified in the Sombric subgroup of the Podzolic or Brunisolic Orders.
id	The soil is imperfectly drained and classified in the Gleyed subgroup of the appropriate soil order.
lo	10 to 50 cm of loam textured material occurs at the soil surface.
mc	Moderately cemented soil horizons are present.
md	Moderately well to well drained, e.g. Orthic Dystric Brunisol instead of Gleyed Dystric Brunisol.
pd	Poorly drained (Gleysolic).
s	Shallow. 50 to 100 cm of surficial deposit overlying another of different origin, or a strongly contrasting change in texture.
so	Terric organic soils (mineral material occurs between 40 and 160 cm of surface).
sp	Sedimentary peat is present in the subsoil.
t	Taxadjuncts are soils that approximate, but do not quite meet the criteria of a taxonomic category. Specific classification given in the soil description section. (Used only for Organic soils in this map area).
vs	Very shallow. 10 to 50 cm of surficial deposit overlying another of different origin, or a strongly contrasting change in texture.

3.2.7 Inferred Soil Properties

The Unified System

The Unified classification system (Asphalt Institute, 1978) (U.S.D.A, 1971) is based on 1) textural characteristics for those soils with a small amount of fines; and 2) on plasticity-compressibility characteristics for soils where fines affect their behaviour. These are shown in Table 3.10.

This classification gives a basis for predicting soil behaviour as an engineering construction material. Eight of the 15 Unified classes are coarse-grained and identified as GW, GP, GM, GC, SW, SP, SM and SC. Fine-grained classes are identified as ML, CL, L, MH, CH and OH. One class of organic soil is identified as Pt. (Asphalt Institute, 1978).

American Association of State Highways Officials (AASHO) System

The AASHO system (Asphalt Institute, 1978) is based on the observed field performance of soils under highway pavement; it is widely used by highway engineers. In this system a soil is placed in one of seven basic group ratings (A-1 to A-7) on the basis of grain size distribution, liquid limit and plasticity index (as shown in Table 3.11). Group A-1 are gravelly soils of high bearing strength and are the best soils for subgrade while groups A-4 to A-7 are the poorest for subgrade. These latter groups are clay soils having low bearing strength when wet.

Table 3.10
Characteristics of the Unified Classification

UNIFIED SYMBOL	MATERIAL CHARACTERISTICS
GW	Well-graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded sands, gravelly sands, little or no fines
SP	Poorly-graded sands, gravelly sands, little or no fines
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silty clays of low plasticity
MP	Inorganic silts, micaceous or diatomateous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity, organic silts
Pt	Peat and other highly organic soils

Table 3.11
Classification of Soils and Soil-Aggregate Mixtures in the ASSHO System

General Classification	Granular Materials (35% or less passing 0.075 mm)							Silt-Clay Materials (More than 35% passing 0.075 mm)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, Percent Passing											
2.00 mm (No. 10)	50 max	---	---	---	---	---	---	---	---	---	---
0.425 mm (No. 40)	30 max	50 max	51 min	---	---	---	---	---	---	---	---
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of Fraction Passing of 0.425 mm (No. 40)											
Liquid Limit	---		---	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Usual Types of Significant Constituent Materials	Stone Fragments Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Rating as Subgrade	Excellent to Good							Fair to Poor			

Plasticity index of A-7-5 subgroup is equal to or less than LL. minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

Atterberg Limits (Liquid Limit and Plastic Limit)

The engineering properties of soils vary with the amount of water present. Atterberg Limits measure the effect of moisture on the consistence of the material.

Atterberg limits are most commonly applied in the planning of road construction. Generally, soils with high liquid limits, such as clays, have poor engineering properties. A low plasticity index, on the other hand, indicates a granular soil with little or no cohesion or plasticity. Some silts and sandy soils are non-plastic (NP).

The liquid limit is the minimum percentage moisture content at which the soil-water mixture changes from a liquid to a plastic state, and represents the moisture content at which the soil will barely flow under an applied force.

The liquid limit varies widely and values as high as 80 to 100 are not uncommon with values of 40 to 60 more typical for clay soils. For silty soils, values of 25 to 50 can be expected, and are typical for medium to fine textured soils in this study area. The liquid limit test is not applicable for sandy soils; such soils are classified as "non-plastic" (NP).

The plastic limit is the minimum percentage moisture content at which the soil-water mixture changes from a plastic to a semi-solid state. It represents the minimum moisture at which puddling is possible and the maximum moisture content at which the soil is friable. It also generally indicates the point of maximum cohesion in the soil.

The plastic limit of silts and clays will not vary too widely and will range from 5 to 20. Normally, silty soils have the lower plastic limit. Pure sand is "non-plastic" (NP).

The plasticity index is the arithmetic difference between the liquid and plastic limits and indicates the range of moisture content within which a soil material is in a plastic condition. Generally the greater the plasticity index, the greater are the plasticity, compressibility and volumetric change characteristics of the soil.

The plasticity index can be as high as 70 to 80 for very plastic clays. Commonly, clays will have P.I.'s between 20 and 40. The silty materials normally range in P.I. between 10 and 20. In quality evaluation for pavement materials, materials are sometimes restricted to those with a liquid limit of 25 or less and a maximum P.I. of 6, i.e., a predominantly granular material. Plasticity index is an important parameter relating to tilth and workability of soil by tillage implements.

Soil Susceptibility to Water Erosion

Soil erosion by water is a complex process involving six major factors that determine the loss of soil at a particular site. The method used is valid for both exposed subsoils and cultivated surface soils. Erodibility is site specific and involves detachment and soil transport by both rainfall and runoff. To determine erodibility at a site, the soil erodibility factor K is calculated by the soil-erodibility nomograph developed by Wischmeier, Johnson and Cross (1971) which incorporates a number of soil factors such as particle size, organic matter content, structure, and permeability into a graphic representation. Once calculated, the K factor is used in the Universal Soil Loss Equation to estimate the annual rate of soil loss in tonnes/hectare.

The calculated K values for soils in the study are corrected for coarse fragment content using a method suggested by J. J. Rasmussen (1980). The corrected K values result in more realistic soil loss estimates when the Universal Soil Loss Equation is applied in the field.

Once the K factor is arrived at via the nomograph, it can be used in conjunction with the slope angle of a site to determine the erosional risks for disturbed areas such as construction sites and agricultural land. For this, the erosional hazards graph is used in relating the soil erodibility factor and associated slope angles to determine the susceptibility to erosion on uncovered soils. Thus the erosion hazard can be estimated for most soils within the map area.

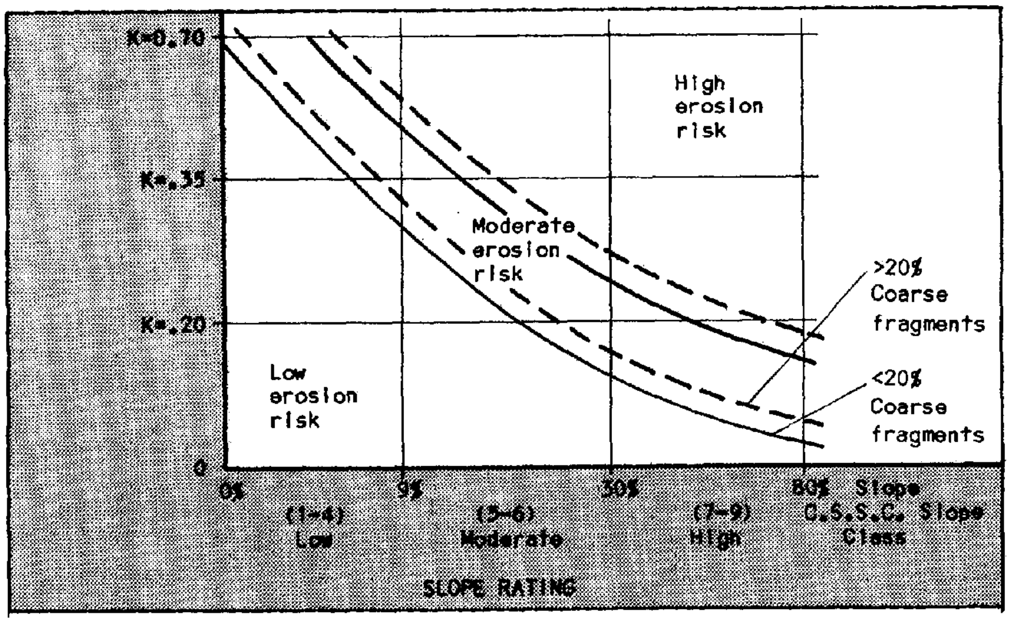


Figure 3.2 Erosion Hazard of Soils (Coen & Holland, 1976).

CHAPTER FOUR
SOIL DESCRIPTIONS

4.1 INTRODUCTION

Chapter Four describes the characterisitics of the thirty-seven individual soils and their phases and variants which are classified in the Duncan-Nanaimo map area. Detailed individual soil profile descriptions and chemical and physical analyses are not included. These are available on request from the British Columbia Soil Information System (Surveys and Resource Mapping Branch, British Columbia Ministry of Environment, Victoria, British Columbia). Summarized physical and chemical data are presented as simple, unweighted means, along with the ranges of values found and the number of samples analysed.

The soils are arranged in alphabetical order and the soil map symbol is indicated in brackets after the soil name. The soil landscape picture indicates a typical landscape in which the soil occurs. The General Comments section includes information on parent materials, topography, soil texture, soil classification, drainage, as well as some comments on land use, agricultural and urban suitability and soil management considerations.

The soil landscape cross-section depicts the physiographic setting, relating the soil with commonly associated soils. The parent material is described according to the terminology of the Terrain Classification System (E.L.U.C., 1976). Table 3.1 should be used for reference.

The generalized soil profile indicates most common depths of major soil horizons. These descriptions should assist map users in identifying the soil in the field.

ARROWSMITH SOILS (AR)

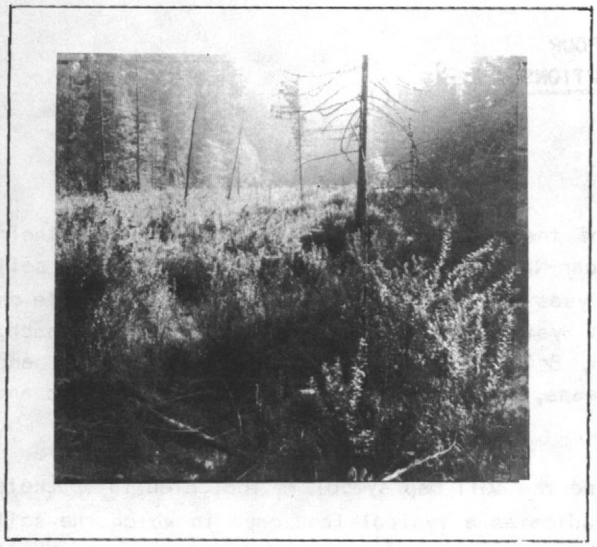


PLATE 4.1: ARROWSMITH SOIL LANDSCAPE

GENERAL COMMENTS

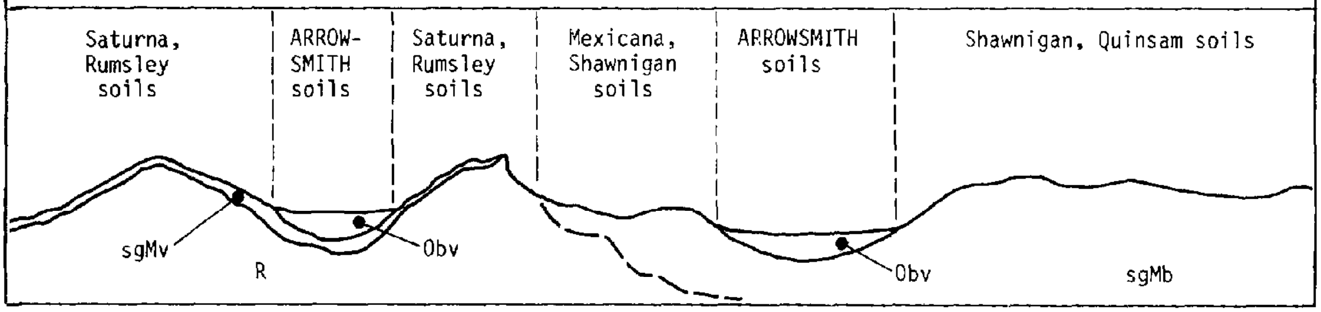
Arrowsmith soils (495 ha) occur in very poorly drained depressional areas throughout the map area. They are level and range in extent from 0.23 to 25 ha with an average map unit size of about 6 ha. The largest occurrence is near the Millstone River southwest of Bowen Park near Nanaimo. These soils have an apparent, year-round water table within 1 m of the soil surface and consist of dominantly mesic organic materials. At depth, normally greater than 160 cm they are generally underlain by sedimentary peat which, in turn, overlays silts and clays.

Arrowsmith soils are at an intermediate stage of decomposition and dominantly have dark brown, mesic material in the middle and bottom tiers. They are classified as **Typic Mesisols**, with minor inclusions of Terric Humic Mesisols.

Arrowsmith soils are considered to be the most desirable organic soils for agricultural use as they have favorable tilth and permeability. Watertables should be maintained at the highest levels which still permit good crop growth and field trafficability. They should be maintained near the soil surface over the winter to prevent undue oxidation and subsidence. Present land use includes vegetable production, forage crops and pasture. Adequate liming and fertilization are required to bring production to full potential.

Arrowsmith soils are severely constrained for urban and related uses by very low bearing strengths and high watertables.

ARROWSMITH SOIL LANDSCAPE CROSS SECTION*



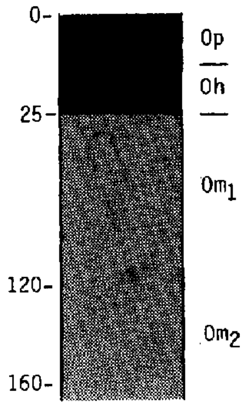
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	organic
TOPOGRAPHY	:	level
ELEVATION RANGE	:	2-300 m asl
ASPECT	:	none
FLOOD HAZARD	:	may be expected
VEGETATION	:	Native vegetation supported by Arrowsmith soils includes a variety of water tolerant plants such as Labrador tea, hard hack, mosses, willow, skunk cabbage, sedges, and reeds as well as some western red cedar and shore pine.

TYPICAL ARROWSMITH SOIL PROFILE

DEPTH (cm)



Op - Black (10YR 2.5/1m), humic organic material; granular, cultivated; very strongly acid.

Oh - Black (10YR 2/1m), humic organic material; very strongly acid.

Om_1 - Dark brown (10YR 3/3m), mesic organic material; very strongly acid.

Om_2 - Dark reddish brown (10YR 3/3m), mesic organic material; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Peatymor
SOLUM DEPTH (cm)	: >160
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: <160
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 25-100; apparent
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: very poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: N/A

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm) No. of Samples	0-40	No. of Samples	40-120	No. of Samples	120-160
BULK DENSITY (g/cm^3)	Est.	(.1-.2)				
AWSC (cm/m)	Est.	20				
TYPE OF ORGANIC MATERIAL		humic		mesic		mesic
RUBBED FIBRE CONTENT %	Est.	(10-40)	Est.	(10-40)	Est.	(10-40)
von POST SCALE		5-6		5-6	Est.	5-6
PYROPHOSPHATE INDEX		3-5		3-5	Est.	3-5

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm) No. of Samples	0-40	No. of Samples	40-120	No. of Samples	120-160
SOIL REACTION 1:1 H_2O	5	5.4 (5.1-5.8)	6	5.5 (5.3-5.7)	3	5.6 (5.3-5.8)
(pH) 1:2 $CaCl_2$	5	5.0 (4.8-5.4)	6	5.3 (5.1-5.5)	3	5.4 (5.1-5.6)
CONDUCTIVITY mS/cm		N/A		N/A		N/A
ORGANIC CARBON (%)	3	43.8 (35.0-50.9)	7	49.7 (33.8-54.5)	3	52.1(48.4-54.8)
NITROGEN (%)	2	1.94 (1.81-2.06)	7	1.98 (1.57-2.44)	3	2.18(1.40-3.16)
EXCHANGE CAPACITY (meq/100g)	2	147.3 (113-181)	7	141 (130-159)	2	147.6(139.2-156.9
EXCHANGEABLE CATIONS - Ca	1	77.0	6	70.6 (48-94)	3	63 (29-81)
(meq./100g) - Mg	1	2.8	6	3.6 (1.8-8.4)	3	5.2 (3.3-7.8)
- Na	1	0.0	6	0.1	3	0.1 (0.1)
- K	1	0.2	5	0.3 (0.2-0.4)	2	0.5 (0.4-0.5)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
ARso	Shallow organic variant; these soils have less than 160 cm of organic material. They are classified as Terric Mesisol.
ARso,t	Shallow organic variant and taxajunct variant; these soils have less than 160 cm of organic material and contain more than 25 cm of humic organic material. They are classified as Terric Humic Mesisol.
ARt	Taxajunct variant; the solum contains more the 25 cm of humic organic material. They are classified as Humic Mesisol.

INFERRED SOIL PROPERTIES
ARROWSMITH SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
AR	0-160	Pt	-	-	-	-

BEDDIS SOILS (BD)

PLATE 4.2: BEDDIS SOIL LANDSCAPE

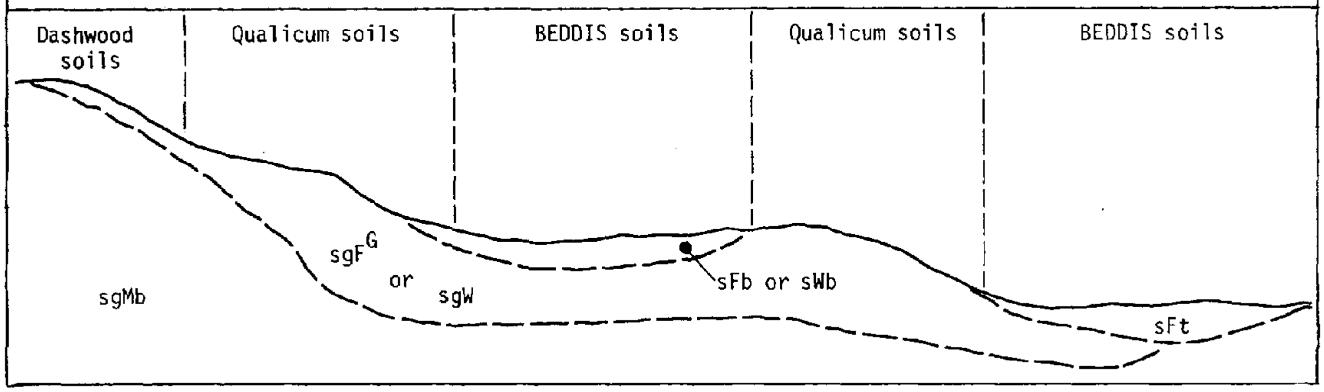
GENERAL COMMENTS

Beddis soils (1090 ha) occur throughout the survey area on nearly level to steep slopes below elevations of about 100 m. Generally they are found on well to rapidly drained sandy fluvial terraces, old post-glacial beaches and other marine deposits.

Beddis soils are stone-free with loamy sand or sandy loam surface horizons. The lower horizons are compact and are loamy sand to sand in texture. They are predominantly **Orthic Dystric Brunisols** although minor components of Orthic Humo-Ferric Podzols also occur.

Agriculturally, Beddis soils are droughty, however, with irrigation and fertilization most crops can be produced. Beddis soils are well suited for forest nursery operations, however, sloping areas are susceptible to erosion. In general, these soils are suitable for urban and related developments.

BEDDIS SOIL LANDSCAPE CROSS SECTION*

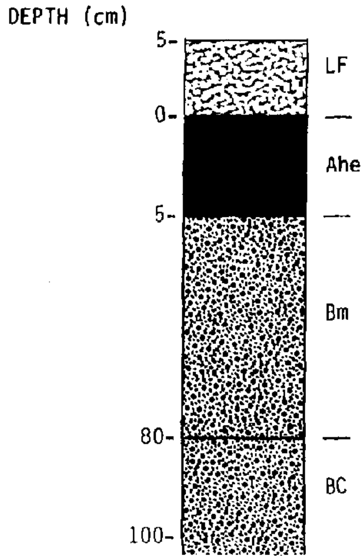


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy fluvial blanket, sandy marine blanket
TOPOGRAPHY	:	0-30%; nearly level to strong slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	rare
VEGETATION	:	The native vegetation is mainly composed of second growth Douglas-fir, western red cedar and grand fir with occasional red alder and maple.

TYPICAL BEDDIS SOIL PROFILE



LF	Loose, non-compact litter over compact fiber; very strongly acid.
Ahe	Reddish yellow (7.5YR 7/6m) sandy loam; moderate, medium granular; very friable; very strongly acid.
Bm	Yellowish brown (10YR 5/6m) loamy sand; moderate, medium subangular blocky breaking to single-grained; very friable; very strongly acid.
BC	Yellowish brown (10YR 5/4m) sandy loam sand to loamy sand; massive breaking to single-grained; friable; medium acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: moder to mull
SOLUM DEPTH (cm)	: >100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: >90
COARSE FRAGMENT CLASS	: 0-1
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: rapid to moderate
SOIL DRAINAGE	: rapid to moderately well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: Loamy sand, sandy loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		rapid - moderate		rapid - moderate
BULK DENSITY (g/cm^3)	3	1.22 (1.19-1.27)	3	1.73 (1.70-1.78)
AWSC (cm/m)	3	10 (8-12)	3	14.7 (9.6-17.4)
AWSC (Corr. for % CF) (cm/m)	3	9 (7-11)	3	14.0 (9.6-17.2)
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0-2
% COARSE FRAGMENTS <7.5cm	Est.	5-20	Est.	0-25
% PASSING SIEVES # 4	2	92.5 (85.4-99.6)	2	99.7 (99.5-99.8)
% PASSING SIEVES # 40	2	79.4 (62.0-96.7)	2	97.3 (95.3-99.2)
% PASSING SIEVES # 200	2	15.4 (13.6-17.1)	2	53.0 (37.9-68.1)
% SAND	17	78.1 (51.0-97.1)	8	74.9 (31.2-97.8)
% CLAY	16	3.2 (1.1-7.1)	8	2.2 (1.0-7.9)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	14	5.5 (4.4-6.0)	11	5.8 (5.7-6.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	30	5.0 (4.0-5.6)	11	5.1 (4.9-5.4)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	22	1.1 (0.3-2.2)	9	0.4 (0.1-1.0)
NITROGEN (%)	9	0.07 (0.02-1.2)	9	0.02 (0.01-0.05)
EXCHANGE CAPACITY (meq/100g)	8	12.0 (5.7-17.4)	9	6.9 (4.9-9.7)
EXCHANGEABLE CATIONS (meq/100g) - Ca	9	1.0 (0.3-2.1)	9	0.8 (0.2-6.3)
- Mg	9	0.2 (0.1-0.5)	8	0.1 (0.1-0.3)
- Na	9	0.1 (0.1)	8	0.1 (0.1-0.2)
- K	9	0.1 (0.1-0.2)	8	0.1 (0.1-0.1)
PHOSPHORUS (ppm)	3	20 (7.5-34)	3	15 (12-17)
SULFUR (ppm)	9	0.5 (0.1-0.8)	9	2.7 (0.3-7.3)
% IRON	29	0.22 (0.03-0.55)	5	0.07 (0.03-0.10)
% ALUMINUM	29	0.39 (0.12-0.82)	5	0.34 (0.22-0.45)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
• BDa	Sombric variant (Gleyed Sombric Brunisol); usually the result of long term cultivation.
BDg	Gravelly phase; the soil profile contains 20 to 50 coarse fragments, usually in the fine gravel size (<2.5 cm).
BDid	Imperfectly drained (wetter) variant (Gleyed Dystric Brunisol, with some Gleyed Humo-Ferric Podzol); occurs in seepage areas, usually along margins of higher fluvial terraces.
BDs	Shallow variant; coarser textured material (very gravelly sand, very gravelly loamy sand) occurs at 50 to 100 cm.

INFERRED SOIL PROPERTIES
BEDDIS SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
BD	0-100	SM	A-2-4	N.P.	N.P.	0.2 - 0.5

BELLHOUSE SOILS (BH)

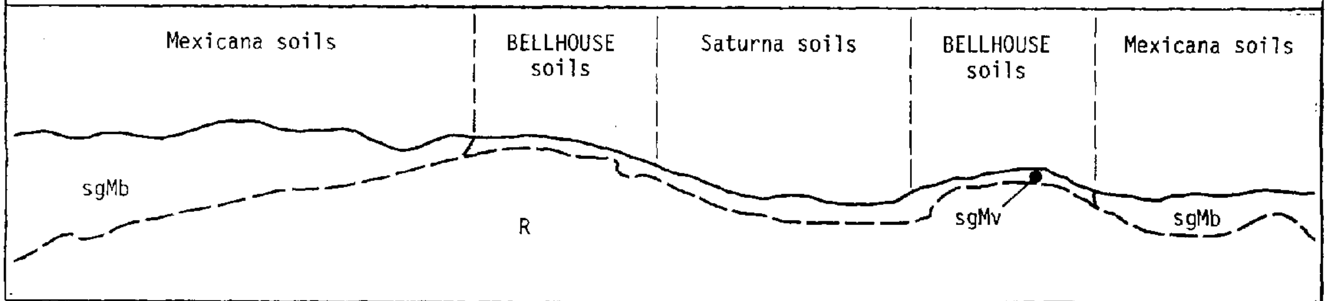
PLATE 4.3: BELLHOUSE SOIL LANDSCAPE

GENERAL COMMENTS

Bellhouse soils (175 ha) have developed on shallow, coarse-textured, colluvial or morainal deposits which overlie gently to moderately sloping sandstone bedrock. Most Bellhouse soils occur in the Yellow Point-Harmac area where open grasslands interspersed with stands of Arbutus and Garry Oak are commonly found. This vegetation type promotes formation of dark, organic matter-enriched A horizons and provides limited natural grazing. These soils are dominantly classified as **Sombric Humo-Ferric Podzol**; lithic phase. Bellhouse soils are considered nonarable because of severe limitations due to shallow depth to bedrock and stoniness.

Bellhouse soils are normally not suited for urban development because of shallowness to bedrock. They are also too shallow for septic tank effluent disposal.

BELLHOUSE SOIL LANDSCAPE CROSS SECTION*



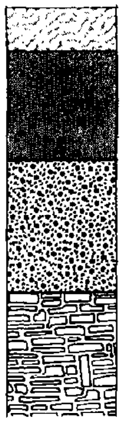
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	gravelly sandy morainal veneer or sandy rubbly colluvial veneer over subdued or ridged sandstone
TOPOGRAPHY	:	2-20%; very gentle to strong slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	dominantly south
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists of open Douglas-fir stands, scattered arbutus and Garry Oak with a ground cover dominated by grasses.

TYPICAL BELLHOUSE SOIL PROFILE

DEPTH (cm)



L - Loose, non-compact litter; very strongly acid.

Ah - Very dark brown (10YR 2/2m) sandy loam; weak to moderate, medium granular; firm; clear, smooth boundary; strongly acid.

Bf - Strong brown (7.5YR 4/6m) sandy loam, weak, fine to medium subangular blocky breaking to single-grain; very friable; strongly acid.

R - Bedrock (sandstone)

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: 30-60
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: 30-60
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 30-60; sandstone bedrock
ROOTING DEPTH (cm)	: 30-60
COARSE FRAGMENT CLASS	: 1- 3
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: moderate to rapid
SOIL DRAINAGE	: well to rapid
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: gravelly sandy loam or gravelly loamy sand

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-20	No. of Samples	20-60
PERMEABILITY (CLASS)		rapid to very rapid		rapid to very rapid
BULK DENSITY (g/cm^3)	Est.	1.5	Est.	1.5
AWSC (cm/m)	2	16.4 (15.0-17.7)	Est.	15.0 (13.0-17.0)
AWSC (corr. for % C.F.) (cm/m)	2	13.2 (11.3-15.0)	Est.	11.0 (8.0-14.0)
% COARSE FRAGMENTS >7.5cm	Est.	0-3	Est.	0-3
% COARSE FRAGMENTS <7.5cm	3	15-35	Est.	15-25
% PASSING SIEVES # 4	Est.	70		
% PASSING SIEVES # 40	Est.	50		
% PASSING SIEVES #200	Est.	20		
% SAND	4	66.2 (55.8-73.7)	1	58.1
% CLAY	4	10.3 (5.3-15.2)	1	13.6

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-20	No. of Samples	20-60
SOIL REACTION (pH) 1:1 H_2O	4	5.2 (4.8-6.0)	3	5.5 (5.2-5.7)
SOIL REACTION (pH) 1:2 $CaCl_2$	4	4.6 (4.1-5.7)	3	5.1 (4.6-5.4)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	6	6.2 (5.0-7.1)	4	2.1 (1.8-2.5)
NITROGEN (%)	6	0.31 (0.22-0.45)	3	0.11 (0.08-0.15)
EXCHANGE CAPACITY (meq/100g)	6	29.8 (22.8-39.3)	3	11.7 (10.4-13.9)
EXCHANGEABLE CATIONS (meq/100g) - Ca	4	4.8 (0.9-15.0)	3	1.2 (0.2-12.0)
- Mg	4	1.1 (0.1-3.5)	3	0.2 (0.01-0.3)
- Na	4	0.2 (0.1-0.3)	3	0.1 (0.1-0.2)
- K	4	0.3 (0.1-0.7)	2	0.3 (0.2-0.3)
PHOSPHORUS (ppm)	4	71.0 (16.0-111.0)	3	21.0 (18.0-25.0)
SULFUR (ppm)	3	2.8 (2.3-3.2)	1	1.0
% IRON	3	0.58 (0.28-0.96)	5	0.24 (0.11-0.47)
% ALUMINUM	3	0.37 (0.22-0.59)	5	0.47 (0.38-0.61)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
BH13	Very shallow lithic phase; sandstone bedrock occurs within 50 cm of the surface. Map units contain numerous bedrock outcrops.

INFERRED SOIL PROPERTIES
BELLHOUSE SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
BH	≤100	GM	A-1-b	N.P.	N.P.	-

BOWSER SOILS (BO)

PLATE 4.4: BOWSER SOIL LANDSCAPE

GENERAL COMMENTS

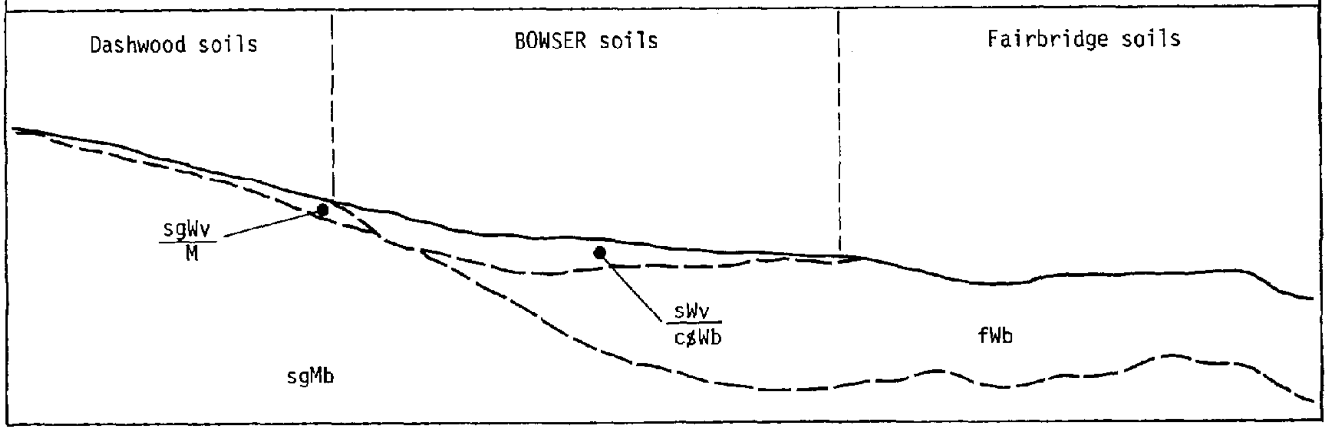
Bowser soils (80 ha) have developed on gently undulating landscapes below 100 m elevation. The parent materials are sandy fluvial or marine veneers underlain by silty marine deposits. Although not extensive, these soils occur throughout the survey area and are usually found in conjunction with Brigantine soils. Bowser soils are imperfectly to poorly drained and have seasonally perched watertables.

Bowser soils are stone-free and have friable, sandy loam to loamy sand surface textures. The lower horizons are either compact silt loam or interlayered silt loam and sands. They are predominantly classified as **Gleyed Humo-Ferric Podzols.**

Adequate drainage, irrigation and fertilization are necessary for good production of a wide range of crops.

Urban and related uses are constrained by high watertables during the winter and spring.

BOWSER SOIL LANDSCAPE CROSS SECTION*



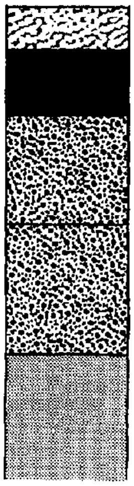
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy marine or fluvial veneer over sandy silt marine
TOPOGRAPHY	:	0-5% slopes; nearly level to moderate slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard to rare
VEGETATION	:	Bowser soils support mainly second-growth stands of Douglas-fir, western red cedar, western hemlock, and red alder. The understory is dominated by sword fern.

TYPICAL BOWSER SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
2-0	L	Loose, non-compact litter; very strongly acid.
0-7	Ah	Very dark brown (10YR 2/2m) sandy loam; moderate, medium granular; very friable; extremely acid.
7-30	Bf	Yellowish red (5.0YR 4/6m) sandy loam; weak to moderate, medium subangular blocky; very friable; very strongly acid.
30-65	Bmgj	Light olive brown (2.5Y 5/4m) sandy loam; many, medium, prominent mottles; moderate, medium subangular blocky; very friable; very strongly acid.
65-100	IIBCg	Grayish brown (2.5Y 5/2m) silt loam; many, medium, prominent mottles; massive breaking to strong, medium, psuedo-angular blocky; firm; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: >100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 100+; compact BC horizon
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 0-1
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 65-100; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: imperfect to poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: sandy loam or loamy sand/silty clay loam or silt loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-40	No. of Samples	40-100
PERMEABILITY (CLASS)		moderate		slow
BULK DENSITY (g/cm^3)	Est.	1.20	Est.	1.50
AWSC (cm/m)	Est.	15.0 (13.0-17.0)	Est.	20.0 (15.0-25.0)
AWSC (Corr. for % CF) (cm/m)	Est.	13.0 (11.0-15.0)	Est.	20.0 (15.0-25.0)
PYROPHOSPHATE INDEX				
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	20	Est.	0
% PASSING SIEVES # 4	Est.	100	Est.	100
% PASSING SIEVES # 40	Est.	65	Est.	100
% PASSING SIEVES #200	Est.	15	Est.	96
% SAND	5	65.8 (56.6-75.3)	5	23.2 (16.4-29.3)
% CLAY	5	8.3 (3.2-14.2)	5	7.8 (5.3-10.0)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-40	No. of Samples	40-100
SOIL REACTION (pH) 1:1 H_2O	2	5.7 (5.5-5.8)	2	5.9 (5.8-6.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	7	4.9 (4.8-5.1)	2	5.2 (5.1-5.3)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	6	1.4 (0.8-2.8)	2	0.4 (0.2-0.6)
NITROGEN (%)	2	0.04 (0.03-0.04)	2	0.02 (0.01-0.03)
EXCHANGE CAPACITY (meq/100g)	2	8.4 (7.3-9.5)	2	9.3 (5.9-12.7)
EXCHANGEABLE CATIONS (meq/100g) - Ca	2	0.63 (0.6-0.7)	2	0.3 (0.2-0.5)
- Mg	2	0.1 (0.1)	2	0.1 (0.1)
- Na	2	0.2 (0.2)	2	0.2 (0.2)
- K	2	0.1 (0.1)	2	0.1 (0.1)
PHOSPHORUS (ppm)	2	7.1 (6.6-7.5)	2	23.0 (17.7-28.2)
SULFUR (ppm)	2	0.2 (0.1-0.3)	2	0.3 (0.1-0.9)
% IRON	6	0.44 (0.22-0.69)		ND
% ALUMINUM	6	0.44 (0.25-0.73)		ND

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
BOg	Gravelly phase; the soil profile contains coarse fragments in excess of 20% (normally 20 to 50%) mostly in the fine gravel size (<2.5 cm).

INFERRED SOIL PROPERTIES
BOWSER SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
BO	0-50	SM-SC	A-2-4	N.P.	N.P.	0.1 - 0.2
	50-100	ML-CL	A-4	25.0	4.0	0.5

BRIGANTINE SOILS (BE)

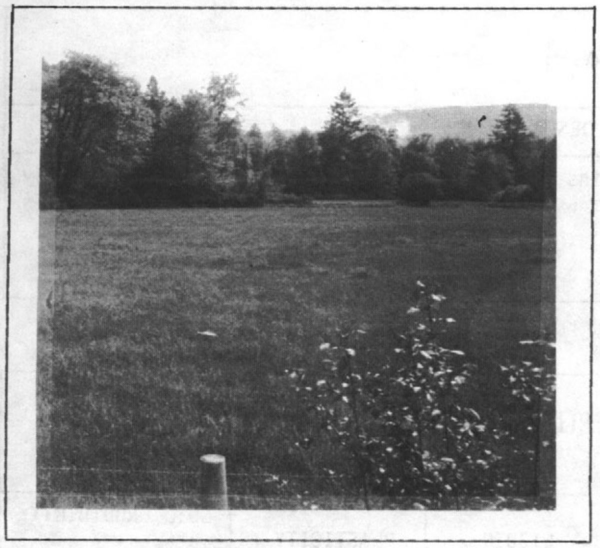


PLATE 4.5: BRIGANTINE SOIL LANDSCAPE

GENERAL COMMENTS

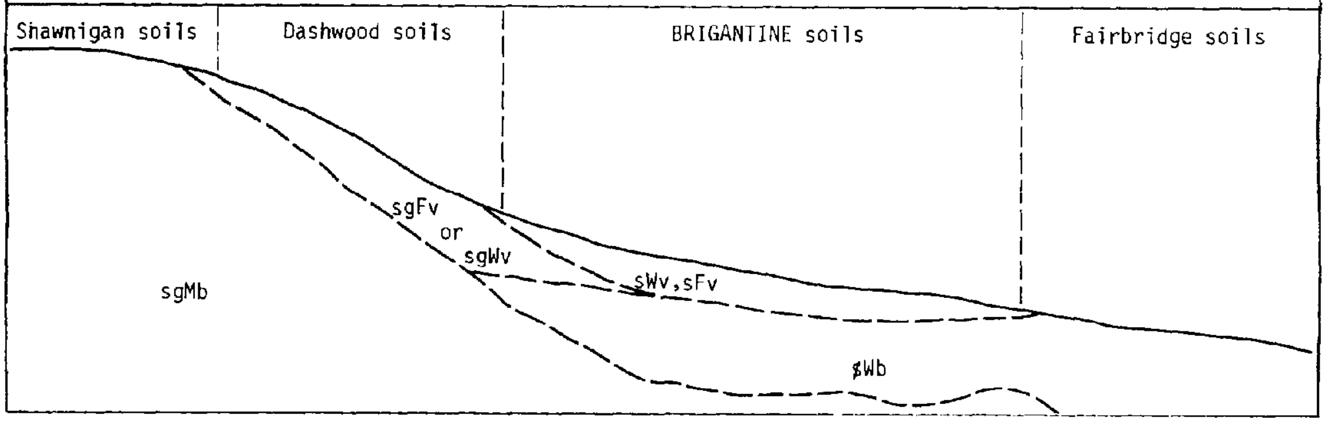
Brigantine soils (520 ha) have developed on gently undulating, coarse-textured, fluvial, fluvioglacial and marine deposits overlying medium-textured marine deposits and occur between sea level and 100 m in elevation. Lateral seepage and/or seasonally perched watertables occur for long periods during the winter months.

Brigantine soils are imperfectly drained, stone-free and have sandy loam to loamy sand surface textures. The surface horizons are very friable while the silt loam textured subsurface is very compact. Brigantine soils are classified as **Gleyed Dystric Brunisols** although significant components of Gleyed Humo-Ferric Podzols also occur.

Adequate drainage, irrigation and fertilization are necessary for good production of a wide range of crops.

Urban and related uses constrained by high watertables during winter and spring.

BRIGANTINE SOIL LANDSCAPE CROSS SECTION*

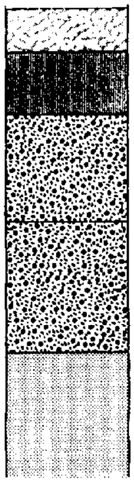


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL :	sandy marine, fluvioglacial or fluvial veneer over fine silty marine
TOPOGRAPHY :	1-15% slopes; nearly level to moderate slopes
ELEVATION RANGE :	0-100 m asl
ASPECT :	all
FLOOD HAZARD :	no hazard to rare
VEGETATION :	Uncleared areas support second growth stands of Douglas-fir, western red cedar, western hemlock, and red alder. The understory is dominated by sword fern.

TYPICAL BRIGANTINE SOIL PROFILE



DEPTH (cm)	Horizon	Description
2-0	L	Loose, non-compact litter, very strongly acid.
0-7	Ah	Dark brown (10YR 3/3m) sandy loam; moderate, medium granular; very friable; very strongly acid.
7-30	Bm	Strong brown (7.5YR 4/6m) sandy loam; weak to moderate, medium subangular blocky; very friable; very strongly acid.
30-65	Bmgj	Olive brown (2.5Y 4/4m) sandy loam; common, medium, distinct mottles; moderate, medium subangular blocky; very friable; very strongly acid.
65-100	IIBCg	Grayish brown (2.5Y 5/2m) silt loam; common, medium, distinct mottles; strong, medium, psuedo-angular blocky; firm; very strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: >100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 110+; compact BC horizon
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 0-1
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 60-100; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: imperfect
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: sandy loam or loamy sand/silty clay loam or silt loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		moderate		slow
BULK DENSITY (g/cm^3)	1	1.2	Est.	1.45
AWSC (cm/m)	1	17.9	Est.	20.0 (15.0-25.0)
(Corr. for % C.F.) (cm/m)	1	15.2	Est.	20.0 (15.0-25.0)
% COARSE FRAGMENTS >7.5cm	5	0	5	0
% COARSE FRAGMENTS <7.5cm	5	5-15	5	0-5
% PASSING SIEVES # 4	1	79.1	Est.	100
% PASSING SIEVES # 40	1	61.3	Est.	100
% PASSING SIEVES #200	1	36.1	Est.	96
% SAND	4	61.9 (56.7-74.5)	7	17.8 (4.3-28.9)
% CLAY	4	14.2 (9.2-18.3)	7	32.4 (21.3-42.4)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	4	4.8 (4.7-5.0)	2	5.3 (5.2-5.3)
SOIL REACTION (pH) 1:2 $CaCl_2$	10	4.8 (4.1-5.3)	2	4.6 (4.4-4.7)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	7	1.8 (0.4-4.2)	1	0.2 (0.2)
NITROGEN (%)	4	0.11 (0.02-0.19)	2	0.01(0.01)
EXCHANGE CAPACITY (meq/100g)	4	18.5 (11.8-23.9)	2	10.9 (9.7-12.2)
EXCHANGEABLE CATIONS (meq/100g) - Ca	4	1.1 (0.3-2.2)	2	4.5 (4.3-4.6)
- Mg	4	0.3 (0.1-0.7)	2	1.0 (0.9-1.0)
- Na	4	0.2 (0.1-0.3)	2	0.3 (0.2-0.3)
- K	4	0.1 (0.1-0.2)	2	0.1 (0.1)
PHOSPHORUS (ppm)	5	8.3 (6.0-12.0)	2	11.8 (9.5-14.2)
SULFUR (ppm)	4	0.9 (0.3-1.4)	2	1.0 (0.9-1.1)
% IRON	3	0.40 (0.30-0.49)	2	0.51 (0.40-0.61)
% ALUMINUM	3	0.66 (0.32-0.87)	2	0.41 (0.33-0.47)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
BEg	Gravelly phase; the upper horizons have coarse textured material containing 20 to 50% gravel.
BEmd	Moderatlely well to well drained variant; drier soil moisture regime, with predominantly Orthic Dystric Brunisol soil development.

INFERRED SOIL PROPERTIES
BRIGANTINE SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
BE	0-50	SM-SC	A-2-4	N.P.	N.P.	0.1 - 0.2
	50-100	ML-CL	A-4	25.3	3.8	0.5

CASSIDY SOILS (CA)

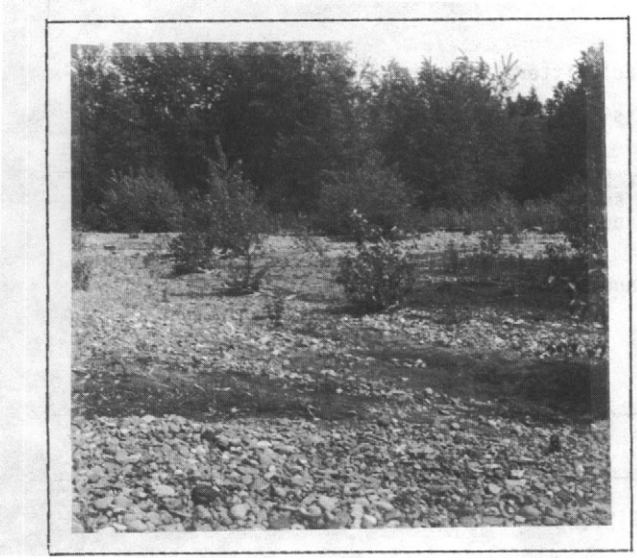


PLATE 4.6: CASSIDY SOIL LANDSCAPE

GENERAL COMMENTS

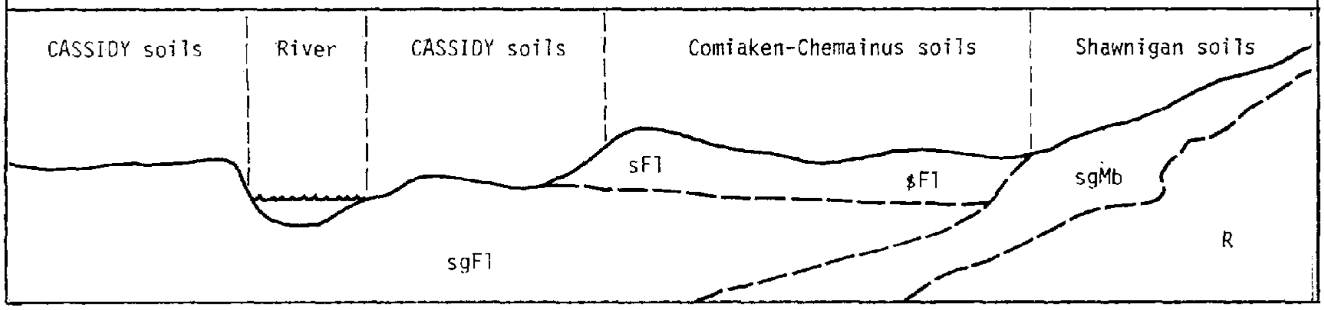
Cassidy soils (1000 ha) occur on very coarse-textured, level to gently sloping terraces and floodplains along the narrow river and stream valleys of the surveyed area. Generally associated with Comiaken and, to a lesser extent, Chemainus soils, Cassidy soils are rapidly drained with an apparent watertable usually at 1 to 5 m depth.

These soils are commonly very gravelly loamy sand or sandy loam texture and contain lenses of sand and gravel. Although some of the Cassidy soils occuring on higher terraces are Orthic Dystric Brunisols, most are classified as **Orthic Regosols, Orthic Humic Regosols or Cumulic Regosols.**

Due to their coarse textures and stoniness, Cassidy soils require substantial amounts of stonepicking, irrigation and fertilization. Consequently, they are of limited value for agriculture.

Urban and related uses are constrained due to susceptibility to flooding. Also septic tank effluent renovation may be incomplete because of coarse subsoil textures.

CASSIDY SOIL LANDSCAPE CROSS SECTION*



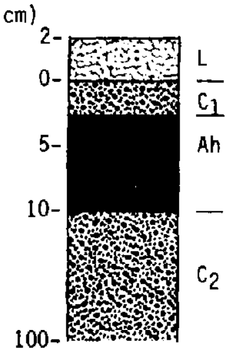
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL :	sandy gravelly fluvial
TOPOGRAPHY :	1-9%; nearly level to gentle slopes
ELEVATION RANGE :	0-150 m asl
ASPECT :	all
FLOOD HAZARD :	may be expected
VEGETATION :	The native vegetation consists of Douglas-fir, grand fir, western red cedar, red alder, and maple. The understory is dominated by salal, bracken, and swordfern.

TYPICAL CASSIDY SOIL PROFILE

DEPTH (cm)



L - Loose, non-compact litter; extremely acid.

C_1- Gravelly sand; single-grained; loose; strongly acid.

Ah - Very dark brown (10YR 2/2m) gravelly sandy loam; moderate, fine to medium, subangular blocky to granular; very friable; abrupt wavy boundary; strongly acid.

C_2 - Very gravelly sand; single grained; loose; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: 0-50
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 50-100
COARSE FRAGMENT CLASS	: 1-4
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 100-500; apparent
PERVIOUSNESS	: rapid
SOIL DRAINAGE	: rapid
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: gravelly loamy sand, gravelly sandy loam, gravelly sand

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		rapid to very rapid		rapid to very rapid
BULK DENSITY (g/cm^3)	Est.	1.8	Est.	2.00
AWSC (cm/m)	1	5.1	Est.	4.0 (3.0-5.0)
AWSC (Corr. for % CF) (cm/m)	1	1.1	Est.	0.5 (0.0-1.0)
% COARSE FRAGMENTS >7.5cm	Est.	5-25	Est.	5-40
% COARSE FRAGMENTS <7.5cm	Est.	35-70	3	35-70
% PASSING SIEVES # 4	1	35.7	1	36.3
% PASSING SIEVES # 40	1	7.6	1	10.2
% PASSING SIEVES #200	1	2.5	1	1.0
% SAND	4	82.5 (63.0-94.7)	2	82.8 (77.7-87.8)
% CLAY	4	3.7 (1.3-5.6)	2	4.1 (1.5-6.6)

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	5	5.8 (5.2-6.4)	6	6.1 (5.6-6.5)
SOIL REACTION (pH) 1:2 $CaCl_2$	6	5.2 (4.7-5.9)	6	5.4 (5.0-6.0)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	4	0.8 (0.4-1.3)	1	0.9
NITROGEN (%)	4	0.03 (0.02-0.04)	2	0.02 (0.01-0.04)
EXCHANGE CAPACITY (meq/100g)	5	8.7 (5.6-12.7)	6	7.6 (4.0-9.9)
EXCHANGEABLE CATIONS (meq/100g) - Ca	4	2.8 (2.3-4.1)	6	2.0 (1.4-3.2)
- Mg	5	0.3 (0.1-0.7)	6	0.2 (0.1-0.3)
- Na	5	0.1 (0.1-0.2)	6	0.1 (0.1)
- K	5	0.3 (0.1-0.5)	6	0.2 (0.1-0.5)
PHOSPHORUS (ppm)	3	95.5 (60.4-161.7)	3	21.4 (10.2-42.0)
SULFUR (ppm)	3	0.3 (0.1-0.5)	3	0.1 (0.1-0.2)
% IRON	4	0.27 (0.13-0.56)	4	0.18 (0.06-0.43)
% ALUMINUM	4	0.26 (0.12-0.45)	4	0.20 (0.12-0.32)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
CAco	Rapidly drained soils developed on coarse textured relatively recent fluvial deposits, containing more than 20% cobbles and stones by volume.
CAco, lo	Rapidly drained soils developed on coarse textured relatively recent fluvial deposits, containing more than 20% cobbles and stones by volume and having a 20 to 50 cm loam textured capping, and having a 20 to 50 cm loam capping.
CAg	Rapidly drained soils developed on coarse textured relatively recent fluvial deposits, with only 20-50% coarse fragments by volume.
CAlo	Rapidly drained soils developed on coarse textured relatively recent fluvial deposits, with 20-50 cm of loam textured capping.

INFERRED SOIL PROPERTIES FOR CASSIDY SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
CA	0-100	GM	A-1-a	NP	-	0.02

CHEMAINUS SOILS (CH)

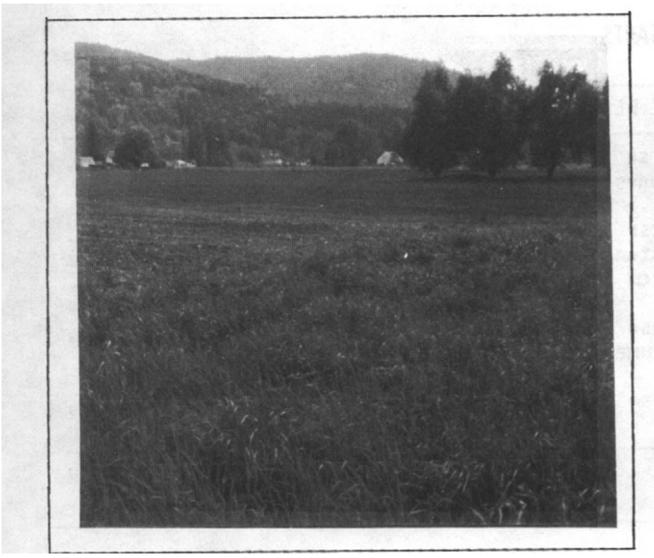


PLATE 4.7: CHEMAINUS SOIL LANDSCAPE

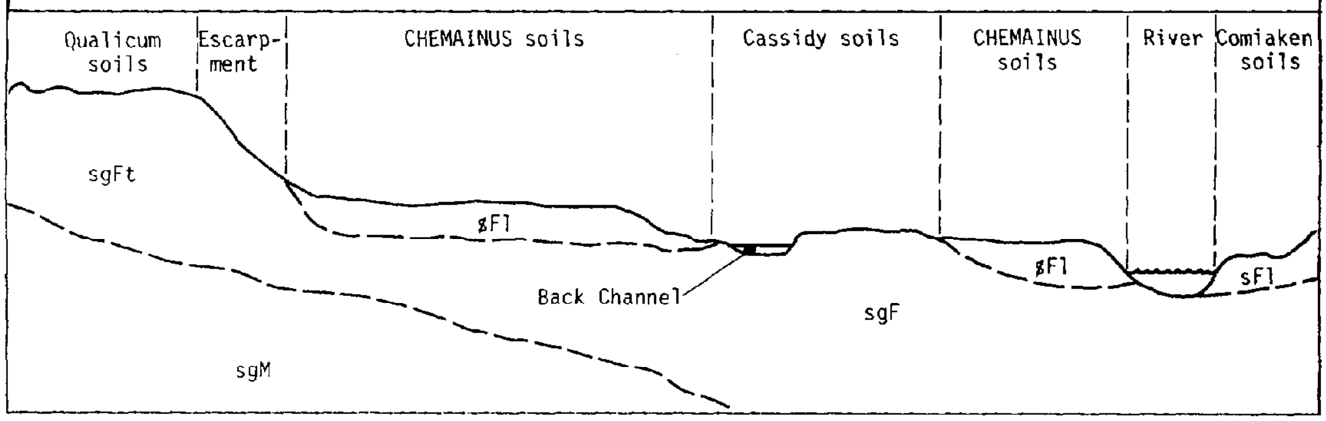
GENERAL COMMENTS

Chemainus soils (2105 ha) occur on level to very gently sloping floodplains and low terraces along streams and rivers. They occur extensively along the Nanaimo, Chemainus, Cowichan, and Koksilah Rivers. These moderately well drained soils have formed in medium textured fluvial deposits that have apparent watertables at 1 to 2 m depth.

Chemainus soils have very dark brown silt loam to loam surface horizons and are dominantly classified as **Orthic Dystric Brunisols** and Orthic Sombric Brunisols, although Cumulic Regosols and Orthic Regosols occur on the more recent deposits.

Chemainus soils are some of the best suited agricultural soils in the survey area, principally because of their high water holding capacity, level topography, and proximity to irrigation water. The dominant land uses are pasture and hay production, but vegetables and small fruits are also grown on the Chemainus River floodplain and the Cowichan River delta. Chemainus soils are well suited for a wide range of crops, however irrigation is necessary for maximizing yields. Flooding can occur during the winter but generally is not a serious limitation to agriculture in these areas.

CHEMAINUS SOIL LANDSCAPE CROSS SECTION*



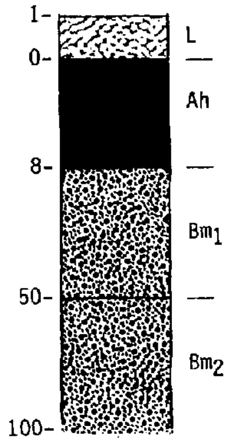
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy silty fluvial level or terrace
TOPOGRAPHY	:	0-5%; level to very gently sloping
ELEVATION RANGE	:	5-150 m asl
ASPECT	:	none
FLOOD HAZARD	:	may be expected to frequent
VEGETATION	:	Chemainus soils are mostly cleared and cultivated. Uncleared areas consist of second growth Douglas-fir, grand-fir, western hemlock, western red cedar, maple, and red alder with a wide variety of shrubs in the understory.

TYPICAL CHEMAINUS SOIL PROFILE

DEPTH (cm)



L - Loose, non-compact litter; strongly acid.

Ah - Very dark brown (10YR 2/2 m) silt loam; moderate, medium granular; friable; non-plastic; medium acid.

Bm_1 - Dark yellowish brown (10YR 4/4 m) silt loam; weak to moderate, medium angular blocky; friable; non-plastic; slightly acid.

Bm_2 - Light olive brown (2.5Y 5/4 m) silt loam; weak to moderate, fine to medium, angular blocky; friable; non-plastic; slightly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	:	N/A
HUMUS FORM	:	mull
SOLUM DEPTH (cm)	:	50-150
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	:	no restricting layer
ROOTING DEPTH (cm)	:	100+
COARSE FRAGMENT CLASS	:	0
DEPTH TO AND TYPE OF WATERTABLE (cm)	:	100-300; apparent
PERVIOUSNESS	:	moderate
SOIL DRAINAGE	:	moderately well
DEPTH TO SALTS (cm)	:	N/A
SOIL TEXTURE	:	fine sandy loam, loam, silt loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		moderate to rapid		moderate to rapid
BULK DENSITY (g/cm^3)	3	1.00 (0.90-1.13)	3	1.00 (0.97-1.04)
AWSC (cm/m)	3	16.6 (14.7-20.2)	3	20.0 (16-24)
AWSC (Corr. for % CF) (cm/m)	3	16.3 (14.1-20.2)	3	20.0 (16-24)
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0	Est.	0
% PASSING SIEVES # 4	7	99.7 (98.5-100.0)	3	99.9 (99.7-100.0)
% PASSING SIEVES # 40	7	83.5 (68.5-99.9)	3	96.8 (90.5-99.9)
% PASSING SIEVES #200	7	55.0 (31.2-65.3)	3	77.0 (70.9-86.2)
% SAND	18	31.2 (3.3-48.8)	6	33.7 (3.2-54.1)
% CLAY	18	10.5 (3.2-29.9)	6	13.2 (7.2-28.0)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	13	5.8 (5.2-6.3)	10	6.0 (5.2-6.3)
SOIL REACTION (pH) 1:2 $CaCl_2$	20	4.8 (4.5-5.6)	10	5.1 (4.5-5.5)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	13	1.12 (0.21-2.26)	5	0.75 (0.31-1.27)
NITROGEN (%)	13	0.08 (0.01-0.10)	7	0.06 (0.02-0.10)
EXCHANGE CAPACITY (meq/100g)	13	14.3 (10.1-22.2)	7	12.4 (10.1-15.9)
EXCHANGEABLE CATIONS (meq/100g) - Ca	13	5.5 (3.5-8.4)	7	5.8 (3.3-8.4)
- Mg	13	1.1 (0.2-2.4)	7	1.3 (0.4-3.2)
- Na	13	0.1 (0.1-0.3)	7	0.2 (0.1-0.3)
- K	13	0.1 (0.0-0.4)	7	0.1 (0.0-0.2)
PHOSPHORUS (ppm)	7	15.4 (7.9-25.6)	5	10.7 (6.2-16.6)
SULFUR (ppm)	8	0.5 (0.1-0.9)	5	0.5 (0.0-0.9)
% IRON	8	0.36 (0.06-0.18)	2	0.14 (0.09-0.19)
% ALUMINUM	8	0.37 (0.24-0.49)	2	0.10 (0.09-0.10)

SOIL PHASES/VARIANTS

SOIL SYMBOL	SOIL DESCRIPTION
CHg	Gravelly phase; contains between 20 and 50% coarse fragments by volume.
CHg,id	Gravelly phase; imperfectly drained variant; gleyed subgroups of Dystric Brunisols and Regosols which contain between 20 and 50% total coarse fragments by volume. Occur on the lowest portions of floodplains.
CHg,s	Gravelly phase; shallow variant; strongly contrasting texture, usually sand or gravelly sand occurs at depths between 50 and 100 cm. Soil contains between 20 and 50% total coarse fragments by volume.
CHid	Imperfectly drained variant; gleyed subgroups of Dystric Brunisols and Regosols. Occurs on lowest portions of floodplains.
CHs	Shallow variant; strongly contrasting texture, usually sand or gravelly sand, occurs at depths between 50 and 100 cm.

INFERRED SOIL PROPERTIES
CHEMAINUS SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
CH	0-100	ML, or ML-CL	A-4, A-7-6	32.8 (24.0-42.6)	10.0 (4.0-16.9)	0.5

COMIAKEN SOILS (CN)

PLATE 4.8: COMIAKEN SOIL LANDSCAPE

GENERAL COMMENTS

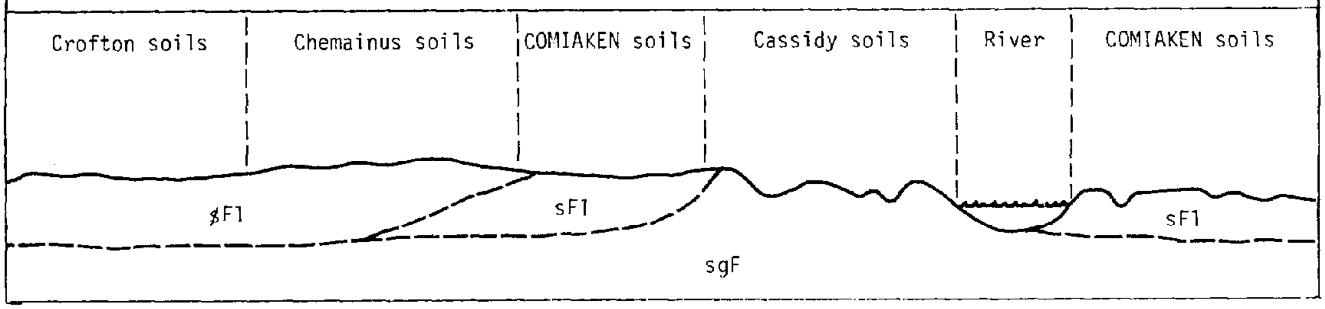
Comiaken soils (575 ha) occur on level to very gently sloping floodplains and are associated with Cassidy and Chemainus soils. The major areas occur along the Nanaimo, Chemainus, Cowichan and Koksilah Rivers. They are generally developed in the sandy fluvial materials associated with levees, point bar deposits and channels. Comiaken soils are well to rapidly drained and generally have an apparent water table at about 2 m for most of the year.

Comiaken soils are rapidly permeable with generally loamy sand or sandy loam textures although interlayered lenses of silt or sand are common. They are dominantly classified as **Cumulic Regosols with** minor occurrences of Cumulic Humic Regosols, Orthic Regosols and Orthic Humic Regosols.

Uncontrolled flooding and intensively channeled topography generally restrict land uses to seasonal pasture and woodlots. With dyking, levelling and irrigation these soils can support a wide range of crops.

Urban and related uses on these soils are not recommended because of the flood hazard.

COMIAKEN SOIL LANDSCAPE CROSS SECTION*

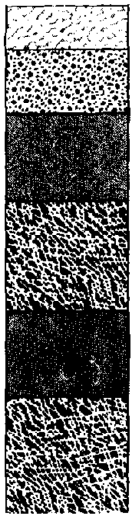


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy fluvial level or terrace
TOPOGRAPHY	:	0-5%; level to very gentle slopes
ELEVATION RANGE	:	0-200 m asl
ASPECT	:	none
FLOOD HAZARD	:	frequent
VEGETATION	:	The native vegetation consists of black cottonwood, red alder with minor willow, vine and bigleaf maple, and grand-fir.

TYPICAL COMIAKEN SOIL PROFILE



DEPTH (cm)	Horizon	Description
2-0	L	Loose non-compact litter; strongly acid.
0-5	C_1	Brown (7.5YR 4/2m) sandy loam; single-grained; very friable, medium acid.
5-15	Ahb_1	Very dark grayish brown (10YR 3/2m) very fine sandy loam; weak, moderate subangular blocky; friable; strongly acid.
15-50	IIC_2	Dark grayish brown (2.5Y 4/2m) sand, single-grained, loose; strongly acid.
50-60	Ahb_2C	Dark brown (10YR 3/3m) loamy sand; weak to moderate, medium granular; very friable; strongly acid.
60-100	IIC_3	Dark grayish brown (2.5Y 4/2m) loamy sand; single grained; loose; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: N/A
SOLUM DEPTH (cm)	: 0-10
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 80
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 200; apparent
PERVIOUSNESS	: rapid
SOIL DRAINAGE	: rapid
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: sand, loamy sand, sandy loam

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		rapid		rapid
BULK DENSITY (g/cm³)	2	1.2 (1.13-1.30)	2	1.2 (1.0-1.4)
AWSC (cm/m)	2	11.0 (8.0-14.0)	3	11.0 (8.0-14.0)
AWSC (Corr. for % CF) (cm/m)	2	11.0 (8.0-14.0)	3	11.0 (8.0-14.0)
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0-5	Est.	0-5
% PASSING SIEVES # 4	2	100	Est.	100 (99.9-100)
% PASSING SIEVES # 40	2	99.6 (99.5-99.7)	Est.	95 (90-100)
% PASSING SIEVES #200	2	57.8 (48.6-55.6)	Est.	50 (40-60)
% SAND	6	73.7 (44.4-93.7)	4	63.0 (38.8-85.6)
% CLAY	6	3.9 (1.0-6.3)	2	7.5 (4.8-13.2)

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	5	5.8 (5.4-6.0)	4	5.7 (5.4-6.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	5	5.1 (4.8-5.4)	4	5.1 (4.9-5.3)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	5	0.7 (0.2-1.1)	4	1.3 (0.8-1.8)
NITROGEN (%)	5	0.04 (0.01-0.07)	4	0.07 (0.03-0.11)
EXCHANGE CAPACITY (meq/100g)	5	10.8 (3.6-15.7)	4	13.1 (7.5-19.7)
EXCHANGEABLE CATIONS (meq/100g) - Ca	5	6.2 (1.9-9.6)	4	7.5 (3.7-11.0)
- Mg	5	0.7 (0.4-1.0)	4	0.7 (0.4-1.1)
- Na	5	0.1 (0.1-0.2)	4	0.1 (0.1-0.2)
- K	5	0.1 (0.01)	4	0.1 (0.1)
PHOSPHORUS (ppm)	5	8.1 (6.3-12.3)	4	10.5 (8.4-12.9)
SULFUR (ppm)	5	1.3 (0.1-2.7)	4	1.4 (0.0-3.3)
% IRON	2	0.44 (0.25-0.63)		
% ALUMINUM	2	0.52 (0.40-0.63)		

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
CNid	Imperfectly drained variant; gleyed subgroups of Dystric Brunisols and Regosols. Occurs on the wetter lowest portions of the floodplain, usually near active channels.
CNs	Shallow variant; strongly contrasting texture usually very gravelly sand, occurs at depths between 50-100 cm.

INFERRED SOIL PROPERTIES COMIAKEN SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
CN	0-100	SM	A-4	NP	NP	0.3

CORYDON SOILS (CR)

PLATE 4.9 CORYDON SOIL LANDSCAPE

GENERAL COMMENTS

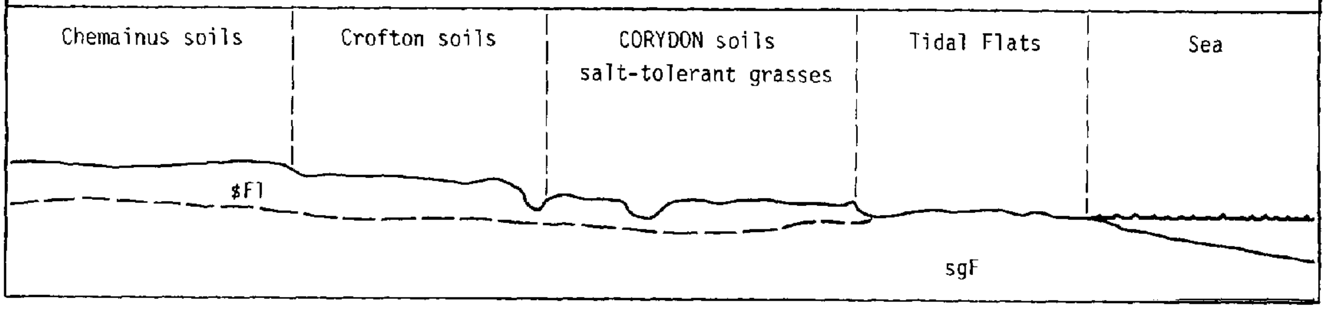
Corydon soils (520 ha) occur on level deltaic areas and are associated with the Crofton and Chemainus floodplain soils. The major areas of occurrence are on the Nanaimo, Cowichan and Chemainus estuaries. These poorly drained soils are frequently flooded by sea water and support only salt tolerant vegetation. They have a year-round watertable within 1 m of the surface. Corydon soils have developed from silty to sandy fluvial materials.

Surface horizons are dark greyish brown silt loams. Lower horizons are highly variable ranging in texture from silt loam to sand with occasional interlayered gravel lenses. Corydon soils are dominantly classified as **Rego Humic Gleysol**; saline phase, although saline phases of Orthic Humic Gleysols, Orthic Gleysols and Rego Gleysols also occur.

Agricultural use is restricted by the need for major reclamation measures (e.g. dyking, drainage, irrigation) to remove flooding and salinity problems. After reclamation and with irrigation a variety of field crops can be grown. The tide lands on which these and associated soils occur have significant value as wildlife habitat.

Urban and related uses are not recommended for Corydon soils. Variable and usually low soil bearing strengths would require that special foundations be considered while excavations and septic tanks should not be considered due to high watertables and flooding. The saline soil conditions will likely cause severe corrosion of uncoated steel and other unprotected underground installations.

CORYDON SOIL LANDSCAPE CROSS SECTION*

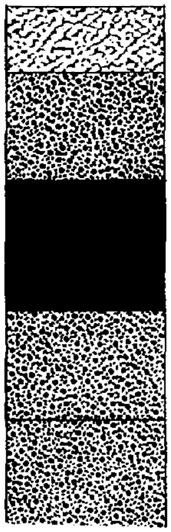


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	silty fluvial level
TOPOGRAPHY	:	0-2%; level
ELEVATION RANGE	:	0-2 m asl
ASPECT	:	none
FLOOD HAZARD	:	frequent
VEGETATION	:	Native vegetation consists mainly of salt tolerant grasses, shrubs, and sedges.

TYPICAL CORYDON SOIL PROFILE



DEPTH (cm)	Horizon	Description
0-27	Ahs	Very dark grayish brown (10YR 3/2 m) silt loam; weakly saline, massive; friable; slightly sticky, slightly plastic; abrupt wavy boundary; extremely acid.
27-49	IICgs1	Sand; moderately saline; many, fine, prominent mottles; weak, medium to coarse subangular blocky breaking to single-grain; loose, non-sticky, non-plastic; abrupt, smooth boundary; very strongly acid.
49-63	Ahbs	Very dark grayish brown (10YR 3/2 m) silt loam; many, fine, prominent mottles; moderately saline; moderate to strong, medium to coarse subangular blocky; firm, slightly sticky, slightly plastic; abrupt, wavy boundary; extremely acid.
63-67	IICgs2	Dark greenish gray (5 G 4/1) loamy sand; many, fine, prominent mottles; strongly saline; weak to moderate, medium subangular blocky; very friable, non-sticky, non-plastic; abrupt, wavy boundary; strongly acid.
67-100	IICgs3	Dark grayish brown (2.5 y 4/2 m) sand; few, medium, prominent mottles; strongly saline; weak, medium to coarse subangular blocky breaking to single-grain; loose, non-sticky, non-plastic; abrupt, wavy boundary; medium acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	:	N/A
HUMUS FORM	:	mull
SOLUM DEPTH (cm)	:	0-30
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	:	no restricting layer
ROOTING DEPTH (cm)	:	40-60
COARSE FRAGMENT CLASS	:	0
DEPTH TO AND TYPE OF WATERTABLE (cm)	:	0-80; apparent
PERVIOUSNESS	:	moderate
SOIL DRAINAGE	:	poor to very poor
DEPTH TO SALTS (cm)	:	0-50
SOIL TEXTURE	:	silt loam, loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		moderate		moderate
BULK DENSITY (g/cm³)	3	1.06 (0.98-1.14)	3	1.09 (0.97-1.18)
AWSC (cm/m)	3	20.9 (16.7-28.0)	4	30.0 (20.0-40.0)
AWSC (Corr. for % CF) (cm/m)	3	20.9 (16.7-28.0)	4	30.0 (20.0-40.0)
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0	Est.	15
% PASSING SIEVES # 4	1	100	Est.	50-100
% PASSING SIEVES # 40	1	100	Est.	50-100
% PASSING SIEVES #200	1	84.3	Est.	85
% SAND	10	6.4 (1.6-25.9)	6	11.5 (5.7-24.4)
% CLAY	11	15.7 (5.8-23.1)	6	13.6 (8.6-20.0)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	7	5.5 (4.6-6.1)	10	5.0 (3.3-6.2)
SOIL REACTION (pH) 1:2 $CaCl_2$	14	5.0 (4.2-5.9)	12	4.5 (3.2-5.7)
CONDUCTIVITY mS/cm	6	8.6 (1.4-13.4)	8	11.2 (1.9-30.1)
ORGANIC CARBON (%)	7	2.5 (1.5-4.7)	5	0.7 (0.2-1.2)
NITROGEN (%)	8	0.20 (0.04-0.41)	10	0.11 (0.01-0.25)
EXCHANGE CAPACITY (meq/100g)	12	20.7 (6.1-43.7)	11	14.8 (5.5-26.2)
WATER SOLUBLE CATIONS (meq/100g) - Ca	12	7.8 (0.2-21.9)	10	7.3 (0.8-32.0)
- Mg	12	31.9 (0.6-100.8)	10	18.7 (4.0-59.0)
- Na	12	145.1 (3.6-495.5)	10	80.9 (10.7-305.2)
- K	12	3.7 (0.1-12.6)	10	1.1 (0.2-2.6)
PHOSPHORUS (ppm)	8	18.0 (5.1-44.2)	10	13.2 (6.4-23.8)
SULFUR (ppm)	8	98.0 (0.1-393.9)	9	184.4 (21.0-687.0)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
CR	Most common soil is a saline phase of a Rego Humic Gleysol soil.

INFERRED SOIL PROPERTIES CORYDON SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
CR	0-100	MH	A-7-5	53.6	14.3	0.55

COWICHAN SOILS (CO)

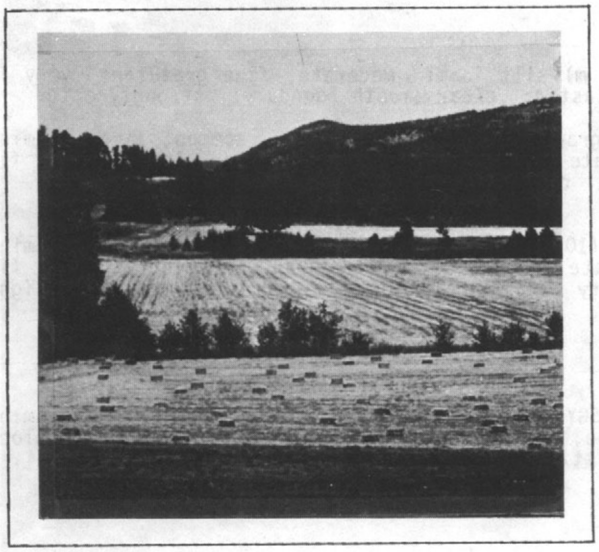


PLATE 4.10: COWICHAN SOIL LANDSCAPE

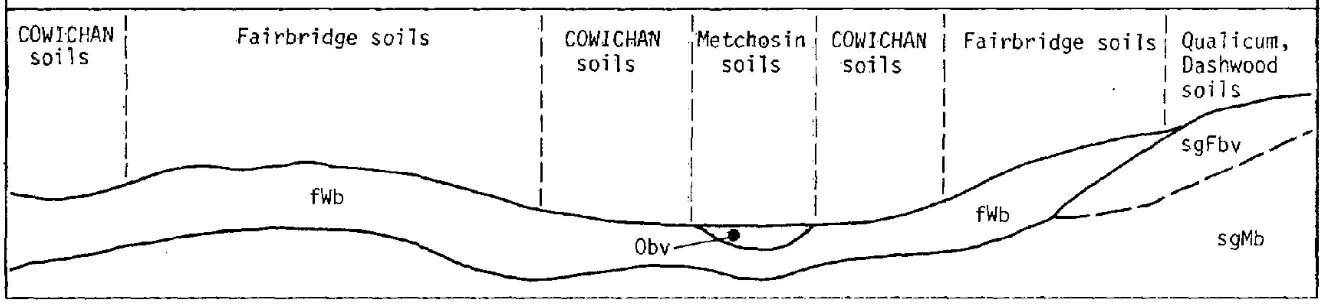
GENERAL COMMENTS

Cowichan soils (2800 hectares) occur below elevations of about 100 m. They occupy depressional to level areas in generally undulating marine sediments, and are usually associated with Fairbridge soils. The largest area occurs south of Duncan near Dougan Lake. Cowichan soils are poorly drained and have a perched water table within 1.5 m or less of the surface throughout most of the year. These soils have a black, organic matter-enriched surface horizon which is silt loam or silty clay loam in texture. The underlying strongly gleyed, greenish grey horizons have higher clay contents and are very sticky when wet. They are dominantly classified as **Humic Luvic Gleysols**, although some Orthic Humic Gleysols and Orthic Gleysols are included.

Cowichan soils contain excess moisture during the spring which causes trafficability problems and planting delays. Winter ponding often kills or injures perennial crops as well. Both these limitations have historically restricted agricultural use to hay production or pasture. Many farmers have increased the range and production of crops by installing artificial drainage. Drainage lines must be closely spaced due to the slow soil permeability.

Urban and related uses are severely constrained by high watertables, susceptibility to surface ponding, generally low bearing strengths and slow permeability.

COWICHAN SOIL LANDSCAPE CROSS SECTION*

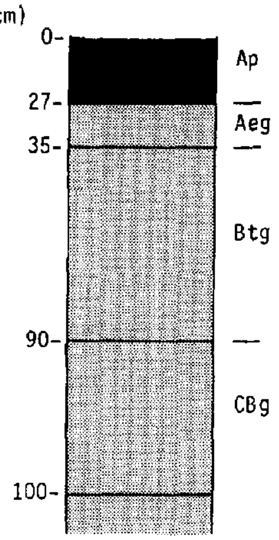


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	fine marine blanket
TOPOGRAPHY	:	0-3% slopes; level to very gentle slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	may be expected
VEGETATION	:	Substantial areas of Cowichan soils are cleared and cultivated, mainly for hay and forage production. Uncleared areas support red alder, willow, maple, western red cedar, and western hemlock including an understory of moisture loving plants such as skunk cabbage.

TYPICAL COWICHAN SOIL PROFILE



Ap (0-27 cm): Black (10YR 2/1 m) silt loam; moderate, fine granular; very friable, sticky, plastic; clear smooth boundary; strongly acid.

Aeg (27-35 cm): Light brownish gray (10YR 6/2) silt loam; common, fine, prominent mottles; moderate to strong, coarse subangular blocky; very firm, sticky, plastic; clear, wavy boundary; slightly acid.

Btg (35-90 cm): Grayish brown (10YR 5/2 m) silty clay; many fine, prominent mottles; moderate to strong, coarse subangular blocky; very firm, very sticky, very plastic; diffuse, irregular boundary; slightly acid to neutral.

CBg (90-100 cm): Greenish gray (5GY 5/1 m) silty clay loam; many coarse prominent mottles; massive, to moderate to strong, medium, subangular blocky; very firm, very sticky, very plastic; slightly acid to neutral.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: 90
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 35-90; 55; Btg horizon
ROOTING DEPTH (cm)	: 40-60
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 0-150; perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: silt loam, silty clay loam, silty clay

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-30	No. of Samples	30-70	No. of Samples	70-100
PERMEABILITY (CLASS)		slow to moderate		slow		slow
BULK DENSITY (g/cm^3)	3	0.98 (0.81-1.05)	2	1.44 (1.34-1.53)	1	1.46
AWSC (cm/m)	3	22.3 (14.2-26.7)	2	20.8 (20.6-21.0)	1	21.0
AWSC (Corr. for % CF)(cm/m)	3	22.3 (14.2-26.7)	2	20.8 (20.6-21.0)	1	21.0
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0	Est.	0	Est.	0
% PASSING SIEVES # 4	Est.	98.0	1	100	3	99.9(99.8-100.0)
% PASSING SIEVES # 40	Est.	95.0	1	98.3	3	98.4 (96.4-99.8)
% PASSING SIEVES #200	Est.	92.0	1	95.0	3	95.3 (89.9-99.4)
% SAND	9	14.3 (2.4-21.0)	18	11.6 (2.4-20.5)	8	16.1 (0.7-43.3)
% CLAY	9	26.1 (10.5-36.0)	18	29.2 (16.5-54.9)	8	26.4 (15.2-31.5)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-30	No. of Samples	30-70	No. of Samples	70-100
SOIL REACTION (pH) 1:1 H_2O	9	5.7 (5.3-6.5)	10	6.4 (5.8-7.9)	8	7.1 (6.6-8.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	14	5.2 (4.6-6.2)	14	5.7 (5.1-7.2)	10	6.2 (5.3-7.4)
CONDUCTIVITY mS/cm		N/A		N/A		N/A
ORGANIC CARBON (%)	10	5.1 (2.3-10.1)	7	0.8 (0.2-1.7)	3	0.3 (0.2-0.6)
NITROGEN (%)	9	0.32 (0.43-1.01)	10	0.05 (0.02-0.09)	6	0.03 (0.02-0.05)
EXCHANGE CAPACITY (meq/100g)	9	36.2 (8.8-130.5)	10	22.3 (19.0-31.5)	6	21.6 (17.1-24.3)
EXCHANGEABLE CATIONS (meq/100g) - Ca	9	10.7 (3.9-31.9)	10	13.0 (9.9-19.9)	6	13.0 (11.9-15.5)
- Mg	9	5.9 (1.4-10.2)	10	7.4 (3.6-15.2)	6	9.8 (4.9-13.7)
- Na	9	0.4 (0.1-1.5)	10	0.5 (0.1-1.9)	6	0.5 (0.1-1.2)
- K	9	0.2 (0.0-1.2)	10	0.1 (0.1-0.2)	6	0.4 (1.0-0.2)
PHOSPHORUS (ppm)	9	11.3 (1.0-67.1)	10	3.6 (2.2-5.4)	7	3.5 (1.9-6.2)
SULFUR (ppm)	5	1.4 (0.4-2.8)	10	0.6 (0.0-1.4)	6	1.0 (0.9-2.0)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
COg	Gravelly phase; small localized areas of fine textured marine material which contains 20 to 50% coarse fragments by volume.
COpt	Peaty phase; surface horizon(s) consist of 15-40 cm surface capping of humic or mesic organic materials. Occurs in very poorly drained depressional sites in Cowichan soil landscapes.
COpt,s	Surface capping of humic or mesic organic materials. Occurs in very poorly drained depressional sites in Cowichan soil landscapes. Shallow variant; strongly contrasting texture and/or differenct genetic material occurs at 50-100 cm. Usually the underlying deposit is a coarse textured morainal deposit.
COs	Shallow variant; strongly contrasting texture and/or different genetic material occurs at 50-100 cm. Usually the underlying deposit is a coarse textured morainal deposit.

INFERRED SOIL PROPERTIES
COWICHAN SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
CO	0-25 0-100	CL ML-CL	A-7-6 A-6	(31.9-47.5) 38.2	(8.2-20.8) 13.5	0.5 0.3

CROFTON SOILS (CF)

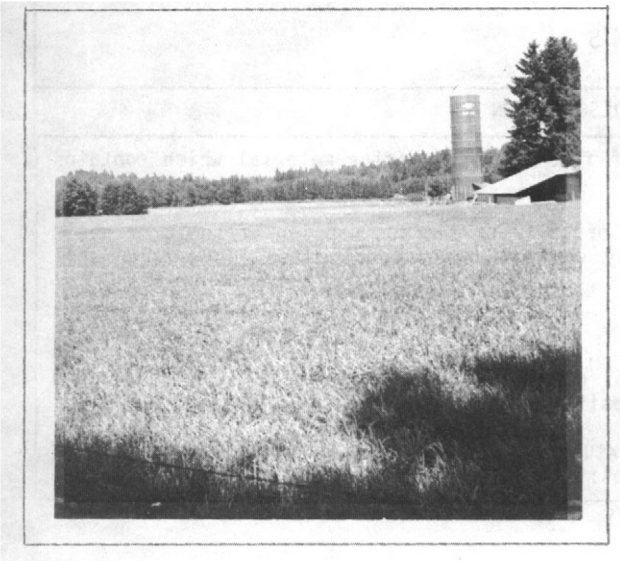


PLATE 4.11: CROFTON SOIL LANDSCAPE

GENERAL COMMENTS

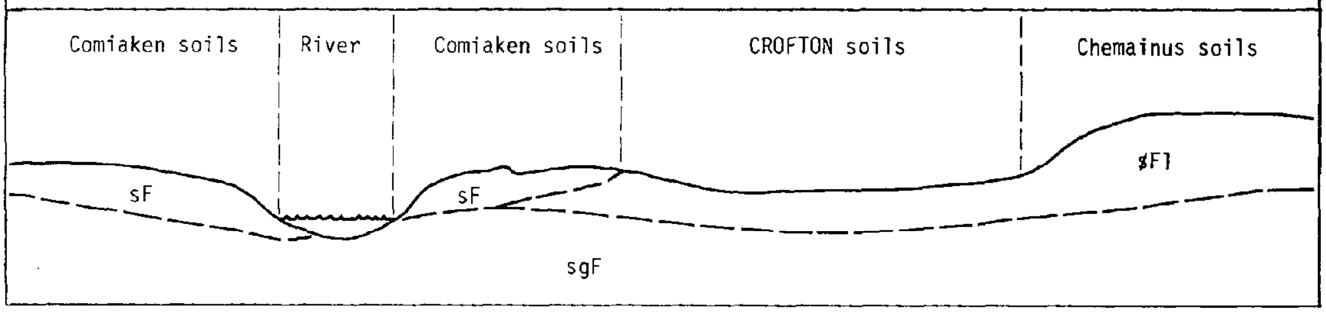
Crofton soils (1390 ha) are found in level to depressional areas on recent floodplains and deltas. The largest areas occur on the floodplains of the Nanaimo, Chemainus, Cowichan and Koksilah rivers where they are associated with Chemainus soils. They are poorly drained with a year-round water table fluctuating between 0 and 2 m. The parent materials are fluvial deposits with predominantly medium textures.

Crofton soils have very dark brown organic matter-enriched surface horizons and silt loam textures. Most Crofton soils are classified as **Orthic Humic Gleysols**, but Rego Humic Gleysols, Orthic Gleysols and Rego Gleysols also occur.

Pasture and hay production are the predominant present uses. However, potential exists for a wide range of crops if drainage and irrigation systems are installed. In the improved state Crofton soils are considered prime agricultural land.

Crofton soils are unsuitable for urban and related uses because of high watertables and frequency of flooding.

CROFTON SOIL LANDSCAPE CROSS SECTION*



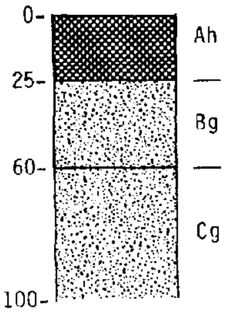
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy silty fluvial level
TOPOGRAPHY	:	0-2%; nearly level
ELEVATION RANGE	:	0-20 m asl
ASPECT	:	none
FLOOD HAZARD	:	frequent
VEGETATION	:	Significant areas of Crofton soils are cleared and under cultivation. Uncleared areas suport black cottonwood, red alder, maple, western red cedar and a variety of shrubs.

TYPICAL CROFTON SOIL PROFILE

DEPTH (cm)



Ah — Very dark brown (10YR 2/2 m) silt loam; weak, medium granular; friable; strongly acid.

Bg — Grayish brown (10 YR 5/2 m) silt loam; many, fine, prominent mottles; weak, moderate subangular blocky; very friable; slightly plastic; strongly acid.

Cg — Grayish brown (10YR 5/2 m) fine sandy loam; common, fine, prominent mottles; massive; slightly plastic; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: 160
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 100
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 0-200; apparent
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: fine sandy loam, loam, silt loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		moderate		moderate
BULK DENSITY (g/cm³)	4	1.07 (0.85-1.17)	4	1.08 (0.89-1.18)
AWSC (cm/m)	4	30.6 (23.0-37.0)	4	26.4 (18.0-33.8)
AWSC (Corr. for % CF) (cm/m)	4	30.6 (23.0-37.0)	4	26.4 (18.0-33.8)
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0	Est.	0
% PASSING SIEVES # 4	1	97.9	1	99.2
% PASSING SIEVES # 40	1	26.2	1	70.6
% PASSING SIEVES #200	1	21.1	1	27.7
% SAND	3	12.0 (7.4-15.2)	6	33.6 (12.4-50.7)
% CLAY	4	17.3 (14.5-19.8)	6	8.9 (0.4-16.9)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	5	5.8 (5.5-5.9)	8	5.8 (5.3-6.1)
SOIL REACTION (pH) 1:2 $CaCl_2$	8	5.0 (5.2-5.3)	8	5.0 (4.4-5.4)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	4	1.5 (0.6-2.3)	1	0.3
NITROGEN (%)	5	0.08 (0.01-0.20)	7	0.06 (0.01-0.11)
EXCHANGE CAPACITY (meq/100g)	5	17.5 (8.0-24.4)	7	13.1 (6.4-18.0)
EXCHANGEABLE CATIONS (meq/100g) - Ca	5	6.9 (4.3-9.6))	7	5.7 (7.5-8.4)
- Mg	5	2.3 (1.1-6.6)	7	1.2 (0.8-1.6)
- Na	5	0.3 (0.2-0.3)	7	0.2 (0.1-0.4)
- K	5	0.1 (0.1)	7	0.1 (0.1)
PHOSPHORUS (ppm)	5	8.4 (6.4-10.8)	8	10.5 (6.0-11.6)
SULFUR (ppm)	4	1.0 (0.1-3.3)	6	0.8 (0.0-1.6)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
CFg	Gravelly phase; the soil profile contains 20 to 50% coarse fragments by volume.
CFpt	Peaty phase; 15-40 cm surface capping of humic or mesic organic materials. Occurs on very poorly drained floodplain sites.
CFs	Shallow variant; strongly contrasting texture (eg: sand, gravelly sand) occuring between 50 and 100 cm depth.

INFERRED SOIL PROPERTIES
CROFTON SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
CF	0-100	MH, ML-CL, or ML	A-7-5, A-7-6, A-6	42.5 (19.8-54.8)	14.3 (0.8-22.1)	0.3 - 0.5

DASHWOOD SOILS (DW)

PLATE 4.12: DASHWOOD SOIL LANDSCAPE

GENERAL COMMENTS

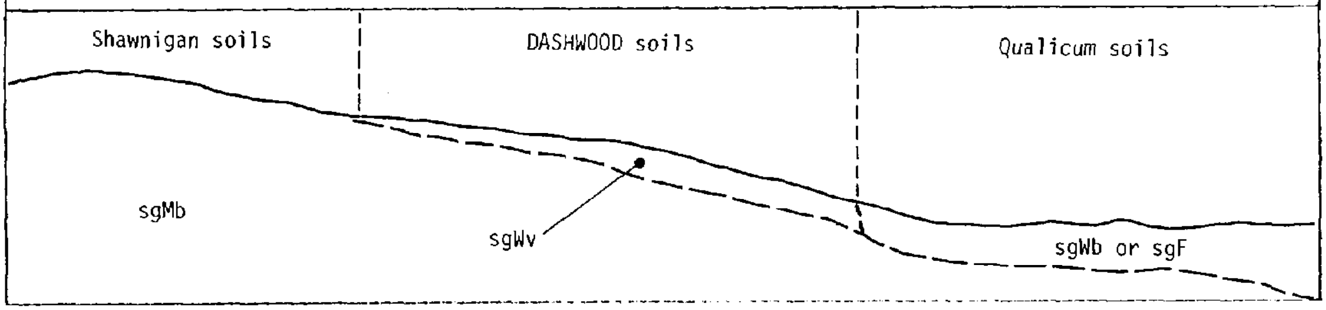
Dashwood soils (2270 ha) are found on very gently to strongly sloping areas in glacial till landscapes. They occur throughout the study area and are generally associated with Qualicum or Deerholme soils. They have developed in well to moderately well drained, coarse-textured fluvial, fluvioglacial or marine deposits which overlie very compact morainal deposits.

The highly permeable upper horizons are characterized by high coarse fragment contents of mostly gravel size with a loamy sand to sand matrix. The underlying till generally occurs at 60 to 100 cm depth and has a strongly cemented upper 20 to 30 cm that is gravelly to very gravelly sandy loam and has very low permeability. Dashwood soils are dominantly **Duric Dystric Brunisols** although some are classified as Duric Humo Ferric Podzols are also included.

Dashwood soils are of limited use for agriculture due to coarse textures, low moisture holding capacity and poor fertility in the upper horizons. Irrigation, fertilization and stone picking will improve their suitability although most remain marginal for agriculture.

Dashwood soils are moderately suited for urban and related uses due to their upland location and high bearing strength although lateral movement of water along the relatively impermeable till contact can lead to excess water in some lower slope areas. In general interceptor ditches (or drain lines) may be required to control spring and winter seepage. Septic tank absorption fields are severely constrained by the coarse textures and strongly cemented subsoil.

DASHWOOD SOIL LANDSCAPE CROSS SECTION*



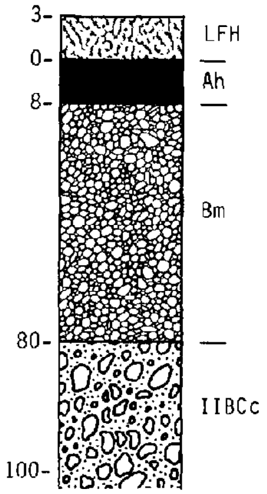
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy gravelly marine or fluvial veneer over sandy gravelly morainal
TOPOGRAPHY	:	5-20% slopes, often seaward sloping
ELEVATION RANGE	:	1-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists mainly of second growth stands of Douglas-fir and western hemlock, while the understory is dominated by salal.

TYPICAL DASHWOOD SOIL PROFILE

DEPTH (cm)



LFH: Loose, non-compact litter; very friable humus; extremely acid.

Ah: Brown (10YR 4/3m) very gravelly loamy sand; weak, fine subangular blocky breaking to single-grain; very friable; strongly acid.

Bm: Brown (7.5YR 4/4m) very gravelly loamy sand; weak, fine subangular blocky breaking to single-grain; very friable; medium acid.

IIBCc: Grayish brown (10YR 5/2m) very gravelly sandy loam; massive; extremely firm; indurated to strongly cemented; medium acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: moder, mull
SOLUM DEPTH (cm)	: 80
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 75-125; 25; Duric Horizon
ROOTING DEPTH (cm)	: 75-125
COARSE FRAGMENT CLASS	: 2-4
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: moderate to slow
SOIL DRAINAGE	: moderately well to well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly loamy sand over very gravelly sandy loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-75	No. of Samples	75+
PERMEABILITY (CLASS)		moderate		slow
BULK DENSITY (g/cm^3)	2	1.65 (1.45-1.85)	1	1.85
AWSC (mm/cm)	2	7.1 (6.6-7.5)	1	6.2
AWSC (Corr. for % CF) (mm/cm)	2	3.9 (2.1-5.6)	1	3.0
% COARSE FRAGMENTS >7.5cm	Est.	5-10	Est.	5-10
% COARSE FRAGMENTS <7.5cm	Est.	40-55	Est.	40-55
% PASSING SIEVES # 4	1	52.9	2	86.5 (84.4-88.6)
% PASSING SIEVES # 40	1	15.1	2	64.6 (59.4-69.8)
% PASSING SIEVES #200	1	7.5	2	33.5 (17.6-49.4)
% SAND	12	76.9 (51.1-98.1)	6	60.0 (42.6-77.2)
% CLAY	12	4.5 (1.0-10.2)	6	11.6 (2.6-19.6)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-75	No. of Samples	75+
SOIL REACTION (pH) 1:1 H_2O	15	5.8 (5.6-6.2)	8	5.9 (5.4-6.8)
SOIL REACTION (pH) 1:2 $CaCl_2$	17	4.9 (4.6-5.6)	8	5.1 (4.6-6.1)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	16	1.6 (0.3-3.3)	8	0.6 (0.3-1.5)
NITROGEN (%)	13	0.07 (0.01-0.19)	8	0.03 (0.01-0.07)
EXCHANGE CAPACITY (meq/100g)	13	14.6 (5.1-23.3)	8	14.6 (5.7-19.2)
EXCHANGEABLE CATIONS (meq/100g) - Ca	13	1.5 (0.4-3.1)	8	4.8 (0.6-12.0)
- Mg	13	0.4 (0.2-0.7)	8	2.2 (0.1-5.9)
- Na	13	0.1 (0.1-0.4)	8	0.2 (0.1-0.4)
- K	13	0.1 (0.1)	8	0.1 (0.1-0.2)
PHOSPHORUS (ppm)	13	34.0 (8.7-80.6)	8	23.8 (3.6-67.1)
SULFUR (ppm)	13	1.4 (0.1-3.6)	7	1.6 (0.1-3.8)
% IRON	18	0.18 (0.02-0.43)	6	0.11 (0.03-0.29)
% ALUMINUM	18	0.40 (0.11-0.58)	6	0.14 (0.09-0.22)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
DWg	Gravelly phase; the upper horizons have coarse textured material which has a lower gravel content than usual (20-50%).
DWid	Imperfectly drained variant; occurs in seepage sites where the underlying slowly pervious morainal deposit restricts drainage.
DWwc	Weakly cemented variant; (Orthic Dystric Brunisol or Orthic Humo-Ferric Podzol instead of Duric Dystric Brunisol or Duric Humo-Ferric Podzol. Cemented horizon which occurs at upper boundary of the morainal deposit is not strongly enough cemented to be a duric horizon.

INFERRED SOIL PROPERTIES
DASHWOOD SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
DW	0-50	GM	A-1-a	NP	NP	0.02-0.03
	50-100	GW	A-1-b	27.6	1.1	0.01-0.02

DEERHOLME SOILS (DE)

PLATE 4.13: DEERHOLME SOIL LANDSCAPE

GENERAL COMMENTS

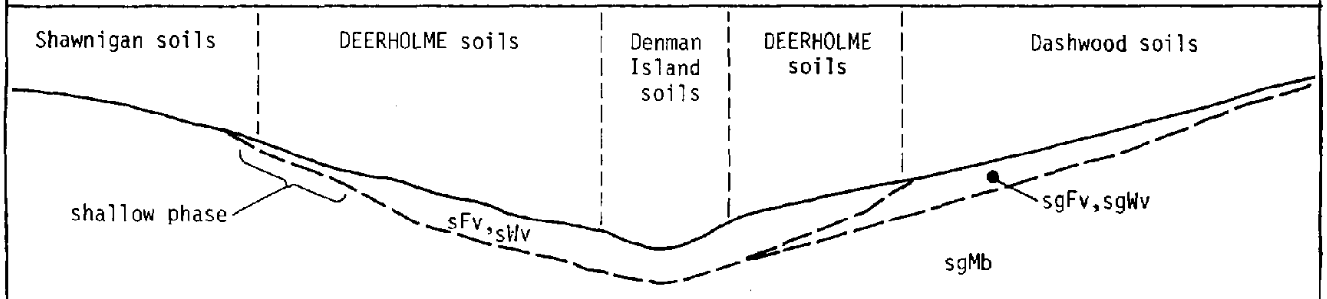
Deerholme soils (170 ha) occupy mid-slope areas in nearly level to moderately sloping landscapes and are usually associated with Dashwood or Denman Island soils. Although not very extensive they occur throughout the surveyed area. Deerholme soils are moderately well to well drained. They have developed in shallow (<1 m) sandy fluvial, fluvioglacial or marine deposits overlying gravelly sandy loam morainal deposits. The upper 20 to 50 cm of the morainal material is typically moderately to strongly cemented.

Moderately permeable loamy sand or sandy loam surface horizons overlie massive, slowly permeable gravelly sandy loam horizons. The soils are classified as dominantly **Duric Dystric Brunisols with** minor inclusions of Duric Humo-Ferric Podzols.

Deerholme soils are restricted agriculturally by summer droughtiness which is due to the low water storage capacity in the sandy surface. With irrigation and fertilization a wide range of crops can be grown. Forest productivity is high due to availability of moisture at depth.

Deerholme soils are moderately suited for urban and related uses due to their upland location and high bearing strength although lateral movement of water along the relatively impermeable till contact can lead to excess water in some lower slope areas. In general, interceptor ditches (or drain lines) may be required to control spring and winter seepage. Septic tank absorption fields are severely constrained by the coarse textures and strongly cemented subsoil.

DEERHOLME SOIL LANDSCAPE CROSS SECTION*



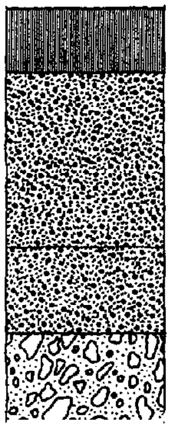
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy marine or fluvial veneer over gravelly sandy morainal
TOPOGRAPHY	:	0-15% slopes; nearly level to moderate slopes
ELEVATION RANGE	:	0-90 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation is mainly composed of second growth Douglas-fir, western red cedar, grand fir, and red alder.

TYPICAL DEERHOLME SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
10 – 0	L-H	Loose, non-compact litter.
0 – 60	Bm	Strong brown (7.5 YR 4/6 m) loamy sand; weak, fine subangular blocky; very friable; non-plastic; very strongly acid.
60 – 86	BCc	Yellowish brown (10 YR 5/4 m) sandy loam; massive, breaking to weak, coarse angular blocky; firm; very strongly acid.
86 –	IIBCc	Light yellowish brown (10 YR 6/4 m) gravelly sandy loam; massive; very firm; strongly cemented; very strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 70-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 85, 50; duric horizon
ROOTING DEPTH (cm)	: 55-100
COARSE FRAGMENT CLASS	: 0-1
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: moderate to rapid
SOIL DRAINAGE	: well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: sandy loam, loamy sand

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-75	No. of Samples	75-100
PERMEABILITY (CLASS)		slow		slow
BULK DENSITY (g/cm^3)	1	1.16	1	1.72
AWSC (cm/m)	1	10.0	1	10.0
AWSC (Corr for % CF) (cm/m)	1	9.0	1	6.0
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	5-10
% COARSE FRAGMENTS <7.5cm	Est.	10	Est.	25-30
% PASSING SIEVES # 4	1	88.7	1	88.8
% PASSING SIEVES # 40	1	60.8	1	73.9
% PASSING SIEVES #200	1	15.4	1	55.6
% SAND	4	79.4 (73.4-82.4)	3	40.3 (37.6-44.1)
% CLAY	4	5.9 (5.4-6.4)	3	15.2 (14.3-16.7)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-75	No. of Samples	75-100
SOIL REACTION (pH) 1:1 H_2O	4	5.5 (5.1-5.7)	3	5.7
SOIL REACTION (pH) 1:2 $CaCl_2$	4	4.7 (4.5-4.9)	3	4.7 (4.6-4.8)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	4	1.2 (0.5-2.1)		ND
NITROGEN (%)	4	0.07 (0.04-0.10)	3	0.02 (0.02-0.03)
EXCHANGE CAPACITY (meq/100g)	4	12.2 (10.6-14.3)	3	11.0 (9.0-12.0)
EXCHANGEABLE CATIONS (meq/100g) - Ca	4	2.0 (1.5-3.1)	3	9.4 (8.6-10.5)
- Mg	4	0.8 (0.3-1.5)	3	3.0 (2.7-3.3)
- Na	4	0.1 (0.1-0.2)	3	0.3 (0.3-0.4)
- K	4	0.1 (0.1-0.2)	3	0.1 (0.1)
PHOSPHORUS (ppm)	4	16.9 (5.4-24.0)	3	8.1 (5.7-9.9)
SULFUR (ppm)	4	0.6 (0.1-1.0)	3	0.9 (0.6-1.4)
% IRON	3	0.19 (0.16-0.24)		ND
% ALUMINUM	3	0.36 (0.31-0.41)		ND

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
DEid	Imperfectly drained (wetter) variant; occurs in seepage sites where the underlying slowly pervious morainal deposit restricts drainage. Soil description is Orthic Dystric Brunisol or Orthic Humo-Ferric Podzol.

INFERRED SOIL PROPERTIES
DEERHOLME SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
DE	0-50	GM	A-2-4	NP	NP	0.1 - 0.2
	50-100	ML	A-4	27.6	1.1	0.1 - 0.25

DENMAN ISLAND SOILS (DA)

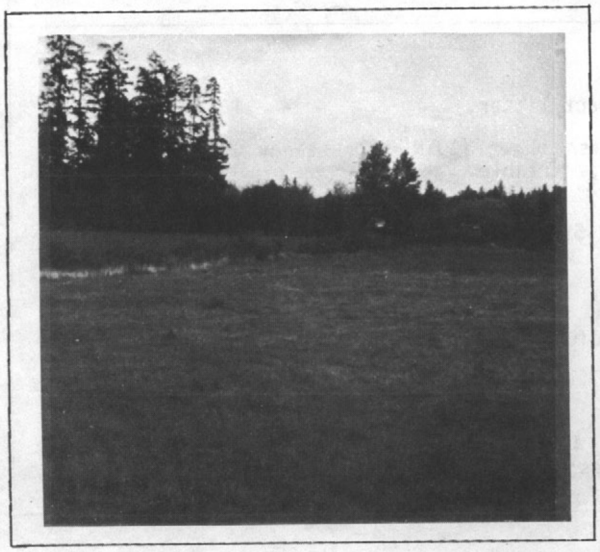


PLATE 4.14: DENMAN ISLAND SOIL LANDSCAPE

GENERAL COMMENTS

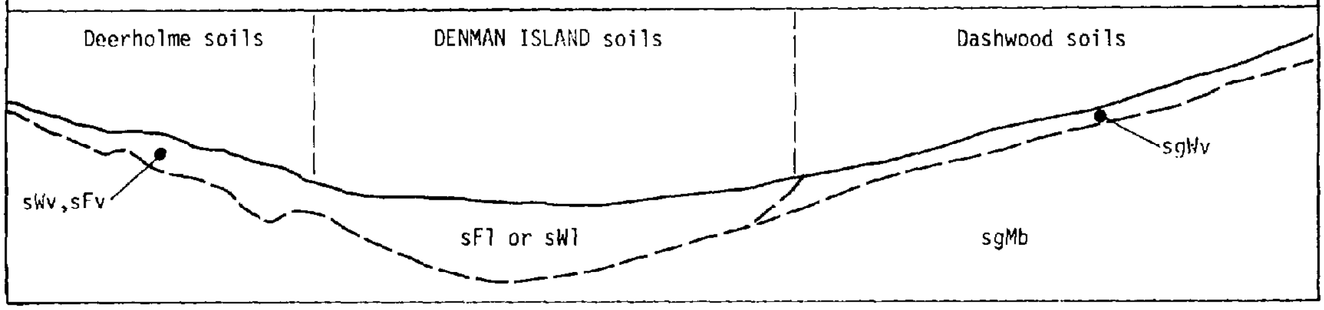
Denman Island soils (85 ha) are found in depressional areas and seepage receiving sites in marine or fluvial landscapes. They are very minor in extent, occurring mainly in the Nanoose Bay area. They are poorly drained and have a perched seasonal watertable.

Denman Island soils are stone-free and generally have a organic matter enriched surface. The have sandy loam to loamy sand textures and normally have an underlying impermeable layer of either compacted moraine or bedrock. These soils are classified as dominantly **Orthic Humic Gleysols** with minor inclusions of Orthic Gleysols.

Most Denman Island soils are presently under forest cover. They are limited for agriculture by perched winter and spring watertables. When improved by drainage and irrigation these soils have the potential to grow a wide range of crops.

Denman Island soils are not recommended for urban and related uses because of seasonal high watertables and seepage.

DENMAN ISLAND SOIL LANDSCAPE CROSS SECTION*

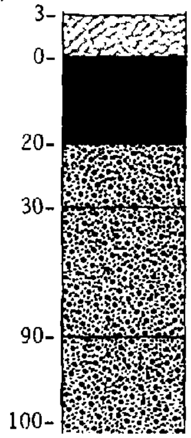


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy fluvial or marine
TOPOGRAPHY	:	2 to 10 percent; nearly level to gentle slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation on Denman Island soils consists of red alder, willow, maple and western red cedar with an understory of moisture loving plants that include skunk cabbage and devils club.

TYPICAL DENMAN ISLAND SOIL PROFILE



Horizon	Description
L	Loose, non-compact litter.
Ah	Very dark grayish brown (10YR 3/2m) sandy loam; moderate, medium granular; friable.
Bm	Strong brown (7.5YR 4/6m) loamy sand; moderate, medium sub-angular blocky; very friable.
Bg	Olive (5Y 4/3m) loamy sand; common, medium prominent mottles; weak, medium angular blocky; very friable.
BCg	Olive grey (5Y 4/2m) loamy sand or sand; common, medium prominent mottles; single grained; loose.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: mull
SOLUM DEPTH (cm)	: 100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 0-1
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 30-90+; perched seasonal
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: loamy sand, sand, sandy loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		rapid		rapid
BULK DENSITY (g/cm³)	Est.	1.3 (1.2-1.4)	Est.	1.7 (1.7-1.8)
AWSC (cm/m)	Est.	12.0	Est.	10.0
AWSC (corr. for % CF) (cm/m)	Est.	10.0	Est.	8.0
% COARSE FRAGMENTS >7.5cm	6	0	6	0
% COARSE FRAGMENTS <7.5cm	6	10 (5-15)	6	10 (5-15)
% PASSING SIEVES # 4	Est.	92	Est.	95
% PASSING SIEVES # 40	Est.	80	Est.	95
% PASSING SIEVES #200	Est.	15	Est.	50
% SAND	Est.	75	Est.	85
% CLAY	Est.	5	Est.	2

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	Est.	5.7		
SOIL REACTION (pH) 1:2 $CaCl_2$	Est.	5.0		
CONDUCTIVITY mS/cm	Est.	N/A		
ORGANIC CARBON (%)	Est.	2.0		
NITROGEN (%)	Est.	0.1		
EXCHANGE CAPACITY (meq/100g)	Est.	14		
EXCHANGEABLE CATIONS (meq/100g) - Ca	Est.	3		
- Mg	Est.	0.4		
- Na	Est.	0.1		
- K	Est.	0.2		
PHOSPHORUS (ppm)	Est.	60		
SULFUR (ppm)	Est.	1		
% IRON	Est.	0.3		
% ALUMINUM	Est.	0.3		

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
DAg	Gravelly phase; the soil profile contains 20 to 50% coarse fragments mostly fine gravel (<2.5 cm) in size.

INFERRED SOIL PROPERTIES DENMAN ISLAND SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
DA	0-100	SM	A-2-4	NP	NP	Est. <0.2

DOUGAN SOILS (DN)

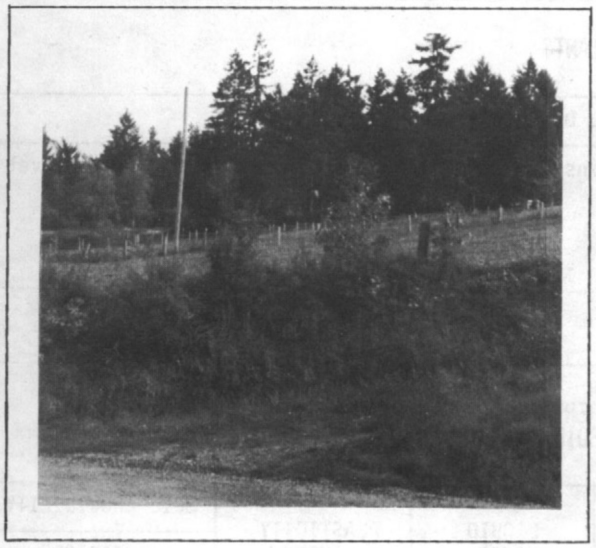


PLATE 4.15: DOUGAN SOIL LANDSCAPE

GENERAL COMMENTS

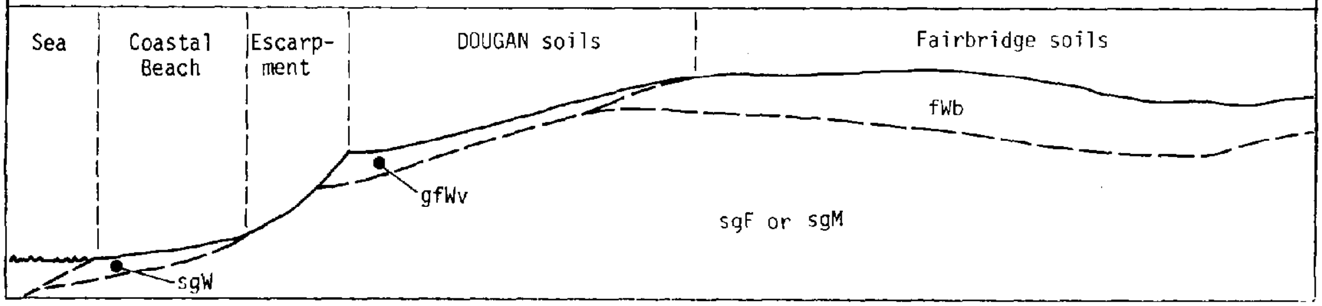
Dougan soils (225 ha) occur on very gentle to moderate slopes with seaward locations in ancient marine landscapes. They are minor in extent and generally found south of Duncan. They have developed in gravelly medium textured marine deposits which overlie coarse-textured deposits of either morainal, fluvioglacial or fluvial origin. These soils are moderately well to imperfectly drained.

Dougan soils have gravelly loam to gravelly silty clay loam upper horizons. The underlying very gravelly sand to gravelly sandy loam occurs within 50 to 100 cm of the surface and may contain a discontinuous cemented horizon. Dougan soils are classified as **Orthic Dystric Brunisols.**

Dougan soils agriculturally have stoniness, aridity and topography limitations and care must be taken to avoid water erosion on sloping areas.

Dougan soils are generally unsuited for urban and related uses. Erodibility and slow perviousness can cause problems.

DOUGAN SOIL LANDSCAPE CROSS SECTION*



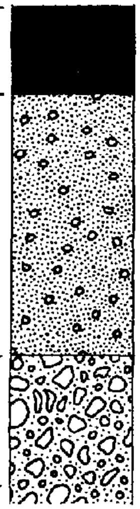
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	gravelly fine marine over sandy gravelly morainal, fluvioglacial or fluvial
TOPOGRAPHY	:	5-15% slopes, often seaward sloping
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists mainly of Douglas-fir, western red cedar, red alder, vine and big leaf maple. The understory is dominated by salal.

TYPICAL DOUGAN SOIL PROFILE

DEPTH (cm)



Horizon	Description
Ap	Dark brown (10YR 4/3m) gravelly loam; moderate, medium granular; friable.
Bm	Dark yellowish brown (10YR 4/6m) gravelly loam to gravelly silt loam; moderate, medium subangular blocky; firm.
IIBC	Olive gray (5Y 5/2m) very gravelly sandy loam; massive; very firm.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 90-110
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 75-125; 25; discontinuous cemented horizon
ROOTING DEPTH (cm)	: 75-125
COARSE FRAGMENT CLASS	: 2
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 75-100 cm; seasonal perched
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: moderately well to imperfect
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: gravelly loam to gravelly silty clay loam, over very gravelly sandy loam to very gravelly sand

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-60	No. of Samples	60+
PERMEABILITY (CLASS)		moderate		slow to rapid
BULK DENSITY (g/cm^3)	Est.	1.2	Est.	1.70
AWSC (cm/m)	Est.	20	Est.	15.0
AWSC (corr. for % C.F.) (cm/m)	Est.	15	Est.	8.0
% COARSE FRAGMENTS >7.5cm	10	3 (0-5)	10	6 (2-10)
% COARSE FRAGMENTS <7.5cm	10	30 (25-40)	10	60 (55-75)
% PASSING SIEVES # 4	Est.	85	Est.	95
% PASSING SIEVES # 40	Est.	75	Est.	95
% PASSING SIEVES #200	Est.	65	Est.	25
% SAND	6	36.7 (29.0-46.9)	2	75.7 (75.3-76.1)
% CLAY	5	15.3 (6.2-24.4)	2	12.7 (7.9-17.4)

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-60	No. of Samples	60+
SOIL REACTION (pH) 1:1 H_2O	Est.	5.7 (5.4-5.9)	Est.	5.3 (5.0-5.6)
SOIL REACTION (pH) 1:2 $CaCl_2$	6	5.2 (4.7-5.7)	4	4.9 (4.8-5.1)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	4	2.6 (1.2-6.2)	1	0.6
NITROGEN (%)	Est.	0.2	Est.	0.05
EXCHANGE CAPACITY (meq/100g)	Est.	18	Est.	9.0
EXCHANGEABLE CATIONS (meq/100g) - Ca	Est.	6	Est.	1.5
- Mg	Est.	2	Est.	0.5
- Na	Est.	0.2	Est.	6.2
- K	Est.	0.3	Est.	6.1
PHOSPHORUS (ppm)	Est.	30	Est.	30
SULFUR (ppm)	Est.	3	Est.	3
% IRON	4	0.41 (0.19-1.04)	1	0.26
% ALUMINUM	4	0.49 (0.21-1.09)	1	0.46

SOIL PHASES/VARIANTS

SOIL SYMBOL	SOIL DESCRIPTION
DNid	Imperfectly drained (wetter) variant (Gleyed Dystric Brunisol instead of Orthic Dystric Brunisol). Occurs on seepage sites.
DNid,mc	Imperfectly drained (wetter) variant (Gleyed Dystric Brunisol instead of Orthic Dystric Brunisol). Occurs on seepage sites. Duric variant (Duric Dystric Brunisol instead of Gleyed Dystric Brunisol); the duric horizon (moderately to strongly cemented) occurs in underlying coarse textured marine, morainal or fluvial materials.
DNmc	Duric variant (Duric Dystric Brunisol instead of Gleyed Dystric Brunisol); the duric horizon (moderately to strongly cemented) occurs in underlying coarse textured marine, morainal or fluvial materials.

INFERRED SOIL PROPERTIES
DOUGAN SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
DN	0-100	ML	A-4	34.0	6.0	Est. 0.3

FAIRBRIDGE SOILS (FB)

PLATE 4.16: FAIRBRIDGE SOIL LANDSCAPE

GENERAL COMMENTS

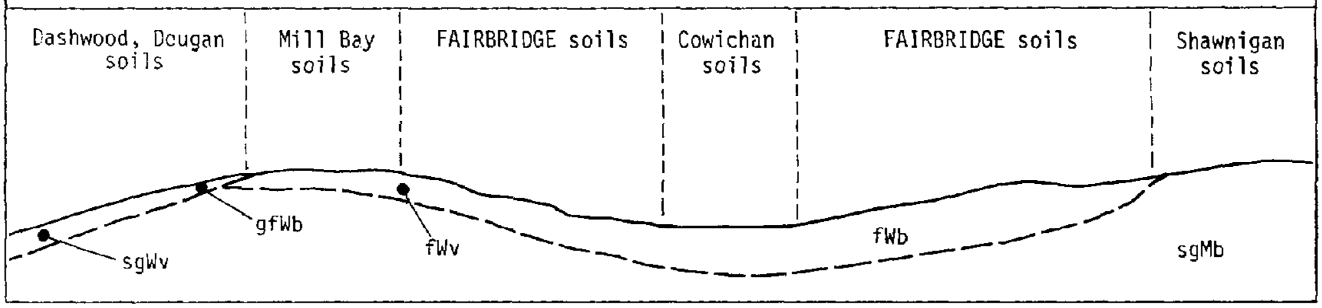
Fairbridge soils (6759 ha) occur below elevations of about 100 m. They occupy nearly level to moderate slopes within generally undulating areas of medium-textured deposits and are usually associated with Cowichan and Hillbank soils. These soils occur most extensively in the Duncan area. Fairbridge soils are imperfectly to moderately well drained and have a perched watertable during the winter months.

Fairbridge soils have a dark yellowish brown surface horizon which contains many concretions. All horizons are stone-free and silt loam or silty clay loam in texture. The lower horizons are very compact and slowly permeable. The seasonally perched watertable causes prominent mottling in the lower horizons. These soils are dominantly classified as **Gleyed Eluviated Dystric Brunisols** with subdominant inclusions of Gleyed Dystric Brunisols and Gleyed Brunisolic Gray Luvisols and Gleyed Humo-Ferric Podzols.

Fairbridge soils are considered prime agricultural land with dairying and hay production being the main present land use. They are suitable for a wide range of crops but irrigation and fertilization are required for optimal yields. Soil moisture content should be carefully observed prior to cultivation since structure deterioration, increased surface erosion, and surface crusting and puddling can result if soil is cultivated when wet. Perched watertables during winter months may adversly affect some perennial crops.

Urban and related uses are constrained by perched watertables, slow permeability and generally low bearing strengths.

FAIRBRIDGE SOIL LANDSCAPE CROSS SECTION*

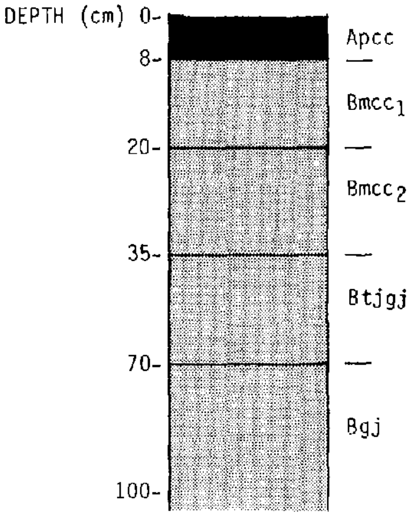


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	silty marine blanket
TOPOGRAPHY	:	2-15%, undulating
ELEVATION RANGE	:	0 to 100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	Substantial areas of Fairbridge soils are cleared and cultivated mainly for pasture and hay production. Uncleared areas support mixed stands of second growth Douglas-fir, western red cedar, red alder, maple, and grand fir. The understory consists of a variety of shrubs usually dominated by salal.

TYPICAL FAIRBRIDGE SOIL PROFILE



Apcc - Dark yellowish brown (10 YR 4/4 m) silt loam; weak, fine to medium, subangular blocky to weak to moderate, very fine to fine subangular blocky; very friable, slightly sticky, slightly plastic; abrupt smooth boundary; medium acid; few, fine, durinodes throughout matrix; spherical.

$Bmcc_1$ - Strong brown (7.5 YR 5/6 m) silt loam; weak to moderate, medium, subangular blocky; very friable, slightly sticky, slightly plastic; gradual, smooth boundary; strongly acid; common, fine, durinodes throughout matrix, spherical

$Bmcc_2$ - Light yellowish brown (2.5 Y 6/4 m) silt loam; moderate, medium, subangular blocky; soft, very friable, slightly sticky, plastic; gradual, wavy boundary; strongly acid; common, fine, durinodes throughout matrix, spherical.

Btjgj- Pale yellow (2.5 Y 7/4 m) silt loam; common medium distinct mottles; moderate, medium to coarse, subangular blocky; slightly hard, sticky, plastic; diffuse wavy boundary; strongly acid.

Bgj - Yellowish brown (10 YR 5/4 m) silt loam; common fine prominent mottles; massive to moderate, fine to medium, angular blocky; firm, plastic; gradual smooth boundary; medium acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 100-130
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 70-100; compact lower horizons
ROOTING DEPTH (cm)	: 80-110
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 70; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: imperfectly
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: silt loam, silty clay loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-35	No. of Samples	35-70	No. of Samples	70-130
PERMEABILITY (CLASS)		moderate		moderate		slow
BULK DENSITY (g/cm^3)	5	1.13 (0.94-1.46)	6	1.38 (1.18-1.50)	3	1.54 (1.42-1.61)
AWSC (mm/cm)	6	25.4 (20.6-29.3)	5	22.3 (16.0-28.0)	3	22.7 (15.6-29.6)
AWSC (corr. for % CF) (cm/m)	6	25.4 (20.6-29.3)	5	22.3 (16.0-28.0)	3	22.7 (15.6-29.6)
% COARSE FRAGMENTS >7.5cm	5	0	5	0	5	0
% COARSE FRAGMENTS <7.5cm	5	0-10	5	0-10	5	0-3
% PASSING SIEVES # 4	7	91.7(84.0-100.0)			5	98.7 (96.1-100.0
% PASSING SIEVES # 40	7	85.9(77.8-97.8)			4	96.7 (92.9-99.3)
% PASSING SIEVES #200	7	80.0 (70.0-92.3)			4	86.5 (74.4-96.7)
% SAND	22	11.5 (1.5-25.4)	21	10.3 (1.4-40.0)	15	7.4 (1.1-25.2)
% CLAY	22	32.0 (9.0-45.5)	21	27.0 (9.4-45.5)	14	26.4 (16.6-36.9)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-35	No. of Samples	35-70	No. of Samples	70-130
SOIL REACTION (pH) 1:1 H_2O	16	5.6 (5.3-6.3)	8	5.7 (5.2-6.4)	16	6.4 (5.3-7.2)
SOIL REACTION (pH) 1:2 $CaCl_2$	16	5.0 ((4.6-5.6)	8	5.1 (4.5-5.9)	16	5.6 (4.4-6.8)
CONDUCTIVITY mS/cm		N/A		N/A		N/A
ORGANIC CARBON (%)	14	3.7 (1.1-8.7)	8	0.8 (0.3-1.9)	9	0.3 (0.1-0.7)
NITROGEN (%)	16	0.09 (0.01-0.19)	8	0.04 (0.02-0.11)	13	0.02 (0.01-0.04)
EXCHANGE CAPACITY (meq/100g)	16	18.5 (9.3-37.8)	8	21.8 (15.6-29.2)	14	21.2 (16.9-31.5)
EXCHANGEABLE CATIONS (meq/100g) - Ca	15	2.8 (0.4-6.6)	8	5.0 (0.3-17.1)	14	10.5 (0.3-17.2)
- Mg	16	1.3 (0.2-3.4)	8	4.2 (0.1-8.3)	14	5.9 (0.1-11.1)
- Na	16	0.1 (0.1-0.3)	8	0.2 (0.1-0.4)	14	0.3 (0.1-0.5)
- K	16	0.3 (0.1-0.7)	8	0.2 (0.1-0.4)	14	0.1 (0.1-0.2)
PHOSPHORUS (ppm)	16	36.3 (2.3-111.5)	8	7.5 (2.9-24.4)	15	6.7 (2.4-13.2)
SULFUR (ppm)	14	2.7 (0.1-11.4)	7	2.6 (0.3-8.8)	10	1.6 (0.1-11.1)
% IRON	31	0.40 (0.07-0.82)				
% ALUMINUM	31	0.40 (0.12-0.08)				

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
FBg	Gravelly phase; solum contains 20-50% gravel; usually occurs on seaward facing slopes.
FBg,l	Gravelly phase; solum contains 20-50% gravel; usually occurs on seaward facing slopes. Shallow lithic phase; bedrock (other than shale or siltstone) occurs within 50 to 100 cm of the surface.
FBg,w	Gravelly phase; solum contains 20-50% gravel; usually occurs on seaward facing slopes. Strongly mottled phase; wetter moisture regime in profile as evidence by prominent mottling within 50 cm of the surface. Seasonal perched water tables present. Landscape position not typical of Gleysolic soils.
FBl2	Shallow lithic phase; bedrock (other than shale or siltstone) occurs within 50 to 100 cm of the surface.
FBw	Strongly mottled phase; wetter moisture regime in profile as evidence by prominent mottling within 50 cm of the surface. Seasonal perched water tables present. Landscape position not typical of Gleysolic soils.

INFERRED SOIL PROPERTIES
FAIRBRIDGE SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
FB	0-100	ML	A-4	37.7 (26.5-50.7)	9.7 (6.5-14.4)	0.4 - 0.5

FLEWETT SOILS (FT)

PLATE 4.17: FLEWETT SOIL LANDSCAPE

GENERAL COMMENTS

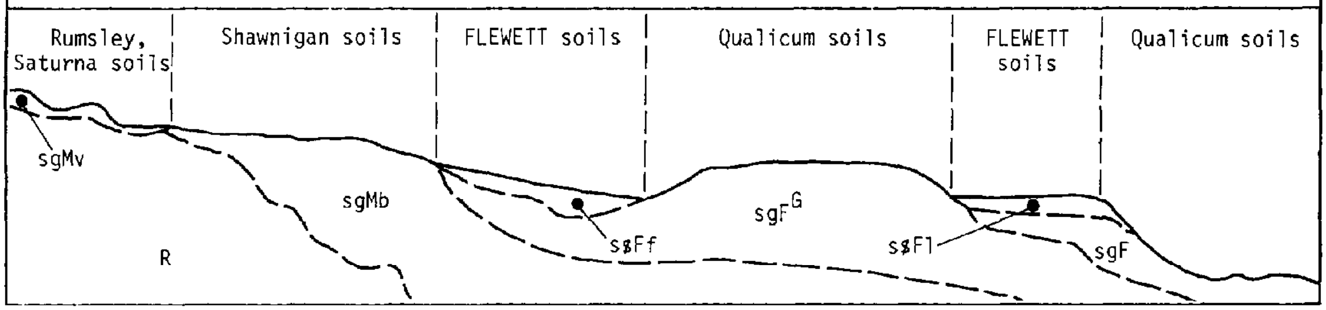
Flewett soils (505 ha) are found on level to very gently sloping river terraces and fluvial fans. They are minor in extent and are generally associated with Qualicum or Quennell soils. They are well drained and not affected by flooding. The parent materials are non-stony, sandy fluvial or fluvioglacial deposits.

Flewett soils have dark reddish brown to yellowish brown fine sandy loam, loam or silt loam surface horizons. Most Flewett soils have coarser textures at depth. They are dominantly classified as **Orthic Dystric Brunisols** with Orthic Humo-Ferric Podzols occurring in some areas.

Flewett soils are considered desirable for agriculture principally because of their textures, negligible slopes, and absence of coarse fragments. Present land uses are pasture and hay production, although these soils are well suited to growing a wide range of crops such as vegetables, berries and some tree fruits. Irrigation is necessary for optimizing yields.

Flewett soils have no limitations for urban and related uses.

FLEWETT SOIL LANDSCAPE CROSS SECTION*

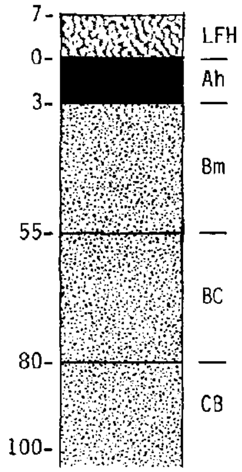


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy silty fluvial, fluvioglacial
TOPOGRAPHY	:	0-5%
ELEVATION RANGE	:	20-200 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard to rare
VEGETATION	:	Substantial areas of Flewett soils are cleared and cultivated. Uncleared areas support Douglas-fir, grand fir, western red cedar and red alder.

TYPICAL FLEWETT SOIL PROFILE



LFH (7–0 cm): Loose, non-compact litter over compact, very friable humus; extremely acid.

Ah (0–3 cm): Very dark brown (10YR 2/2m) fine sandy loam; weak, medium granular; friable; very strongly acid.

Bm (3–55 cm): Dark yellowish brown (10YR 4/4m) fine sandy loam; weak to moderate, medium subangular blocky; friable; strongly acid.

BC (55–80 cm): Olive brown (2.5Y 4/4m) fine sandy loam; massive; firm; medium acid.

CB (80–100 cm): Dark grayish brown (2.5Y 4/2m) fine sandy loam; massive; firm; pH 5.6.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Moder
SOLUM DEPTH (cm)	: 85-100+
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: >100
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: silt loam, loam, fine sandy loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		moderate		moderate
BULK DENSITY (g/cm^3)	1	1.05	1	1.29
AWSC (cm/m)	1	14.0	1	14.0
AWSC (corr. % CF) (cm/m)	1	12.0	1	11.0
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0-5
% COARSE FRAGMENTS <7.5cm	Est.	0-10	Est.	0-10
% PASSING SIEVES # 4	1	96.4	Est.	95
% PASSING SIEVES # 40	1	90.0	Est.	85
% PASSING SIEVES #200	1	68.1	Est.	60
% SAND		48.2 (23.6-65.9)	4	38.0 (11.1-71.8)
% CLAY	8	3.6 (0.1-7.7)	4	9.1 (0.8-15.0)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	5	5.4 (5.2-5.9)	4	5.6 (5.3-6.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	5	4.7 (4.3-5.2)	4	4.8 (4.5-5.3)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	5	1.1 (0.5-1.6)	4	0.3 (0.1-0.6)
NITROGEN (%)	5	0.06 (0.03-0.09)	4	0.02 (0.01-0.03)
EXCHANGE CAPACITY (meq/100g)	5	10.7 (7.1-14.4)	4	9.4 (8.1-11.4)
EXCHANGEABLE CATIONS (meq/100g) - Ca	5	1.6 (0.7-2.3)	4	2.9 (1.2-4.4)
- Mg	5	0.3 (0.2-0.4)	4	0.9 (0.1-1.4)
- Na	5	0.1 (0.1)	4	0.2 (0.1-0.3)
- K	5	0.1 (0.1)	4	0.1 (0.1)
PHOSPHORUS (ppm)	4	138.9 (68.2-223.3)	4	25.2 (8.0-38.9)
SULFUR (ppm)	5	1.0 (0.2-3.5)	4	1.6 (0.3-2.4)
% IRON	5	0.31 (0.17-0.41)	1	0.12
% ALUMINUM	5	0.45 (0.25-0.77)	1	0.27

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
FTg	Gravelly phase; solum contains 20 to 50% gravel.
FTg,id	Gravelly phase; solum contains 20 to 50% gravel. Imperfectly drained (wetter) variant (Gleyed Dystric Brunisol); occurs on seepage sites.
FTid	Imperfectly drained (wetter) variant (Gleyed Dystric Brunisol); occurs on seepage sites.

INFERRED SOIL PROPERTIES
FLEWETT SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
FT	0-100	ML	A-4	NP	NP	0.55

GALIANO SOILS (GA)

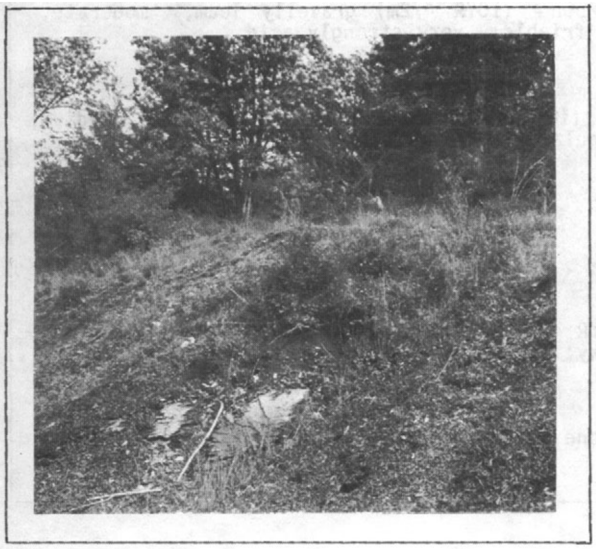
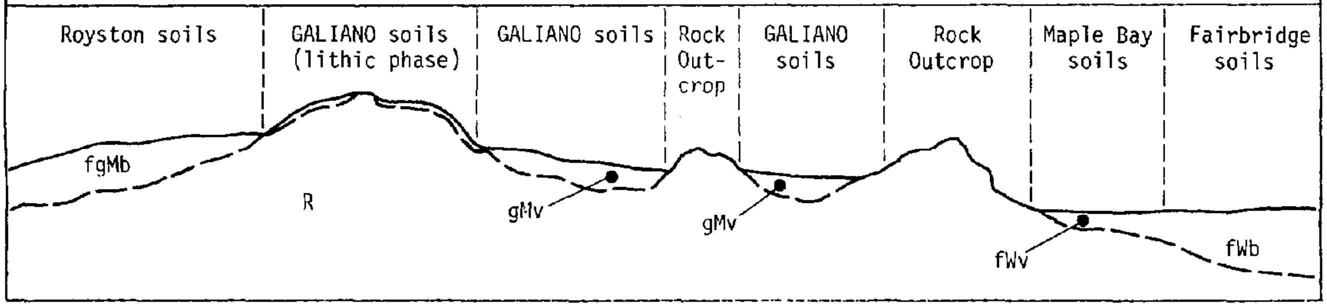


PLATE 4.18: GALIANO SOIL LANDSCAPE

GENERAL COMMENTS

Galiano soils (1320 ha) have developed on coarse to medium textured morainal or colluvial veneers overlying shale or siltstone bedrock. These soils occur mainly in the Cedar area, west of Maple Bay and on the lower south slope of Mount Prevost. The soft, easily-weathered bedrock does not produce stoniness, rockiness, or slope limitations for agriculture that are as severe as those for other shallow to bedrock soils. Most Galiano soils are forested or are used for pasture and are classified as **Orthic Dystric Brunisol** lithic phase. Limitations for urban development are not as severe as for other shallow to bedrock soils. The topography is generally more moderate, finer surface textures and the permeable paralithic subsoil pose only moderate limitations for excavations and service installations.

GALIANO SOIL LANDSCAPE CROSS SECTION*



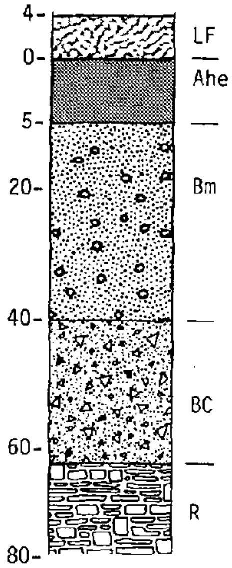
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	gravelly fine morainal veneer or fine rubbly colluvial veneer over siltstone or shale
TOPOGRAPHY	:	0-15% slopes (subdued bedrock-controlled topography)
ELEVATION RANGE	:	20-120 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists of semi-open stands of Douglas-fir, lodgepole pine, arbutus, some western red cedar and western hemlock. The understory is usually dominated by salal.

TYPICAL GALIANO SOIL PROFILE

DEPTH (cm)



Horizon	Description
LF	Loose, non-compact litter and fiber, medium acid.
Ahe	Dark grayish brown (10YR 4/2m) gravelly loam; moderate, fine granular; friable; very strongly acid.
Bm	Yellowish brown (10YR 4/2m) gravelly loam; moderate, medium to coarse subangular blocky; friable; very strongly acid.
BC	Pale brown (10YR 6/3m) gravelly loam; very fine to fine subangular blocky; friable to firm; very strongly acid.
R	Shale or siltstone bedrock

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	:	50-100
HUMUS FORM	:	Moder, Mull
SOLUM DEPTH (cm)	:	50-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	:	50-100; bedrock
ROOTING DEPTH (cm)	:	50-100
COARSE FRAGMENT CLASS	:	0-3
DEPTH TO AND TYPE OF WATERTABLE (cm)	:	N/A
PERVIOUSNESS	:	moderate
SOIL DRAINAGE	:	well to moderately well
DEPTH TO SALTS (cm)	:	N/A
SOIL TEXTURE	:	gravelly loam to gravelly sandy loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-70
PERMEABILITY (CLASS)		moderate
BULK DENSITY (g/cm^3)	Est.	1.35
AWSC (cm/m)	2	15.1 (12.9-17.3)
AWSC (corr. for % CF) (cm/m)	2	10.4 (7.7-13.0)
% COARSE FRAGMENTS >7.5cm	Est	5-10
% COARSE FRAGMENTS <7.5cm	Est	25-40
% PASSING SIEVES # 4	1	94.1
% PASSING SIEVES # 40	1	80.5
% PASSING SIEVES #200	1	69.5
% SAND	8	48.9 (42.8-60.1)
% CLAY	8	14.7 (8.3-22.4)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-70
SOIL REACTION (pH) 1:1 H_2O	7	5.5 (5.4-5.6)
SOIL REACTION (pH) 1:2 $CaCl_2$	8	4.8 (4.8-4.9)
CONDUCTIVITY mS/cm		N/A
ORGANIC CARBON (%)	8	0.9 (0.3-1.3)
NITROGEN (%)	7	0.07 (0.03-0.10)
EXCHANGE CAPACITY (meq/100g)	7	15.1 (17.2-24.9)
EXCHANGEABLE CATIONS (meq/100g) - Ca	7	7.8 (4.5-9.9)
- Mg	7	3.0 (2.5-4.1)
- Na	7	0.3 (0.2-0.4)
- K	7	0.6 (0.2-0.6)
PHOSPHORUS (ppm)	5	5.3 (3.6-9.7)
SULFUR (ppm)	6	1.2 (0.3-2.5)
% IRON	6	0.30 (0.21-0.47)
% ALUMINUM	6	0.28 (0.19-0.43)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
GAl3	Very shallow lithic phase; shale or siltstone bedrock occurs within 50 cm of the surface.
GAr	Rubbly/blocky phase; the solum contains >50% angular coarse fragments, usually derived from local bedrock.
GAvg	Very gravelly phase; the solum contains >50% coarse fragments.

INFERRED SOIL PROPERTIES GALIANO SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
GA	≤100	ML	A-4	27.9 (23.4-32.4)	4.6 (2.6-6.5)	<0.15

HILLBANK SOILS (HT)

PLATE 4.19: HILLBANK SOIL LANDSCAPE

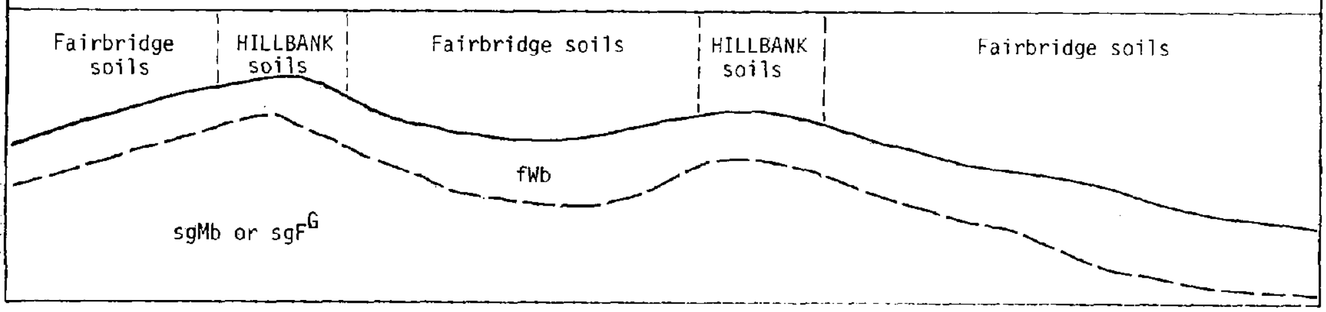
GENERAL COMMENTS

Hillbank soils (1 185 ha) occur below elevations of about 100 m. They occupy very gentle to strong slopes within undulating silty marine landscapes and are usually associated with Fairbridge soils. Most of these soils are mapped as secondary components in Fairbridge - Hillbank complexes, and are found in the Duncan area. They are moderately well drained. Hillbank soils have dark brown organic matter-enriched silt loam surface horizons that contain many concretions. The lower horizons are lighter brown with silt loam textures. Faint mottling sometimes occurs below 50 cm depth. Hillbank soils are classified as **Orthic Dystric Brunisols** with inclusions of Eluviated Dystric Brunisols and Brunisolic Gray Luvisols.

Most Hillbank soils are used for hay and pasture. With supplemental irrigation they are considered quality agricultural soils suitable for a wide range of crops.

Hillbank soils are moderately suited for urban and related uses. Low bearing strength, slow perviousness and ease of erodibility can cause problems.

HILLBANK SOIL LANDSCAPE CROSS SECTION*

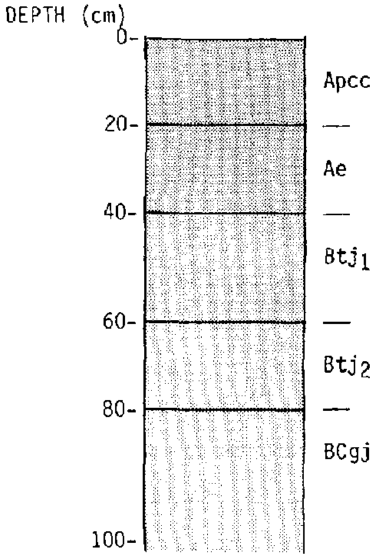


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	silty to sandy silty marine blanket
TOPOGRAPHY	:	5-20%; very gentle to strong slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation on Hillbank soils consists of Douglas-fir, western red cedar, grand fir, red alder and maple. The understory is dominated by salal.

TYPICAL HILLBANK SOIL PROFILE



Apcc - Dark yellowish brown (10YR 4/4m) silt loam; weak to moderate, medium to coarse, subangular blocky to moderate, fine, granular; very friable; abrupt smooth boundary.

Ae - Very pale brown (10YR 7/4 D) silt loam; massive, to moderate, medium to coarse, angular blocky; very hard; clear smooth boundary; medium acid.

Btj_1 - Light yellowish brown (10YR 64m) silty clay loam; weak, medium, prismatic to moderate medium angular blocky; very hard; diffuse smooth boundary; strongly acid.

Btj_2 - Yellowish brown (10YR 5/6m) silt loam; weak, medium, prismatic to moderate medium angular blocky; firm; diffuse smooth boundary; medium acid.

BCgj - Yellowish brown (10YR 5/4m) silt loam; few medium distinct mottles; massive, to moderate, medium, angular blocky; firm; gradual smooth boundary; medium acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: >100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: slow
SOIL DRAINAGE	: moderately well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: silt loam, loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-40	No. of Samples	40-80	No. of Samples	80-100
PERMEABILITY (CLASS)		moderate		moderate		slow
BULK DENSITY (g/cm^3)	2	1.14(1.12-1.16)	2	1.41(1.26-1.56)	1	1.60
AWSC (cm/m)	2	23.5(19.0-28.0)	2	23.2(20.4-26.0)	1	13.7
AWSC (corr. for % CF) (cm/m)	2	23.5(19.0-28.0)	2	23.2(20.4-26.0)	1	13.7
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0	Est	0
% COARSE FRAGMENTS <7.5cm	Est.	0-3	Est.	0	Est	0-5
% PASSING SIEVES # 4	Est.	100	Est.	100	Est	100
% PASSING SIEVES # 40	Est.	100	Est.	100	Est	100
% PASSING SIEVES #200	Est.	97	Est.	97	Est	97.0
% SAND	5	14.8 (9.6-21.1)	2	6.3 (4.3-8.2)	6	12.7 (5.7-19.7)
% CLAY	5	16.1 (14.8-17.4)	2	27.8 (24.5-31.1)	6	18.1 (14.2-22.3)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-40	No. of Samples	40-80	No. of Samples	80-100
SOIL REACTION (pH) 1:1 H_2O	5	5.6 (5.3-5.8)	2	5.6 (5.5-5.6)	7	5.6 (5.1-6.1)
SOIL REACTION (pH) 1:2 $CaCl_2$	8	5.0 (4.6-5.8)	3	5.2 (4.7-6.1)	8	4.9 (4.4-5.6)
CONDUCTIVITY mS/cm		N/A		N/A		
ORGANIC CARBON (%)	8	2.5 (0.5-5.8)	1	0.5	4	0.3 (0.2-0.4)
NITROGEN (%)	5	0.14 (0.03-0.24)	2	0.03 (0.02-0.03)	6	0.01 (0.01-0.03)
EXCHANGE CAPACITY (meq/100g)	5	20.5 (10.1-29.8)	2	16.5 (15.9-17.2)	7	15.5 (9.3-19.0)
EXCHANGEABLE CATIONS (meq/100g) - Ca	5	5.7 (1.3-9.1)	2	6.1 (5.5-6.6)	7	6.1 (2.2-15.4)
- Mg	5	1.4 (0.9-2.0)	2	3.3 (3.2-3.4)	7	3.3 (1.9-5.5)
- Na	5	0.2 (0.1-0.2)	2	0.2 (0.1-0.2)	7	0.2 (0.1-0.3)
- K	5	0.3 (0.2-0.5)	2	0.4 (0.4-0.5)	7	0.2 (0.1-0.4)
PHOSPHORUS (ppm)	5	61.0 (3.8-125.4)	2	8.5 (6.0-11.0)	6	12.9 (9.0-21.3)
SULFUR (ppm)	5	0.6 (0.1-0.8)	2	0.7 (0.3-1.1)	6	0.7 (0.1-1.3)
% IRON	4	0.40 (0.19-0.60)		ND		ND
% ALUMINUM	4	0.41(0.15-0.55)		ND		ND

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
HTg	Gravelly phase; the solum contains 20 to 50% gravels. Usually found on seaward facing sloping terrain.
HTg,12	Gravelly phase; the solum contains 20 to 50% gravels. Usually found on seaward facing sloping terrain. Shallow lithic phase; bedrock (other than shale or siltstone) occurs within 50 to 100 cm of the surface.
HT 12	Shallow lithic phase; bedrock (other than shale or siltstone) occurs within 50 to 100 cm of the surface.
HTs	Shallow phase; depth to another parent material occurs within 100 cm of the surface.

INFERRED SOIL PROPERTIES
HILLBANK SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
HT	0-100	ML	A-4	29.1 (28.9-29.3)	6.3 (6.0-6.7)	0.4 - 0.5

HOLLINGS SOILS (HO)

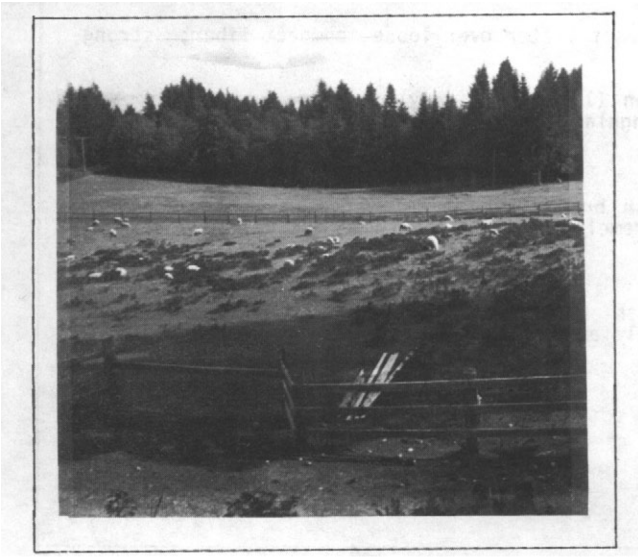


PLATE 4.20: HOLLINGS SOIL LANDSCAPE

GENERAL COMMENTS

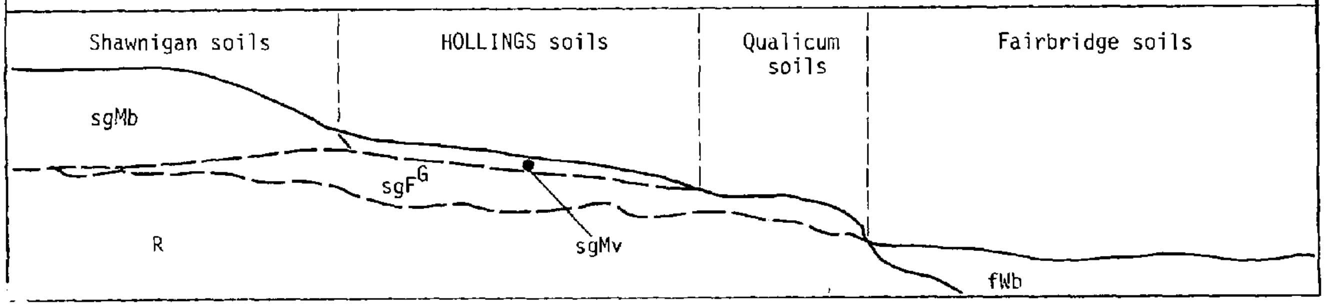
Hollings soils (425 ha) occur on undulating landscapes with very gentle to very strong slopes and mostly occur in the Cobble Hill - Mill Bay area. They have developed in very gravelly sandy shallow morainal deposits overlying very gravelly sandy fluvial or fluvioglacial deposits. They are well to rapidly drained and moderately to slowly pervious.

Hollings soils have a yellowish brown sandy loam surface overlying light yellowish brown sand at depth. These soils contain a 20 to 30 cm thick discontinuous strongly cemented horizon at the contact of the underlying material. They are classified as **Duric Dystric Brunisols;** however minor areas of Duric Humo-Ferric Podzols also occur.

These soils are mostly under forest cover at the present time. Agriculturally, they have moderate limitations due to low fertility, aridity and stoniness. With irrigation, fertilization and stone picking they can be improved.

Hollings soils are generally suitable for urban and related uses, however problems with septic tank absorption fields could arise due to poor filtration of effluent and the occurrence of a restricting layer within 1 m of the surface.

HOLLINGS SOIL LANDSCAPE CROSS SECTION*



*see Table 3.1 for explanation of terrain symbols

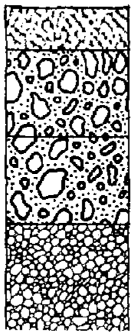
LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	gravelly sandy morainal, overlying fluvial or fluvioglacial deposits
TOPOGRAPHY	:	5-35% very gentle to very strong slopes
ELEVATION RANGE	:	100 m+, very minor areas below 100m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation is mainly Douglas-fir, western hemlock, western red cedar, red alder, and maple with an understory dominated by salal.

TYPICAL HOLLINGS SOIL PROFILE

DEPTH (cm)

3- LF
0- Bm
35- Bc
60- II BC



Loose, non-compact litter over loose, compact fiber; strongly acid.

Yellowish brown (10YR 5/4m) very gravelly sandy loam; weak moderate subangular blocky; very friable; very strongly acid.

Light yellowish brown (10YR 6/4m) very gravelly sandy loam; massive; extremely firm; strongly cemented; very strongly acid.

Light yellowish brown (10YR 6/4m) sand; single-grain; loose; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 160
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 30-50; duric horizon
ROOTING DEPTH (cm)	: 30
COARSE FRAGMENT CLASS	: 2-4
DEPTH TO AND TYPE OF WATERTABLE (cm)	: >100
PERVIOUSNESS	: moderate to slow
SOIL DRAINAGE	: well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly sandy loam, very gravelly loamy sand

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		slow		moderate
BULK DENSITY (g/cm^3)	1	1.26		ND
AWSC (cm/m)	1	12.5		ND
AWSC (coor. for % CF) (cm/m)	1	5.6		ND
% COARSE FRAGMENTS >7.5cm	Est.	0-5	Est.	5
% COARSE FRAGMENTS <7.5cm	Est.	40-50	Est.	40-60
% PASSING SIEVES # 4	Est.	60	1	35.0
% PASSING SIEVES # 40	Est.	40	1	13.6
% PASSING SIEVES #200	Est.	20	1	4.2
% SAND	11	62.3 (41.1-75.7)		ND
% CLAY	11	11.0 (4.1-16.2)		ND

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	3	5.6 (5.4-5.8)	2	5.9 (5.7-6.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	13	5.0 (4.6-5.4)	2	5.2 (4.8-5.6)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	9	1.4 (0.4-2.5)	2	0.4 (0.2-0.6)
NITROGEN (%)	3	0.05 (0.02-0.08)	1	0.02
EXCHANGE CAPACITY (meq/100g)	3	10.0 (8.9-12.0)	2	9.9 (8.7-11.1)
EXCHANGEABLE CATIONS (meq/100g) - Ca	3	0.8 (0.7-0.9)	2	0.9 (0.7-1.1)
- Mg	3	0.2 (0.2-0.3)	2	0.3 (0.3-0.3)
- Na	3	0.1 (0.1-0.2)	2	0.2 (0.2-0.2)
- K	3	0.2 (0.2-0.2)	2	0.1 (0.1-0.2)
PHOSPHORUS (ppm)	3	54.8 (33.4-96.9)	2	35.7 (33.3-38.0)
SULFUR (ppm)	3	1.6 (0.8-2.1)		ND
% IRON	9	0.18 (0.08-0.38)		ND
% ALUMINUM	9	0.35 (0.23-0.52)		ND

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
HOmc	Moderately cemented phase; a discontinuous moderately cemented pan occurs between 50 to 100 cm from the surface.

INFERRED SOIL PROPERTIES
HOLLINGS SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
HO	0-100	GW	A-1-a	NP	NP	Est. <0.1

KAPTARA SOILS (KP)

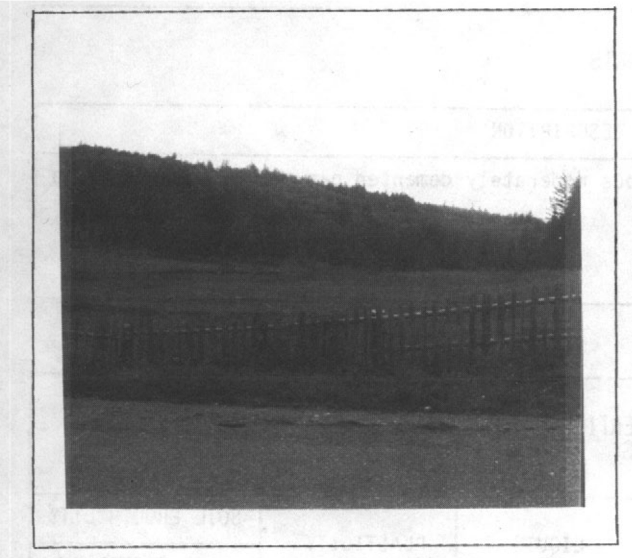


PLATE 4.21: KAPTARA SOIL LANDSCAPE

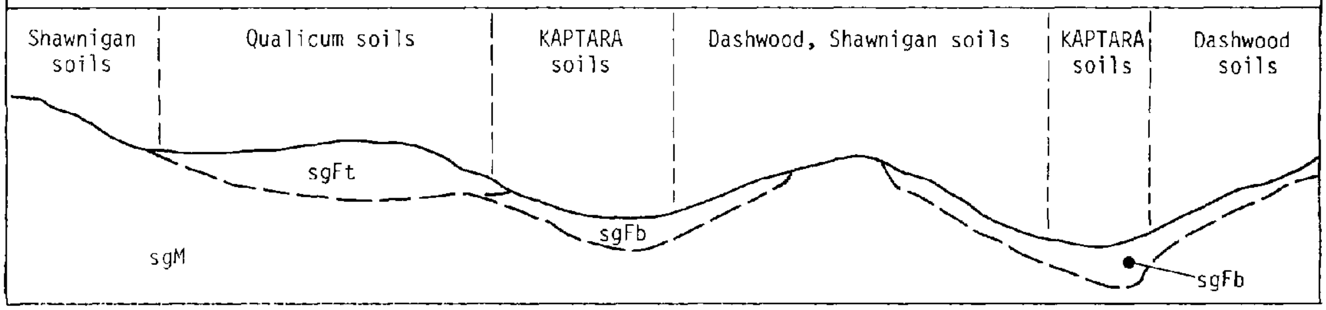
GENERAL COMMENTS

Kaptara soils (130 ha) have developed on deep, coarse-textured fluvial and fluvioglacial landforms. They also occur on coarse-textured marine deposits. Kaptara soils are very minor in extent and occur in small areas associated with more extensive areas of Qualicum and Quennel soils. These poorly drained soils normally occur in seepage locations or where an underlying impermeable layer restricts drainage and causes a perched water table.

Kaptara soils have dark, organic matter-enriched surfaces and very gravelly loamy sand textures. They are classified as **Orthic Humic Gleysols.**

Kaptara soils are marginal for agricultural uses and unsuitable for urban uses due to coarse-textures and wetness.

KAPTARA SOIL LANDSCAPE CROSS SECTION*



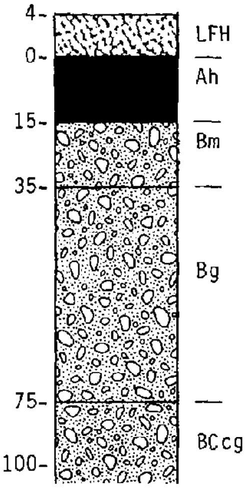
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL :	sandy gravelly fluvial, glaciofluvial or marine
TOPOGRAPHY :	0-15%; level to depressional
ELEVATION RANGE :	0-100 m asl
ASPECT :	all
FLOOD HAZARD :	rare
VEGETATION :	The native vegetation consists of red alder, maple, western red cedar, willow, including an understory dominated by moisture loving plants such as skunk cabbage.

TYPICAL KAPTARA SOIL PROFILE

DEPTH (cm)



LFH — Loose, non-compact litter; very strongly acid.

Ah — Very dark brown (10YR 2/2m) gravelly loamy sand; moderate, medium granular; very friable; very strongly acid.

Bm — Brown (7.5YR 4/4m) very gravelly loamy sand; weak, fine subangular blocky breaking to single-grained; very friable; very strongly acid.

Bg — Olive gray (5Y 4/2w) very gravelly loamy sand; common, medium prominent mottles; weak, medium subangular blocky breaking to single-grained; nonsticky.

BCcg — Olive gray (5Y 4/2w) very gravelly sand; common, medium prominent mottles; moderate, medium angular blocky breaking to single-grained; nonsticky; discontinuous moderate cementation.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 75-110
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 75-126; 20-30; moderately cemented horizon
ROOTING DEPTH (cm)	: 75
COARSE FRAGMENT CLASS	: 2-3
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 30-100+; perched
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly loamy sand

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-75	No. of Samples	75+
PERMEABILITY (CLASS)		very rapid		slow - moderate
BULK DENSITY (g/cm^3)	Est.	1.75	Est.	1.85
AWSC (cm/m)	Est.	11.0 (10.0-12.0)	Est.	2.4 (2.0-3.0)
AWSC (corr. for % CF) (cm/m)	Est.	5.0 (4.0-6.0)	Est.	1.0 (0.8-1.5)
% COARSE FRAGMENTS >7.5cm	3	5-15	3	10-20
% COARSE FRAGMENTS <7.5cm	3	45-65	3	50-70
% PASSING SIEVES # 4	Est.	45	Est.	50
% PASSING SIEVES # 40	Est.	25	Est.	20
% PASSING SIEVES #200	Est.	5	Est.	5
% SAND	Est.	75	Est.	85
% CLAY	Est.	5	Est.	3

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-75	No. of Samples	75+
SOIL REACTION (pH) 1:1 H_2O	1	5.7		
SOIL REACTION (pH) 1:2 $CaCl_2$	1	4.8		
CONDUCTIVITY mS/cm		N/A		
ORGANIC CARBON (%)	1	1.3		

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
KPg	Gravelly phase; the solum has a lower gravel content than usual (20 to 50%).
KPpt	Peaty phase; surface horizon(s) consist of 15 to 40 cm of humic or mesic organic materials. Occurs in seepage and/or depressional sites.

INFERRED SOIL PROPERTIES
KAPTARA SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
KP	0-100	GW	A-1-a	NP	NP	Est. 0.02

KOKSILAH SOILS (KH)

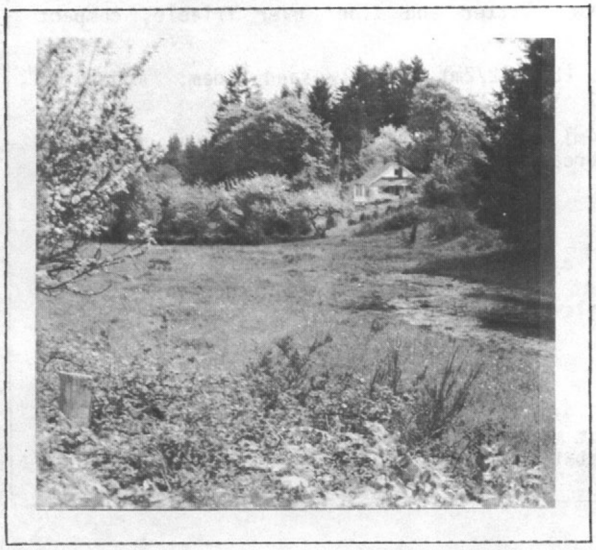


PLATE 4.22: KOKSILAH LANDSCAPE

GENERAL COMMENTS

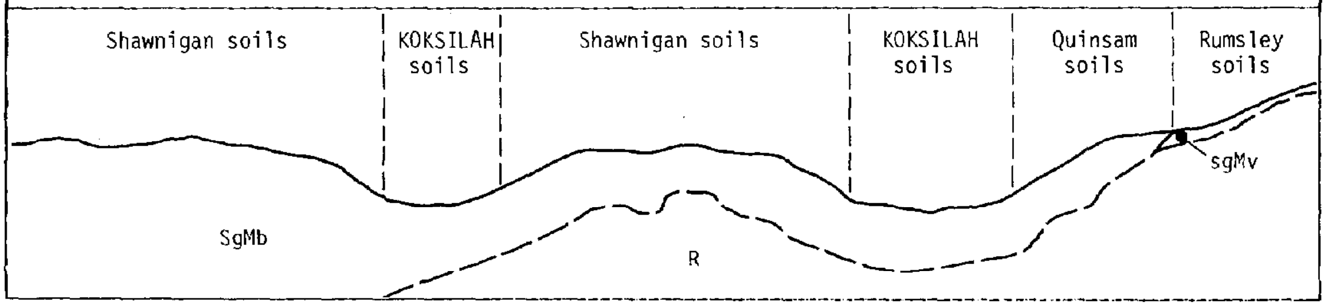
Koksilah soils (40 ha) occur in low-lying seepage receiving sites on coarse-textured morainal deposits. They are very limited in extent and are found in association with extensive areas of Shawnigan and Quinsam soils. They are poorly drained with a perched water-table for much of the year. They have developed in sandy gravelly morainal materials and are often very cobbly and stony.

Characteristically, they have an organic matter enriched surface horizon and gravelly to very gravelly sandy loam or loamy sand textures. They are classified as dominantly **Orthic Humic Gleysol**.

Koksilah soils are generally unsuitable for agriculture due to their coarse textures, poor drainage and distribution (ie. scattered across non-agricultural landscapes in small pockets).

Koksilah soils are also unsuitable for urban and related uses due to wetness.

KOKSILAH SOIL LANDSCAPE CROSS SECTION*



*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy gravelly morainal blanket
TOPOGRAPHY	:	less than 9%; level to gentle slopes
ELEVATION RANGE	:	100+ m asl
ASPECT	:	all
FLOOD HAZARD	:	rare
VEGETATION	:	The native vegetation consists of red alder, maple, western red cedar, and willow, including an understory dominated by moisture loving plants such as skunk cabbage.

TYPICAL KOKSILAH SOIL PROFILE

DEPTH (cm)

Depth (cm)	Horizon	Description
4-0	LFH	Loose, non-compact litter and fiber over friable, compact humus.
0-15	Ah	Very dark brown (10YR 2/2m) gravelly sandy loam; moderate, medium granular; very friable.
15-35	Bm	Brown (7.5YR 4/4m) very gravelly sandy loam; weak, fine subangular blocky breaking to single-grained; very friable.
35-75	Bg	Olive gray (5Y 4/2w) very gravelly sandy loam; common, medium, prominent mottles; weak medium subangular blocky breaking to single-grained; nonsticky.
75-100	BCcg	Olive gray (5Y 4/2w) very gravelly sandy loam; common, medium, prominent mottles; massive; very firm; non sticky; continuous cementation.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 75-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 75-125; 20-30; moderately cemented horizon
ROOTING DEPTH (cm)	: 75
COARSE FRAGMENT CLASS	: 2-3
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 30-100+; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly loamy sand

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-75	No. of Samples	75+
PERMEABILITY (CLASS)		very rapid		slow
BULK DENSITY (g/cm^3)	Est.	1.65	Est.	1.85
AWSC (cm/m)	Est.	15.0	Est.	12.5
AWSC (corr. for % CF) (cm/m)	Est.	8.0	Est.	5.6
% COARSE FRAGMENTS >7.5cm	Est.	5-15	Est.	5-15
% COARSE FRAGMENTS <7.5cm	Est.	40-55	Est.	45-50
% PASSING SIEVES # 4	Est.	60	Est.	60
% PASSING SIEVES # 40	Est.	40	Est.	40
% PASSING SIEVES #200	Est.	20	Est.	20
% SAND	Est.	60	Est.	60
% CLAY	Est.	8	Est.	6

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-75	No. of Samples	75+
SOIL REACTION (pH) 1:1 H_2O	Est.	5.7	Est.	5.8
SOIL REACTION (pH) 1:2 $CaCl_2$	Est.	5.1	Est.	5.1
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	Est.	1.3	Est.	0.3

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
KH	No phases or variants mapped.

INFERRED SOIL PROPERTIES KOKSILAH SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
KH	0-100	GM	A-1-b	NP	NP	0.1 - 0.25

KULLEET SOILS (KT)

PLATE 4.23: KULLEET SOIL LANDSCAPE

GENERAL COMMENTS

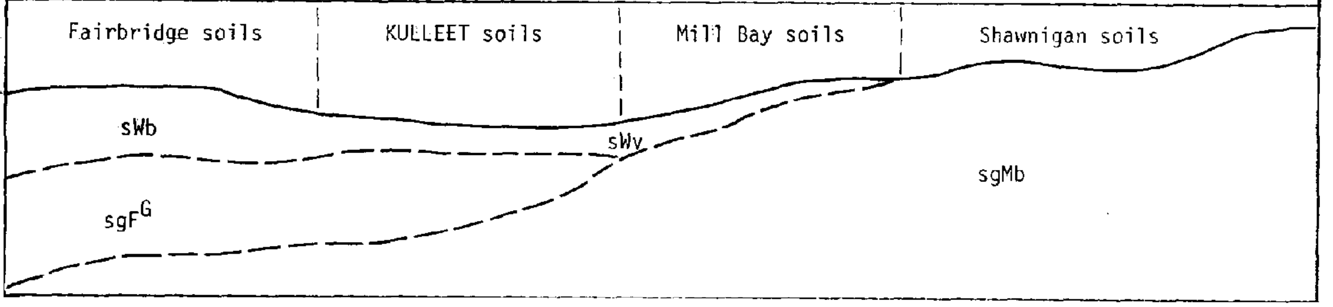
Kulleet soils (110 ha) occur below elevations of about 100 m on gently undulating marine landscapes. These soils have developed in silty marine parent materials which overlay coarse textured marine or fluvial deposits. Most Kulleet soils are found south of Duncan and are minor in extent. They are imperfectly drained.

The upper horizons are stone-free, silt loams or silty clay loam, contain many concretions and are mottled below 50 cm due to seasonal saturation from heavy winter rains. These are underlain by gravelly sandy loams or gravelly loamy sands. They are classified as **Gleyed Dystric Brunisols.**

Kulleet soils are suitable for a wide range of crops however supplemental irrigation and fertilization are required for optimal yields.

Kulleet soils are moderately suited for urban and related uses but have some restrictive features such as seasonal wetness.

KULLEET SOIL LANDSCAPE CROSS SECTION*



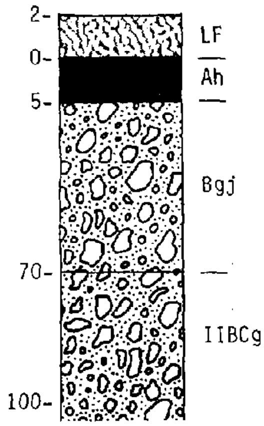
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	silty marine overlying sandy gravelly fluvial
TOPOGRAPHY	:	2-15%
ELEVATION RANGE	:	<100 m
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists of second growth Douglas-fir, grand fir, western red cedar, and red alder.

TYPICAL KULLEET SOIL PROFILE

DEPTH (cm)



LF: Loose, non-compact litter, strongly acid.

Ah: Very dark brown (10YR 2/2m) silt loam; weak, fine granular; loose; medium acid.

Bgj: Yellowish brown (10YR 5/6m) silt loam; common, medium, faint mottles; moderate, medium subangular blocky breaking to weak, fine subangular blocky; very friable; very strongly acid.

IIBCg: Light yellowish brown (10YR 6/4m) gravelly loamy sand; many medium prominant (7.5YR 5/8m) mottles; single-grain; very friable; very strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 70-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 70; abrupt texture change gravelly coarse texture
ROOTING DEPTH (cm)	: 70
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 70-100; seasonal perched
PERVIOUSNESS	: slow to moderate
SOIL DRAINAGE	: imperfect
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: silt loam, overlying gravelly sandy loam or gravelly loamy sand

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)			
		No. of Samples	0-70	No. of Samples	70-100
PERMEABILITY (CLASS)			moderate		moderate
BULK DENSITY (g/cm^3)		Est.	1.00 (0.09-1.20)	Est.	1.60
AWSC (cm/m)		Est.	20.0 (15.0-25.0)	Est.	8.0 (7.0-9.0)
AWSC (corr. for % CF) (cm/m)		Est.	18.0 (14.0-22.0)	Est.	3.0 (2.0-4.0)
% COARSE FRAGMENTS	>7.5cm	Est.	0	Est.	0-5
	<7.5cm	Est.	0-5	Est.	20-30
% PASSING SIEVES	# 4	Est.	100	Est.	100
	# 40	Est.	100	Est.	65
	#200	Est.	97	Est.	20
% SAND		Est.	30	Est.	80.0
% CLAY		Est.	20	Est.	10.0

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)			
		No. of Samples	0-70	No. of Samples	70-100
SOIL REACTION (pH)	1:1 H_2O	1	5.5	1	5.3
	1:2 $CaCl_2$	1	5.0	1	4.8
CONDUCTIVITY mS/cm			N/A		N/A
ORGANIC CARBON (%)		Est.	1.4	1	1.21
% IRON		Est.	0.20	1	0.38
% ALUMINUM		Est.	0.35	1	0.29

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
KT	No phases or variants mapped

INFERRED SOIL PROPERTIES KULLETT SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
KT	0-100	ML	A-4	40	10	Est. 0.5

MAPLE BAY SOILS (MY)

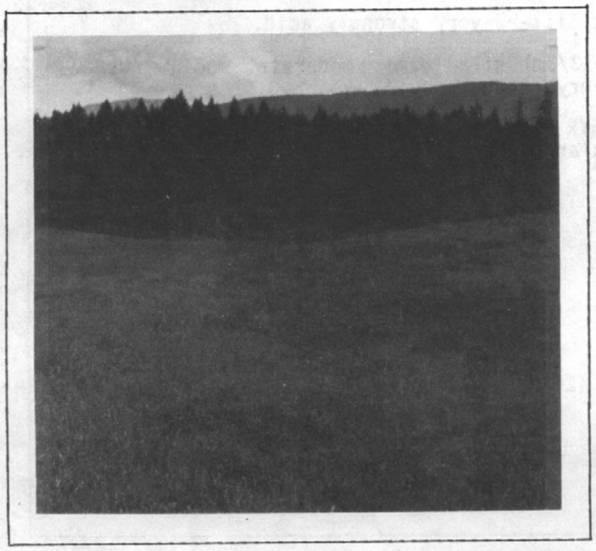


PLATE 4.24: MAPLE BAY SOIL LANDSCAPE

GENERAL COMMENTS

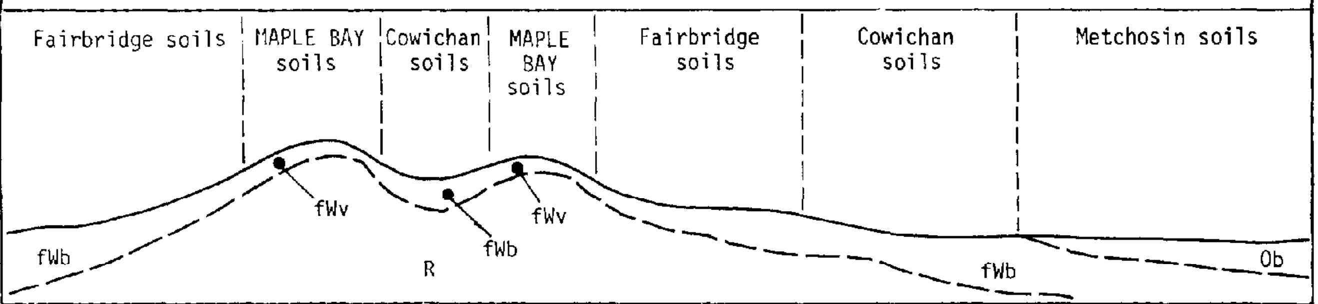
Maple Bay soils (265 ha) occur below elevations of about 100 m. They occupy very gentle to strong slopes within undulating landscapes and are usually associated with Fairbridge soils. The largest areas of these soils occurs north of Duncan, west of Maple Bay and south of Mount Richards. Maple Bay soils are well to moderately well drained. They have developed in shallow, silty marine sediments overlying shale, siltstone or claystone bedrock.

These soils have a thin dark brown organic matter-enriched silt loam surface horizon underlain by a brown to yellowish brown silt loam. These soils are classified as **Orthic Dystric Brunisol** lithic phase.

Maple Bay soils have slight to moderate limitations to agriculture and are suitable for a wide range of crops. Fast structure deterioration, erosion, crusting and puddling can result if the soil is cultuvated when wet. Supplemental irrigation is required for optimal yields. Although the proximity of the soft bedrock to the surface may interfere with cultivation, the main limitation is from topography.

Maple Bay soils are only moderately suited for urban and related uses due to shallow depth to bedrock.

MAPLE BAY SOIL LANDSCAPE CROSS SECTION*



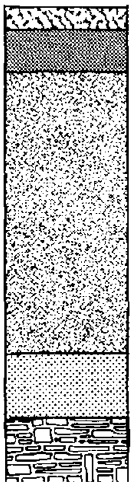
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	fine marine veneer over shale or siltstone bedrock
TOPOGRAPHY	:	5-30%; very gentle to strong slopes
ELEVATION RANGE	:	10-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists mainly of Douglas-fir with minor inclusions of grand fir, maple, red alder, and lodgepole pine. The understory is dominated by salal.

TYPICAL MAPLE BAY SOIL PROFILE

DEPTH (cm)



LF Loose non-compact litter, very strongly acid.

Ah Dark brown (10YR 3/3m) silt loam; moderate, medium grandular; friable; very strongly acid.

Bm Strong brown (7.5YR 4/6m) silt loam; weak to moderate, fine to medium subangular blocky; friable; extremely acid.

BC Yellowish brown (10YR 5/6m) silt loam; massive; firm; extremely acid.

R Shale or siltstone bedrock.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	:	40-70
HUMUS FORM	:	Mull
SOLUM DEPTH (cm)	:	40-70
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	:	40-70; bedrock
ROOTING DEPTH (cm)	:	40-70
COARSE FRAGMENT CLASS	:	0
DEPTH TO AND TYPE OF WATERTABLE (cm)	:	N/A
PERVIOUSNESS	:	moderate
SOIL DRAINAGE	:	well to moderately well
DEPTH TO SALTS (cm)	:	N/A
SOIL TEXTURE	:	silt loam

SOIL PHYSICAL PROPERTIES		No. of Samples	SOIL DEPTHS (cm) 0-70	No. of Samples	
PERMEABILITY (CLASS)			moderate		
BULK DENSITY (g/cm^3)		2	1.20		
AWSC (cm/m)		Est.	18.0		
AWSC (corr. for % CF) (cm/m)		Est.	18.0		
% COARSE FRAGMENTS	>7.5cm	Est.	0		
	<7.5cm	Est.	0-10		
% PASSING SIEVES	# 4	1	96.6		
	# 40	1	84.5		
	#200	1	74.1		
% SAND		6	24.2 (14.7-31.4)		
% CLAY		6	19.2 (13.9-25.8)		

SOIL CHEMICAL PROPERTIES		No. of Samples	SOIL DEPTHS (cm) 0-70	No. of Samples	
SOIL REACTION (pH)	1:1 H_2O	6	5.4 (5.2-5.5)		
	1:2 $CaCl_2$	6	4.4 (4.0-4.7)		
CONDUCTIVITY mS/cm			N/A		
ORGANIC CARBON (%)		6	1.5 (1.1-2.3)		
NITROGEN (%)		6	0.07 (0.03-0.11)		
EXCHANGE CAPACITY (meq/100g)		6	18.8 (17.5-19.7)		
EXCHANGEABLE CATIONS (meq/100g)	- Ca	6	2.9 (2.5-4.2)		
	- Mg	6	1.4 (0.7-2.4)		
	- Na	6	0.2 (0.1-0.2)		
	- K	6	0.3 (0.1-0.5)		
PHOSPHORUS (ppm)		6	28.5 (7.3-61.8)		
SULFUR (ppm)		6	0.5 (0.0-1.5)		
% IRON		5	0.37 (0.24-0.57)		
% ALUMINUM		5	0.41 (0.37-0.44)		

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
MYg	Gravelly phase; small localized areas of fine textured material which contains 20 to 50% coarse fragments.
MY13	Very shallow lithic phase; shale or siltstone bedrock occurs within 50 cm of the surface. This phase most frequently occurs on hill and ridge crests.

INFERRED SOIL PROPERTIES MAPLE BAY SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
MY	≤100	ML	A-4	36.0	8.8	0.4

METCHOSIN SOILS (MT)

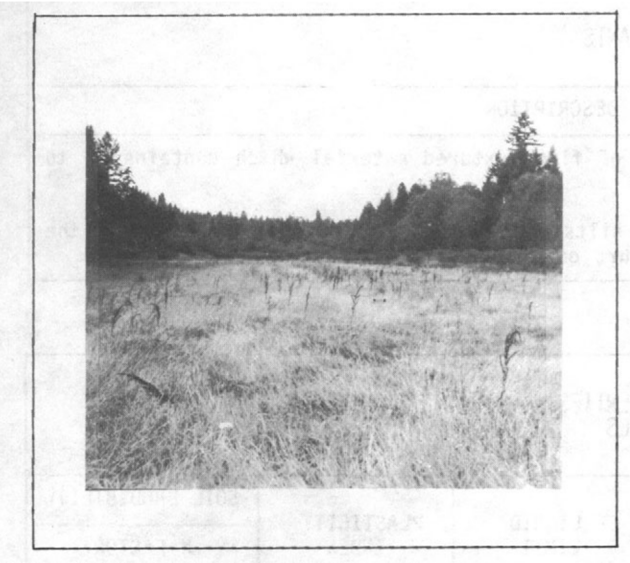


PLATE 4.25: METCHOSIN SOIL LANDSCAPE

GENERAL COMMENTS

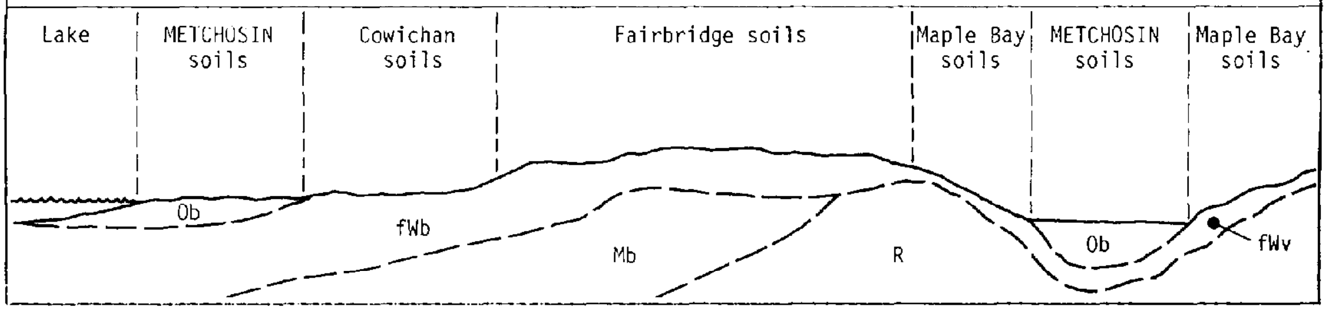
Metchosin soils (1415 ha) occur in very poorly drained depressional areas. They are moderately to rapidly pervious and have very high water holding capacity. The watertable is at or near the surface for most of the year but can drop considerably in the late summer and fall.

These organic soils are at an advanced stage of decomposition with dominantly dark brown to black humic material in the middle and bottom tiers. They are level to nearly level with greater than 160 cm depth to mineral materials and are classified as **Typic Humisols.**

With adequate watertable control and maintenance, Metchosin soils have good potential for a variety of agricultural crops such as vegetables, forages and blueberries. The watertable should be controlled at the highest level which permits good crop growth and field trafficability. The watertable should be raised close to the surface over the winter to prevent oxidation of organic matter and reduce the rate of subsidence. Deep draining will cause excessive subsidence.

Urban and related uses are not recommended. Very low bearing capacity and high watertables make road and building construction difficult and expensive. Septic tank effluent disposal is impractical due to high watertables.

METCHOSIN SOIL LANDSCAPE CROSS SECTION*



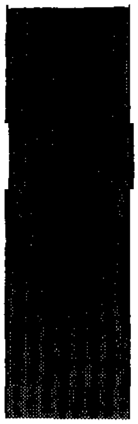
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	organic
TOPOGRAPHY	:	level to nearly level
ELEVATION RANGE	:	2-200 m
ASPECT	:	none
FLOOD HAZARD	:	may be expected
VEGETATION	:	Native vegetation includes a variety of water tolerant plants such as Labrador tea, hardhack, willow, skunk cabbage, sedges and reeds.

TYPICAL METCHOSIN SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
0-40	Oh_1	Black (10YR 2/1m) well decomposed organic material; moderate, fine granular; strongly acid.
40-	Oh_2	Black (10YR 2/1m) well decomposed organic material; strongly acid.
120-	Om	Partially decomposed organic material; extremely acid.
160-	Oh_3	Black (10YR 2/1m) well decomposed organic material; very strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: N/A
SOLUM DEPTH (cm)	: >160
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 20-50
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 25-100; apparent and perched
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: very poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: N/A

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)					
	No. of Samples	0-40	No. of Samples	40-120	No. of Samples	120-160
BULK DENSITY (g/cm^3)	2	0.35(0.25-0.55)	Est.	.30(0.20-0.45)	Est.	.30(0.20-0.45)
AWSC (cm/m)	Est.	15.0	Est.	15.0	Est.	15.0
TYPE OF ORGANIC MATERIAL		humic		humic		humic
RUBBED FIBRE CONTENT %	Est.	<10		<10		<10
von POST SCALE	2	8 (7-10)	2	8 (7-10)	Est.	8 (7-10)
PYROPHOSPHATE INDEX	Est.	1-3	2	1-3	Est.	1-3
% COARSE >7.5cm		0		0		0
FRAGMENTS <7.5cm		0		0		0

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)					
	No. of Samples	0-40	No. of Samples	40-120	No. of Samples	120-160
SOIL REACTION 1:1 H_2O	2	4.8 (4.0-5.6)	4	4.0-5.8	1	5.4
(pH) 1:2 $CaCl_2$	2	4.4 (3.4-5.3)	1	4.6	1	5.1
CONDUCTIVITY mS/cm		N/A		N/A	1	N/A
ORGANIC CARBON (%)	1	30.9	1	42.7	1	5.0
NITROGEN (%)	1	1.50	1	2.19	1	3.2
EXCHANGE CAPACITY (meq/100g)	1	112.0	1	159.0	1	90.0
EXCHANGEABLE CATIONS - Ca	1	47.36	1	60.0	1	40.0
(meq/100g) - Mg	1	5.30	1	7.0	1	7.0
- Na	1	0.48	1	0.2	1	0.2
- K	1	0.41	1	0.1	1	0.1
PHOSPHORUS (ppm) - available	1	13.8	3	6.0 (2.6-10.9)	1	4.0

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
MTso	Shallow organic variant; these soils have from 40 to 160 cm of organic material. They are classified as Terric Mesisol.
MTso,t	Shallow organic variant; taxadjunct variant. These soils have from 40 to 160 cm of organic material and more than 25 cm of mesic-type organic material. The classification is Terric Mesic Humisol.
MTt	Taxadjunct variant; this variant contains more than 25 cm of mesic-type organic material. The classification is Mesic Humisol.

INFERRED SOIL PROPERTIES
METCHOSIN SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
MT	0-160	Pt	-	-	-	-

MEXICANA SOILS (ME)

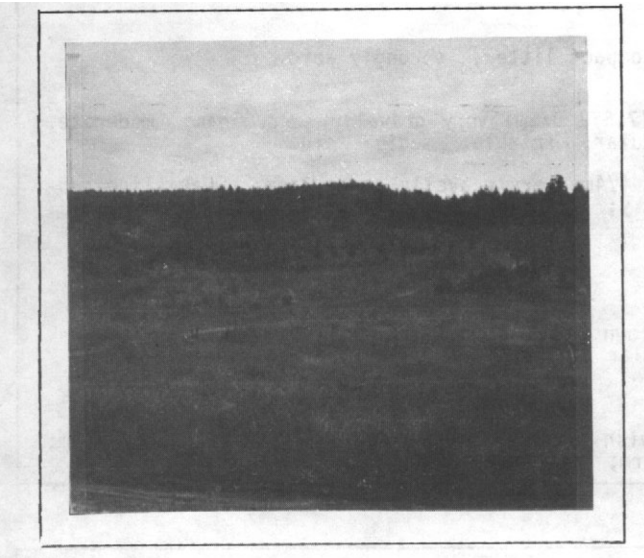


PLATE 4.26: MEXICANA SOIL LANDSCAPE

GENERAL COMMENTS

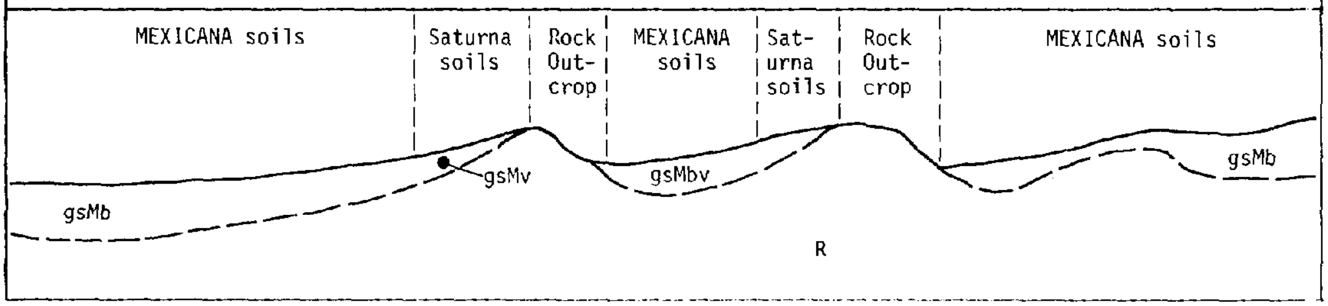
Mexicana soils (2615 ha) generally are found on nearly level to moderate slopes with underlying sedimentary bedrock. The most extensive occurances are in the Cedar - Yellow Point area. Mexicana soils have developed in gravelly, moderately coarse morainal materials which were partially derived from the underlying sedimentary bedrock as evidenced by the common occurrence of sandstone clasts.

These soils have brown friable gravelly sandy loam surface horizons overlying light brown massive gravelly sandy loam at about 100 cm depth. They are classified as **Orthic Dystric Brunisols with** minor occurrences of Orthic Humo-Ferric Podzols.

Mexicana soils are considered marginal for agricultural use due to stoniness and aridity. They often occur in small areas isolated by conglomerate or sandstone ridges which interfere with agricultural use. Most areas are presently under forest cover.

Mexicana soils are suitable for urban and related uses as bearing capacity is high and there are no wetness or flooding problems. Permeability is generally adequate for septic tank effluent disposal.

MEXICANA SOIL LANDSCAPE CROSS SECTION*

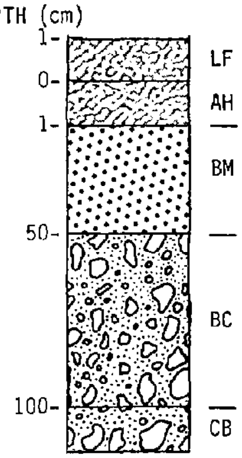


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL :	gravelly sandy morainal
TOPOGRAPHY :	2-15%; nearly level to moderate slopes
ELEVATION RANGE :	0-100 m asl
ASPECT :	all
FLOOD HAZARD :	no hazard
VEGETATION :	The native vegetation consists mainly of Douglas-fir with minor inclusions of lodgepole pine, western hemlock, and arbutus. The understory is dominated by salal.

TYPICAL MEXICANA SOIL PROFILE



LF — Loose, non-compact litter; strongly acid.

AH — Dark brown (7.5YR 3/2m) very gravelly sandy loam; moderate, medium grandular; friable; medium acid.

BM — Brown (7.5YR 4/4m) very gravelly sandy loam; weak, fine subangular blocky; friable; strongly acid.

BC — Yellowish brown (10YR 5/6m) very gravelly sandy loam; weak fine subangular blocky; firm; very strongly acid.

CB — Light yellowish brown (10YR 6/2m) very gravelly sandy loam; massive; firm; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 100-150
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: no restricting layer
ROOTING DEPTH (cm)	: 75-100
COARSE FRAGMENT CLASS	: 2-4
DEPTH TO AND TYPE OF WATERTABLE (cm)	: >100
PERVIOUSNESS	: moderate
SOIL DRAINAGE	: moderately well to well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: gravelly to very gravelly sandy loam, gravelly to very gravelly loamy sand

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-40	No. of Samples	40-100
PERMEABILITY (CLASS)		moderate to rapid		moderate to slow
BULK DENSITY (g/cm^3)	1	1.55	Est.	1.65
AWSC (cm/m)	2	13.2 (8.3-18.0)	2	17.1 (17.0-17.1)
AWSC (corr. for % CF) (cm/m)	2	6.1 (5.0-7.2)	2	9.2 (6.8-11.6)
% COARSE FRAGMENTS >7.5cm	2	5-10	2	5-10
% COARSE FRAGMENTS <7.5cm	2	40-60	2	40-60
% PASSING SIEVES # 4	1	70.6	2	81.1 (77.9-84.3)
% PASSING SIEVES # 40	1	53.2	2	61.9 (54.2-69.6)
% PASSING SIEVES #200	1	36.9	2	37.4 (26.2-48.5)
% SAND	9	54.3 (41.8-65.1)	6	46.8 (34.3-59.8)
% CLAY	9	9.7 (3.4-18.8)	6	8.9 (3.8-16.2)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-40	No. of Samples	40-100
SOIL REACTION (pH) 1:1 H_2O	4	6.1 (5.9-6.3)	3	5.8 (5.5-6.2)
SOIL REACTION (pH) 1:2 $CaCl_2$	13	5.2 (4.6-5.4)	5	4.8 (4.3-5.3)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	7	1.3 (1.0-1.6)	2	0.6 (0.5-0.8)
NITROGEN (%)	3	0.06 (0.06-0.07)	3	0.04 (0.02-0.05)
EXCHANGE CAPACITY (meq./100g)	3	15.5 (11.2-19.3)	3	16.7 (11.7-21.3)
EXCHANGEABLE CATIONS (meq./100g) - Ca	3	5.5 (4.5-6.5)	3	4.8 (3.3-6.7)
- Mg	3	0.9 (0.6-1.1)	3	1.8 (0.5-2.5)
- Na	3	0.2 (0.1-0.2)	3	0.2 (0.1-0.2)
- K	3	0.3 (0.2-0.4)	3	0.1 (0.1-0.2)
PHOSPHORUS (ppm)	2	4.6 (3.7-5.4)	1	4.6 (4.6)
SULFUR (ppm)		0.9 (0.6-1.2)	1	0.8 (0.8)
% IRON	13	0.26 (0.11-0.45)	1	0.21
% ALUMINUM	13	0.31 (0.21-0.43)	1	0.26

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
MEid	Imperfectly drained (wetter) variant (Gleyed Dystric Brunisol and Gleyed Humo-Ferric Podzol). Occurs on seepage sites usually on lower slopes.
MEvg	Very gravelly phase. The solum has higher than usual gravel content (>50%).

INFERRED SOIL PROPERTIES MEXICANA SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
ME	0-100	GM	A-2-4. A-4	29.0 (26.0-34.6)	6.2 (4.3-8.9)	<0.12

MILL BAY SOILS (MB)

PLATE 4.27: MILL BAY SOIL LANDSCAPE

GENERAL COMMENTS

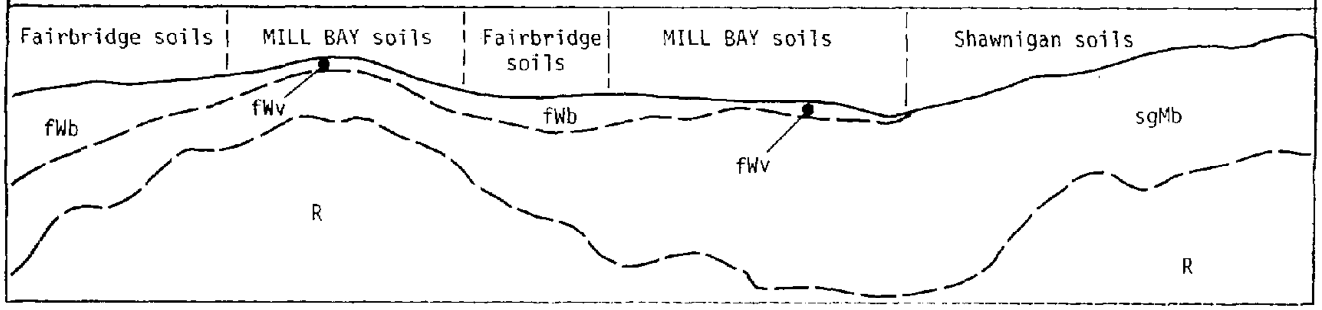
Mill Bay soils (1120 ha) occur between sea level and 100 m in elevation on gently undulating landscapes. They are common near Duncan but occur throughout the survey area. These soils are moderately well to imperfectly drained with a perched watertable during the winter. They have developed in stratified parent materials that consist of fine marine veneer overlying gravelly sandy moraine.

Mill Bay soils have stone-free, upper horizons that contain many concretions and have silt loam texture. These are underlain by a very gravelly sandy loam horizon that is moderately to strongly cemented. These soils are classified as **Duric Dystric Brunisols.**

Dairying and forage production are the predominant present land uses, however an increased range of crops is possible with supplemental irrigation and fertilization. A perched watertable during winter and the presence of a root restricting duric horizon will adversely affect some perennial crops. Soil structure deterioration, erosion, crusting and puddling can result if the soil is cultivated when wet.

Mill Bay soils have moderate to high bearing strengths, however, septic tank effluent disposal is impeded by cemented subsoils.

MILL BAY SOIL LANDSCAPE CROSS SECTION*



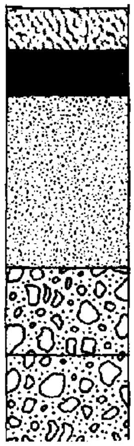
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	fine marine veneer over gravelly sandy moraine
TOPOGRAPHY	:	1-15% slopes, often gently undulating; level to moderate slopes
ELEVATION RANGE	:	0-100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	Native vegetation consists mainly of stands of second growth Douglas-fir associated with grand fir, western red cedar, red alder and occasional western hemlock. The understory consists of a variety of shrubs usually dominated by salal.

TYPICAL MILL BAY SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
2-	LF	Loose, non-compact litter and fiber, strongly acid.
0-	Ah	Very dark grayish brown (10YR 3/2m) silt loam; weak, fine granular; loose; medium acid.
4-	Bm	Yellowish brown (10YR 5/6m) silt loam; moderate, medium subangular blocky breaking to weak, fine subangular blocky; very friable; very strongly acid.
75-	IIBCc	Grayish brown (2.5Y 5/2m) very gravelly sandy loam; massive; extremely firm; strong cementation; strongly acid.
100-	IICB	Light brownish gray (2.5Y 6/2m); very gravelly sandy loam; massive; firm; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull, Moder
SOLUM DEPTH (cm)	: 100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 50-100; 5-25 cm; duric horizon
ROOTING DEPTH (cm)	: 50-100
COARSE FRAGMENT CLASS	: 0-1 above morainal contact; 3-4 in morainal material
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 75-100; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: moderately well to imperfect
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: silt loam over gravelly sandy loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-60	No. of Samples	60+
PERMEABILITY (CLASS)		moderate		slow - moderate
BULK DENSITY (g/cm³)	2	1.0 (0.9-1.1)	2	1.7 (1.4-1.9)
AWSC (cm/m)	4	18.7 (13.6-22.4)	2	8.0 (7.9-8.0)
AWSC (corr. for % CF) (cm/m)	4	16.9 (11.4-20.1)	2	3.3 (1.8-4.8)
% COARSE FRAGMENTS >7.5cm	2	0	Est.	5-10
% COARSE FRAGMENTS <7.5cm	2	0-10	Est.	40-55
% PASSING SIEVES # 4	1	92.1	2	52.9 (33.9-71.9)
% PASSING SIEVES # 40	1	77.7	2	32.7 (16.7-48.6)
% PASSING SIEVES #200	1	64.8	2	14.6 (12.7-16.4)
% SAND	10	24.2 (17.4-34.2)	5	55.0 (35.0-75.3)
% CLAY	10	17.2 (8.9-26.7)	7	16.5 (12.5-22.1)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-60	No. of Samples	60+
SOIL REACTION (pH) 1:1 H_2O	6	5.4 (4.9-6.0)	6	5.6 (5.2-5.9)
SOIL REACTION (pH) 1:2 $CaCl_2$	12	4.8 (4.2-5.3)	10	4.8 (4.4-5.7)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	9	1.7 (0.2-3.3)	6	0.4 (0.2-0.5)
NITROGEN (%)	6	0.06 (0.03-0.09)	4	0.02 (0.01-0.03)
EXCHANGE CAPACITY (meq/100g)	6	19.1 (14.4-24.1)	6	12.2 (4.0-18.8)
EXCHANGEABLE CATIONS (meq/100g) - Ca	5	2.2 (0.9-3.1)	7	4.2 (0.2-7.3)
- Mg	5	0.6 (0.5-1.0)	7	1.4 (0.01-2.6)
- Na	6	0.2 (0.1-0.3)	7	0.1 (0.1-0.2)
- K	6	0.3 (0.1-0.5)	7	0.2 (0.02-0.3)
PHOSPHORUS (ppm)	6	36.0 (6.1-110.0)	6	35.1 (12.1-77.5)
SULFUR (ppm)	5	0.5 (0.2-0.8)	6	3.3 (0.9-5.2)
% IRON	5	0.37 (0.25-0.62)		ND
% ALUMINUM	5	0.57 (0.32-0.68)		ND

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
MBg	Gravelly phase; surface veneer of fine marine deposits contain 20 to 50% coarse fragments.
MBg,pd	Gravelly phase and poorly drained variant; seepage areas; occurs in very small localized units and is insignificant in extent.
MBwc	Weakly cemented variant (Orthic Dystric Brunisol or Orthic Humo-Ferric Podzol instead of Duric Dystric Brunisol or Duric Humo-Ferric Podzol). The cemented horizon at upper boundary of morainal deposit is not sufficiently cemented to meet the criteria of a duric horizon.

INFERRED SOIL PROPERTIES MILL BAY SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
MB	0-60	ML	A-4	38.2	10.0 (8.9-11.2)	0.4 - 0.5
	60-100	GM	A-2-4	NP	ND	<0.1

PARKSVILLE SOILS (PA)

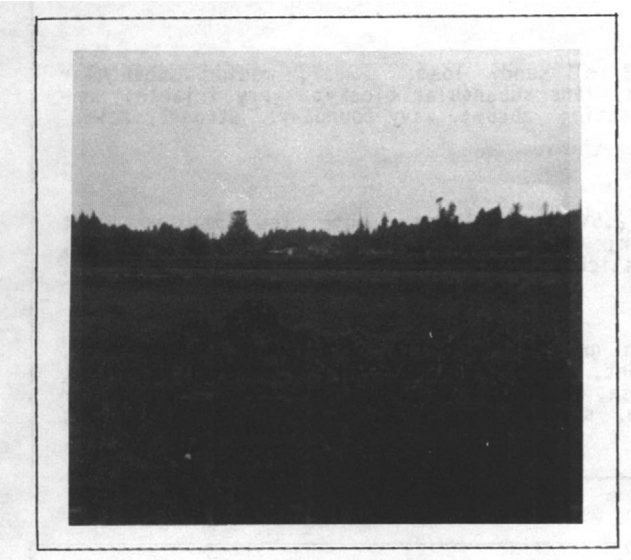


PLATE 4.28: PARKSVILLE SOIL LANDSCAPE

GENERAL COMMENTS

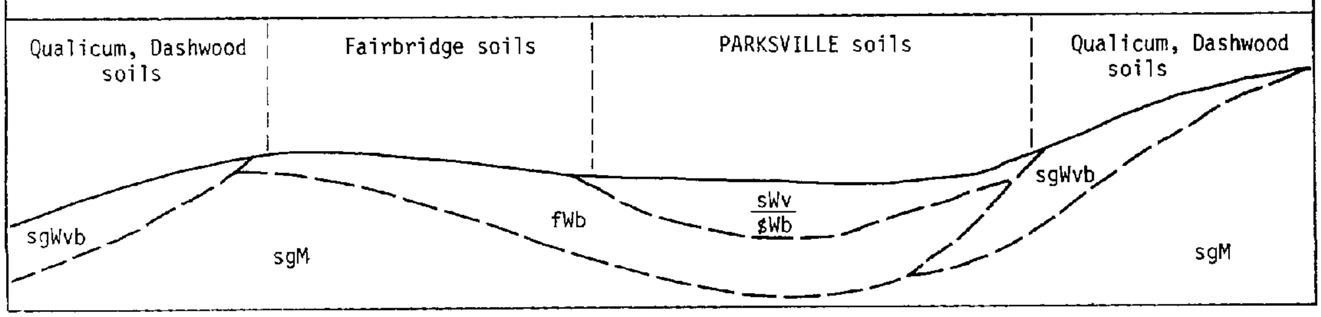
Parksville soils (340 ha) are minor in extent and are found on level to depressional sites on marine landscapes in association with Cowichan and Fairbridge soils. They are poorly drained with seasonal perched watertables at 15 to 100 cm depth. They have developed in non-stony, sandy fluvial or sandy marine veneers that are underlain by fine marine material. Parksville soils are distinguished from Tolmie soils by a thicker (>30 cm) sandy veneer.

Characteristically they have a dark brown or black organic matter-enriched surface horizon which grades into a light brown to grey, prominantly mottled silty loam to silty clay at depths below 40 cm. These soils are classified as **Orthic Humic Gleysols.**

Present land use is mainly hay and pasture as spring planting of other crops is often impractical due to wet soil conditions. With irrigation and drainage Parksville soils can be used for growing a wide range of crops.

Urban and related uses are not recommended due to winter ponding.

PARKSVILLE SOIL LANDSCAPE CROSS SECTION*



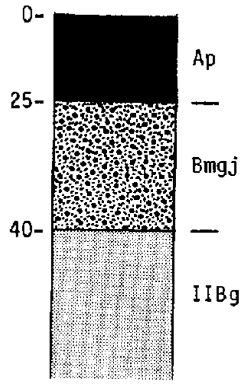
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy marine or fluvial veneer overlying fine marine
TOPOGRAPHY	:	level to very slightly sloping
ELEVATION RANGE	:	less than 100 m asl
ASPECT	:	none
FLOOD HAZARD	:	rare
VEGETATION	:	The native vegetation consists of red alder, willow, maple, and western red cedar, including an understory of moisture loving plants such as skunk cabbage.

TYPICAL PARKSVILLE SOIL PROFILE

DEPTH (cm)



Ap - Black (10YR 2/1m) sandy loam; weak, medium subangular blocky to weak, fine subangular blocky; very friable, non-sticky, non-plastic; abrupt, wavy boundary; strongly acid.

Bm - Olive brown (2.5Y 4/4m) loamy sand; few, medium, faint mottles; weak, coarse subangular blocky to single-grain; friable, non-sticky, non-plastic; abrupt, wavy boundary; medium acid.

IIBg - Light brownish gray (2.5Y 6/2m) silty clay loam; many, medium prominant, brownish yellow (10YR6/8) mottles; weak, medium to coarse, subangular blocky to weak, fine, subangular blocky; firm, sticky, plastic; gradual, wavy boundary; slightly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: >150
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 60-100; compact lower horizons
ROOTING DEPTH (cm)	: <70
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 15-100; seasonal perched
PERVIOUSNESS	: slow to moderate
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: sandy loam or loamy sand over silt loam

SOIL PHYSICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-40	No. of Samples	40-100
PERMEABILITY (CLASS)		moderate		slow
BULK DENSITY (g/cm^3)	2	1.2 (1.05-1.43)	1	1.7
AWSC (cm/m)	2	9.2 (4.3-14.1)	1	23
AWSC (corr. for % CF) (cm/m)	2	9.2 (4.3-14.1)	1	23
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0-5	Est.	0
% PASSING SIEVES # 4	1	97.0	1	99.8
% PASSING SIEVES # 40	1	79.9	1	94.4
% PASSING SIEVES #200	1	3.3	1	79.3
% SAND	2	73.1 (57.9-88.2)	5	19.2 (6.7-51.7)
% CLAY	2	4.8 (1.6-7.9)	5	27.6 (11.5-38.0)

SOIL CHEMICAL PROPERTIES		SOIL DEPTHS (cm)		
	No. of Samples	0-40	No. of Samples	40-100
SOIL REACTION (pH) 1:1 H_2O	2	5.9 (5.9)	5	6.6 (6.1-6.9)
SOIL REACTION (pH) 1:2 $CaCl_2$	2	5.1 (5.1-5.2)	6	5.9 (5.4-6.3)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	1	0.5 (0.5)	4	0.2 (0.1-0.6)
NITROGEN (%)	2	0.09 (0.03-0.15)	4	0.02 (0.01-0.05)
EXCHANGE CAPACITY (meq/100g)	2	13.3 (8.1-18.5)	5	14.0 (7.3-22.5)
EXCHANGEABLE CATIONS (meq/100g) - Ca	2	3.7 (1.3-6.3)	5	7.7 (3.9-12.6)
- Mg	2	0.7 (0.2-1.2)	5	3.7 (1.6-7.1)
- Na	2	0.1 (0.1-0.2)	5	0.3 (0.2-0.4)
- K	2	0.1 (0.1)	5	0.1 (0.1-0.2)
PHOSPHORUS (ppm)	2	19.7 (9.6-29.7)	5	7.6 (4.7-13.7)
SULFUR (ppm)	2	0.5 (0.1-0.8)	5	0.1 (0.0-0.6)
% IRON	2	0.37 (0.23-0.51)	1	0.41
% ALUMINUM	2	0.34 (0.27-0.40)	1	0.21

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
PAg	Gravelly phase; coarse textured surface veneer contains 20 to 50% gravel.
PApt	Peaty phase; surface horizon(s) consist of 15 to 40 cm of humic or mesic organic materials. Very poorly drained.

INFERRED SOIL PROPERTIES
PARKSVILLE SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
PA	0-40	SW	A-3	NP	NP	0.2
	40-100	ML-CL	A-6	34.6	13.8	0.6

QUALICUM SOILS (QU)

PLATE 4.29: QUALICUM SOIL LANDSCAPE

GENERAL COMMENTS

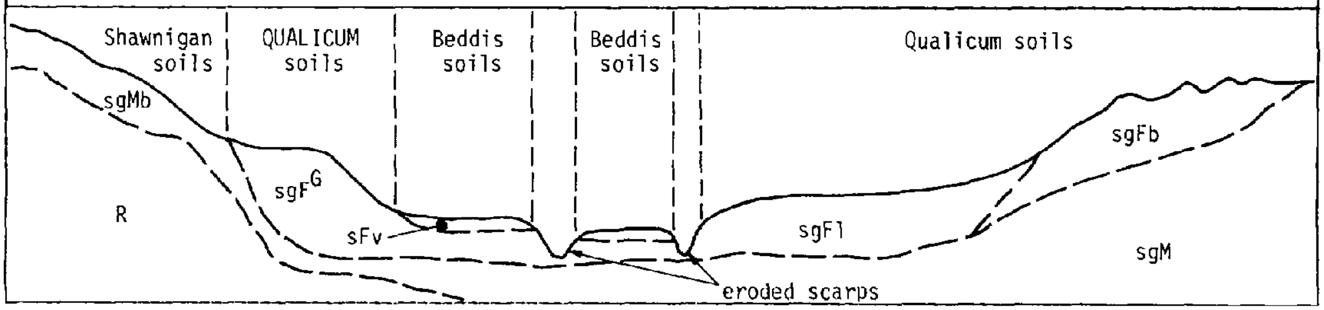
Qualicum soils (8360 ha) have developed on deep coarse-textured **fluvial** and **fluvioglacial** deposits associated with all major streams and rivers in the survey area. They also occur on deep, coarse-textured marine deposits. Qualicum soils are rapidly drained, rapidly permeable, and generally do not have a water-table within 3 m of the surface. Many of these deep glacial outwash deposits provide good aquifer potential as evidenced by numerous springs and seepage areas along their escarpments.

Qualicum soils have very gravelly loamy sand textures with discontinuous weakly cemented horizons sometimes present at 60 cm to 100 cm depth. They are classified as **Orthic Dystric Brunisols** with minor inclusions of Orthic Humo-Ferric Podzols.

Qualicum soils vary from marginal to unsuitable for agriculture. The high coarse fragment content and sandy textures result in aridity, stoniness and fertility limitations.

Urban and related uses are recommended where care is taken to avoid contamination of the groundwater which could occur due to incomplete filtration of septic tank effluent by the coarse-textured soil and parent material. Gravelly and loam phases are more suitable for septic tank effluent disposal. Areas where Qualicum soils occur generally have economically significant gravel deposits.

QUALICUM SOIL LANDSCAPE CROSS SECTION*



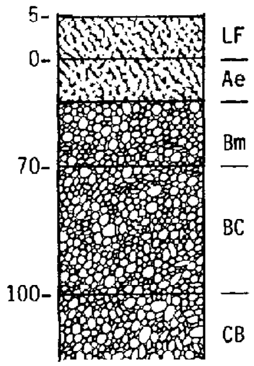
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL :	sandy gravelly fluvial, glaciofluvial, or marine blanket
TOPOGRAPHY :	0-40% (terraced, hummocky, ridged, subdued)
ELEVATION RANGE :	20-100 m asl
ASPECT :	all
FLOOD HAZARD :	no hazard
VEGETATION :	The native vegetation consists mainly of Douglas-fir and lodgepole pine with minor inclusions of western hemlock, grand fir, and arbutus. The understory is dominated by salal.

TYPICAL QUALICUM SOIL PROFILE

DEPTH (cm)



Horizon	Description
LF	Loose, non-compact litter over loose compact fiber; strongly acid.
Ae	Pale brown (10YR 6/3) very gravelly loamy sand; weak, medium subangular blocky; loose; non-plastic; strongly acid.
Bm	Dark yellowish brown (10YR 4/4m) very gravelly loamy sand; weak, fine to medium subangular blocky; very friable; strongly acid.
BC	Light yellowish brown (10YR 6/4m) very gravelly sand; massive; firm; weakly cemented; strongly acid.
CB	Grayish brown (10YR 5/2m) very gravelly sand; single-grain; loose; very strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	:	N/A
HUMUS FORM	:	Mor
SOLUM DEPTH (cm)	:	100+
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	:	50-100; discontinuous weakly cemented horizon
ROOTING DEPTH (cm)	:	40-100+
COARSE FRAGMENT CLASS	:	3-4
DEPTH TO AND TYPE OF WATERTABLE (cm)	:	N/A
PERVIOUSNESS	:	rapid
SOIL DRAINAGE	:	rapid
DEPTH TO SALTS (cm)	:	N/A
SOIL TEXTURE	:	very gravelly sand, very gravelly loamy sand, very gravelly sandy loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-60	No. of Samples	60-100
PERMEABILITY (CLASS)		rapid - very rapid		rapid - very rapid
BULK DENSITY (g/cm^3)	1	1.5 (1.3-1.7)	1	1.9 (1.7-2.1)
AWSC (cm/m)	1	11.0 (10.0-12.0)	1	8.0
AWSC (corr. for % C.F.) (cm/m)	1	5.0 (4.0-6.0)	1	3.0
% COARSE FRAGMENTS >7.5cm	2	5-15	2	10-20
% COARSE FRAGMENTS <7.5cm	2	45-65	2	50-70
% PASSING SIEVES # 4	3	52.6 (43.3-60.1)	3	58.2 (36.3-77.2)
% PASSING SIEVES # 40	3	24.8 (14.6-35.3)	3	36.9 (10.2-54.9)
% PASSING SIEVES #200	3	6.0 (1.4-13.8)	3	23.1 (1.0-30.7)
% SAND	17	77.3 (45.2-86.4)	4	90.5 (77.7-95.6)
% CLAY	17	7.7 (1.0-15.5)	4	2.4 (0.3-6.6)

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-60	No. of Samples	60-100
SOIL REACTION (pH) 1:1 H_2O	14	5.9 (4.6-6.4)	13	5.9 (5.4-6.5)
SOIL REACTION (pH) 1:2 $CaCl_2$	40	5.2 (4.5-5.9)	17	5.4 (4.9-6.0)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	26	1.9 (0.3-1.9)	10	0.2 (0.1-0.5)
NITROGEN (%)	10	0.03 (0.01-0.07)	7	0.01 (0.01-0.02)
EXCHANGE CAPACITY (meq/100g)	11	6.5 (3.8-11.1)	6	6.9 (3.9-9.6)
EXCHANGEABLE CATIONS (meq/100g) - Ca	10	1.1 (0.1-3.11)	13	1.0 (0.3-3.2)
- Mg	11	0.1 (0.1-0.2)	12	0.2 (0.1-0.8)
- Na	11	0.1 (0.1-0.2)	13	0.1 (0.1-0.2)
- K	11	0.1 (0.1-0.5)	13	0.1 (0.1-0.5)
PHOSPHORUS (ppm)	6	90.4 (29.4-137.8)	7	71.7 (32.7-117.3)
SULFUR (ppm)	5	2.4 (0.3-3.8)	3	16.0 (10.9-20.6)
% IRON	29	0.17 (0.01-0.35)	3	0.10 (0.06-0.16)
% ALUMINUM	19	0.31 (0.17-0.76)	3	0.16 (0.12-0.21)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
QUco	Cobbly phase; the upper horizons contain >20% by volume cobbles and/or stones.
QUg	Gravelly phase; the upper horizons contain between 20 and 50% coarse fragments by volume. The usual condition of this soils is coarse fragment contents in excess of 50%.
QUid	Imperfectly drained variant; occurs in seepage sites where drainage is restricted. Soil classification is Gleyed Dystric Brunisol.
QUlo	Loamy phase; loam textured surface 20 to 50 cm thick.
QUmc	Duric variant; moderate to strong cementation occurs in the subsoil. Soil classification is Duric Dystric Brunisol.
QUg,id	Imperfectly drained variant; gravelly phase; occurs in seepage sites where drainage is restricted. Soil classification is Gleyed Dystric Brunisol.
QUg,lo	Loamy variant, gravelly phase; loam textured surface 20 to 50 cm thick and the upper horizons contains between 20 and 50% coarse fragments by volume.
QUg,mc	Duric variant, gravelly phase; moderate to strong cementation occurs in the subsoil and the upper horizons contain between 20 and 50% coarse fragments by volume.

INFERRED SOIL PROPERTIES
QUALICUM SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
QU	0-100	GW	A-1-a	NP	NP	0.03

QUENNELL SOILS (QL)

PLATE 4.30: QUENNELL SOIL LANDSCAPE

GENERAL COMMENTS

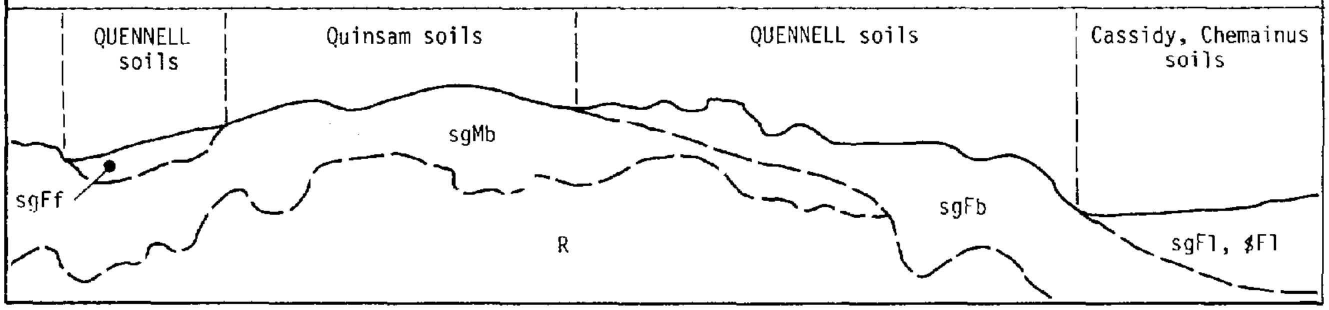
Quennell soils (280 ha) have developed on deep, coarse-textured fluvial and fluvioglacial deposits associated with all major streams and rivers in the survey area. They also occur on coarse-textured marine deposits. Quennell soils are rapidly drained, rapidly permeable, and generally do not have a watertable within 3 m of the surface. Many of these deep glacial outwash deposits provide good aquifer potential as evidenced by numerous springs and seepage areas along their escarpments.

Characteristically, Quennell soils have very gravelly loamy sand textures with discontinuous weakly cemented horizons sometimes present at 60 cm to 100 cm depth. They are classified as **Orthic Humo-Ferric Podzols.**

Quennell soils vary from marginal to unsuitable for agriculture. The high coarse fragment content and sandy textures result in aridity, stoniness and fertility limitations.

Urban and related uses are recommended where care is taken to avoid contamination of the groundwater which could occur due to incomplete filtration of septic tank effluent by the coarse-textured soil and parent material. Gravelly and loam phases are more suitable for septic tank effluent disposal. Areas where these soils occur generally have economically significant gravel deposits.

QUENNELL SOIL LANDSCAPE CROSS SECTION*



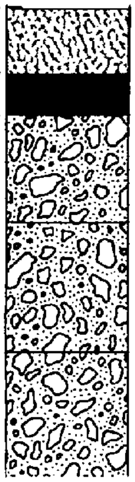
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	gravelly sandy fluvial or glaciofluvial
TOPOGRAPHY	:	0-40% (terraced, hummocky, subdued); very gentle slopes with minor areas of very strong slopes
ELEVATION RANGE	:	100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists mainly of Douglas-fir with minor inclusions of lodgepole pine and western hemlock. The understory is dominated by salal.

TYPICAL QUENNELL SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
5-0	LF	Loose, non-compact litter over loose compact fiber; strongly acid.
0-3	Ae	Light brownish grey (10YR 6/2m) very gravelly loamy sand; weak, medium subangular blocky to single-grained; friable; strongly acid.
3-53	Bf	Strong brown (7.5YR 4/6m) very gravelly loamy sand; weak, fine, subangular blocky to single-grained; soft, very friable; clear, wavy boundary; medium acid.
53-100	Bm	Grayish brown (10YR 5/2m) very gravelly sand; weak, fine, subangular blocky to single-grained; soft, very friable; medium acid.
100-	BC	Very dark grayish brown (2.5YR 3/2m) very gravelly sand, massive to single-grained; non sticky, non plastic; discontinuous weak cementation; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 100+
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 100; 25; discontinuous weakly cemented layer
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 3-5
DEPTH TO AND TYPE OF WATERTABLE (cm)	: >300
PERVIOUSNESS	: rapid
SOIL DRAINAGE	: rapid
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly sand, very gravelly loamy sand, very gravelly sandy loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		rapid to very rapid		rapid to very rapid
BULK DENSITY (g/cm^3)	1	1.5	Est.	1.9
AWSC (cm/m)	1	11.0 (10.0-12.0)	Est.	8.0
AWSC (coor. for % C.F.) (cm/m)	1	5.0 (4.0-6.0)	Est.	3.0
% COARSE FRAGMENTS >7.5cm	Est.	5-15	Est.	10-20
% COARSE FRAGMENTS <7.5cm	Est.	45-65	Est.	60-70
% PASSING SIEVES # 4		ND	1	36.2
% PASSING SIEVES # 40		ND	1	11.6
% PASSING SIEVES #200		ND	1	1.7
% SAND	16	74.8 (51.8-93.7)	4	90.0 (86.4-93.7)
% CLAY	16	7.0 (2.4-13.4)	4	3.2 (0.3-6.3)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	6	5.7 (5.3-5.9)	2	5.7 (5.6-5.8)
SOIL REACTION (pH) 1:2 $CaCl_2$	23	5.0 (4.1-5.4)	5	5.2 (5.0-5.3)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	19	1.6 (0.7-3.4)	1	0.3
NITROGEN (%)	4	0.04 (0.02-0.06)	2	0.02 (0.01-0.04)
EXCHANGE CAPACITY (meq/100g)	4	12.3 (7.3-15.1)	1	4.5
EXCHANGEABLE CATIONS (meq/100g) - Ca	4	1.2 (0.7-1.6)	1	0.2
- Mg	4	0.1 (0.1-0.2)	1	0.0
- Na	4	0.1 (0.1)	1	0.1
- K	4	0.1 (0.1-0.2)	1	0.0
PHOSPHORUS (ppm)	3	90.0 (71-150)	2	73.0 (53.9-92.1)
SULFUR (ppm)	2	5.6 (5.1-6.0)	1	5.7
% IRON	23	0.35 (0.09-0.69)	1	0.08
% ALUMINUM	23	0.53 (0.21-1.07)	1	0.35

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
QLg	Gravelly phase; the upper horizons contain between 20 and 50% coarse fragments by volume; the usual condition of this soil is coarse fragment contents in excess of 50%.
QLmc	Duric variant; moderate to strong cementation occurs in lower subsoil. Soil classification is Duric Humo-Ferric Podzol.

INFERRED SOIL PROPERTIES
QUENNELL SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
QL	0-100	GW	A-1-a	NP	NP	0.03

QUINSAM SOILS (QN)

PLATE 4.31: QUINSAM SOIL LANDSCAPE

GENERAL COMMENTS

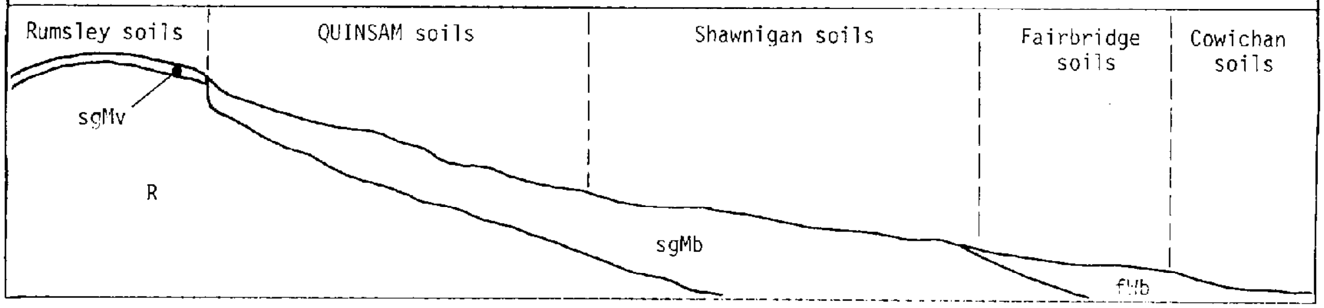
Quinsam soils (3245 ha) occur on gentle to very strong slopes near or above 100 m elevation. The most extensive areas occur at higher elevations along the western edge of the survey area where they are associated with Shawnigan soils and shallow soils over bedrock such as Rumsley or Saturna. They are moderately well drained with some lateral water movement during rainy periods. They have developed in sandy gravelly morainal materials and are often very stony.

The upper horizons are strong brown, very friable and have gravelly sandy loam textures. These grade into a mottled and strongly cemented horizon at 70 to 100 cm depth. Quinsam soils are classified as **Duric Humo-Ferric Podzols.**

Most Quinsam soils are under forest cover but some have been converted into pasture and hay production. Low fertility, aridity, stoniness and some steep slopes are the main restrictions to agricultural use. Where climate and aspect are suitable these soils have potential for tree fruit and grape production.

Quinsam soils have high bearing strengths but septic tank effluent disposal is impeded by the cemented subsoils.

QUINSAM SOIL LANDSCAPE CROSS SECTION*

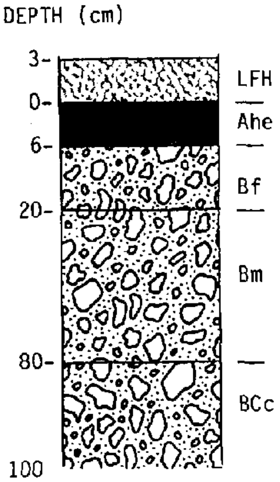


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	: sandy gravelly morainal blanket
TOPOGRAPHY	: 5-40%; gentle to very strong slopes
ELEVATION RANGE	: 100+ m asl
ASPECT	: all
FLOOD HAZARD	: no hazard
VEGETATION	: The native vegetation consists mainly of Douglas-fir, western hemlock, western red cedar, alder, with an understory dominated by salal.

TYPICAL QUINSAM SOIL PROFILE



Loose, non-compact litter over compact friable humus; very strongly acid.

Dark brown (10YR 3/3m) very gravelly sandy loam; very strongly acid.

Strong brown (7.5YR 4/6m) very gravelly sandy loam; weak, fine subangular blocky; very friable; very strongly acid.

Strong brown (7.54YR 5/6m) very gravelly sandy loam; weak, fine subangular blocky; very friable; strongly acid.

Light yellowish brown (2.5Y 6/4m) gravelly to very gravelly sandy loam; common, medium distinct mottles; massive; extremely firm; strongly cemented; strongly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 100+
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 70-120, 10-60; duric horizon
ROOTING DEPTH (cm)	: 70-90
COARSE FRAGMENT CLASS	: 3-5
DEPTH TO AND TYPE OF WATERTABLE (cm)	: >100
PERVIOUSNESS	: slow
SOIL DRAINAGE	: moderately well to well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly sandy loam; very gravelly loamy sand

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-70	No. of Samples	70-100
PERMEABILITY (CLASS)		moderate		slow
BULK DENSITY (g/cm^3)	1	1.7	Est.	2.0
AWSC (cm/m)	Est.	15.0	Est.	12.5
AWSC (corr. for % CF) (cm/m)	1	7.7	Est.	5.6
% COARSE FRAGMENTS >7.5cm	3	5-15	3	5-15
% COARSE FRAGMENTS <7.5cm	3	40-55	3	45-50
% PASSING SIEVES # 4	1	58.7	1	53.6
% PASSING SIEVES # 40	1	33.7	1	16.2
% PASSING SIEVES #200	1	20.7	1	7.4
% SAND	22	53.9 (30.6-78.7)	5	60.8 (43.9-73.6)
% CLAY	22	7.8 (1.5-15.4)	5	6.5 (1.4-14.4)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-70	No. of Samples	70-100
SOIL REACTION (pH) 1:1 H_2O	10	5.6 (5.5-5.8)	5	5.8 (5.2-6.0)
SOIL REACTION (pH) 1:2 $CaCl_2$	10	4.9 (4.7-5.2)	5	4.9 (4.7-5.1)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	23	1.7 (0.7-2.36)	3	0.6 (0.2-0.8)
NITROGEN (%)	7	0.05 (0.03-0.10)	5	0.02 (0.01-0.04)
EXCHANGE CAPACITY (meq/100g)	7	10.5 (7.3-16.0)	5	11.9 (6.5-21.9)
EXCHANGEABLE CATIONS (meq/100g) - Ca	7	0.8 (0.2-1.8)	4	0.6 (0.2-1.2)
- Mg	7	0.2 (0.1-0.4)	4	0.2 (0.1-0.4)
- Na	7	0.2 (0.1-0.4)	5	0.2 (0.1-0.3)
- K	7	0.1 (0.1)	5	0.1 (0.1)
PHOSPHORUS (ppm)	6	11.3 (7.7-18.6)	5	24.3 (9.0-42.4)
SULFUR (ppm)	5	0.3 (0.1-0.6)	4	2.1 (1.4-2.6)
% IRON	29	0.29 (0.13-0.55)	2	0.14 (0.12-0.15)
% ALUMINUM	29	0.45 (0.28-0.69)	2	0.28 (0.20-0.35)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
QNg	Gravelly phase; the solum has a lower gravel content (20 to 50%).
QNid	Imperfectly drained (wetter) variant; occurs in seepage sites on lower slopes where the slowly pervious duric horizon restricts drainage.
QNlo	Loamy variant; upper 50 cm has finer than usual texture (loam).
QNwc	Weakly cemented variant (Orthic Humo-Ferric Podzol instead of Duric Humo-Ferric Podzol). The cemented horizon occuring between 50 to 100 cm depth is not sufficiently cemented to be a duric horizon.

INFERRED SOIL PROPERTIES
QUINSAM SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY
						K FACTOR
QN	0-100	GM	A-1-a	NP	NP	<0.2

ROYSTON SOILS (RN)

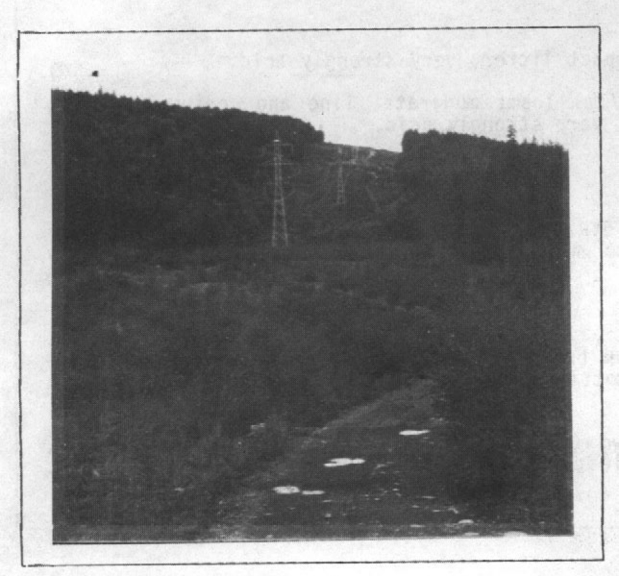


PLATE 4.32: ROYSTON SOIL LANDSCAPE

GENERAL COMMENTS

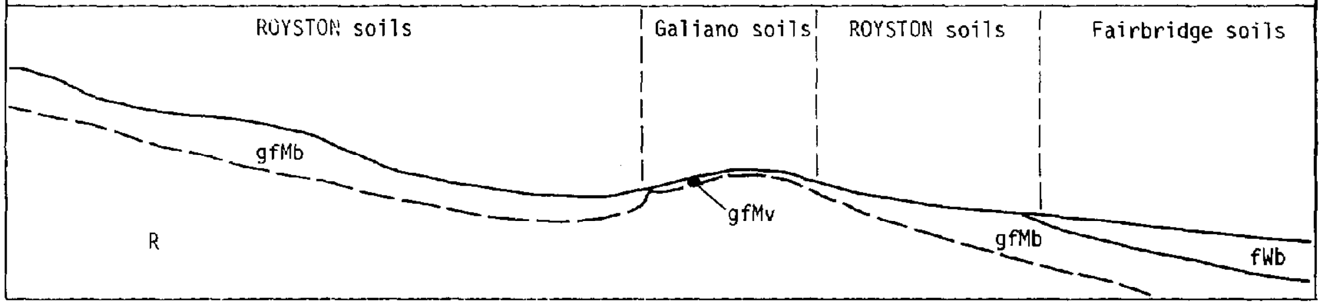
Royston soils (1215 ha) occur on gently to steeply sloping areas near or above 100 m. The most extensive area is located along the lower southern slopes of Mount Prevost. Royston soils have developed in moderately stony, medium-textured morainal deposits which are partially derived from less resistant sedimentary bedrock formations. These medium-textured tills form a minor portion of the morainal deposits in the survey area and are only found where siltstone, claystone or shale is underlying or nearby. These soils are imperfectly drained with seasonal perched watertables and lateral water movement over the unweathered compact parent material during rainy periods.

They are characterized by loam to clay loam textures with a mottled horizon overlying a very compact horizon at 1 m. Royston soils are classified as **Gleyed Dystric Brunisols.**

Most Royston soils presently support highly productive forests. Agriculturally, they are restricted by stoniness and topography. When improved they are useful for a wide range of crops where topography permits.

Royston soils have high bearing strengths but septic tank effluent disposal is impeded by the slowly permeable subsoil.

ROYSTON SOIL LANDSCAPE CROSS SECTION*



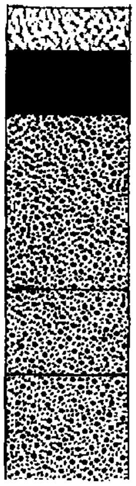
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	gravelly fine morainal blanket
TOPOGRAPHY	:	very gentle to strong slopes
ELEVATION RANGE	:	usually higher than 100 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	Native vegetation consists of Douglas-fir with minor inclusions of western red cedar, alder and maple.

TYPICAL ROYSTON SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
1-	L	Loose, non-compact litter, very strongly acid.
0-	Ah	Black (10YR 2/1m) loam; moderate, fine and medium granular; very friable, very strongly acid.
5-	Bm	Dark brown (7.5YR 4/4m) cobbly, gravelly loam; weak to moderate, fine to medium, subangular blocky; friable; very strongly acid.
80-	BCg	Light yellowish brown (10YR 6/4m) gravelly loam; many medium, distinct mottles; massive; firm; strongly acid.
100-	CBg	Yellowish brown (10YR 5/4m) gravelly, loam; many, medium, distinct mottles; massive; very firm; weakly cemented; medium acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 80-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 60-100; compact lower horizons
ROOTING DEPTH (cm)	: 80
COARSE FRAGMENT CLASS	: 3-1
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 80-90; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: imperfect
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: gravelly loam, gravelly clay loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
PERMEABILITY (CLASS)		moderate		moderate - slow
BULK DENSITY (g/cm^3)	1	1.5	2	1.65 (1.5-1.9)
AWSC (cm/m)	2	14.0 (12.6-15.3)	3	18.2 (15.7-19.7)
AWSC (corr. for % C.F.) (cm/m)	2	10.5 (9.5-11.5)	3	15.3 (11.6-18.8)
% COARSE FRAGMENTS >7.5cm	2	0-10	2	0-5
% COARSE FRAGMENTS <7.5cm	2	15-40	2	15-40
% PASSING SIEVES # 4	1	74.7	1	76.5
% PASSING SIEVES # 40	1	54.5	1	74.3
% PASSING SIEVES #200	1	41.1	1	41.1
% SAND	12	42.8 (35.5-57.1)	4	40.5 (32.8-49.1)
% CLAY	12	13.9 (5.2-23.9)	4	13.8 (8.7-17.3)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-50	No. of Samples	50-100
SOIL REACTION (pH) 1:1 H_2O	7	5.5 (5.2-5.8)	5	5.6 (5.1-6.6)
SOIL REACTION (pH) 1:2 $CaCl_2$	12	4.9 (4.4-5.5)	6	5.0 (4.3-5.8)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	9	1.6 (0.5-3.1)	4	0.4 (0.2-0.5)
NITROGEN (%)	7	0.11 (0.04-0.17)	4	0.04 (0.02-0.04)
EXCHANGE CAPACITY (meq/100g)	7	22.6 (13.6-30.8)	4	13.0 (10.5-15.7)
EXCHANGEABLE CATIONS (meq/100g) - Ca	7	7.1 (6.9-9.1)	4	6.1 (3.2-10.6)
- Mg	7	2.3 (2.0-2.7)	4	2.4 (1.4-3.8)
- Na	7	0.2 (0.1-0.3)	4	0.2 (0.1-0.2)
- K	7	0.8 (0.4-1.3)	4	0.1 (0.1-0.2)
PHOSPHORUS (ppm)	5	32.7 (21.9-44.3)	5	5.9 (2.5-8.1)
SULFUR (ppm)	3	0.5 (0.3-0.7)	3	0.3 (0.0-0.5)
% IRON	3	0.22 (0.12-0.76)		ND
% ALUMINUM	3	0.25 (0.16-0.60)		ND

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
RNco	Cobbly phase (>20% cobbles and/or stones)
RNmd	Moderately well to well drained variant; drier soil moisture regime, with Orthic Dystric Brunisol instead of Gleyed Dystric Brunisol.
RNvg	Very gravelly phase; the solum has higher than usual gravel content (>50%)

INFERRED SOIL PROPERTIES ROYSTON SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
RN	0-100	GM	A-4	28.5 (26.7-30.3)	5.9 (5.2 - 6.6)	0.1 - 0.3

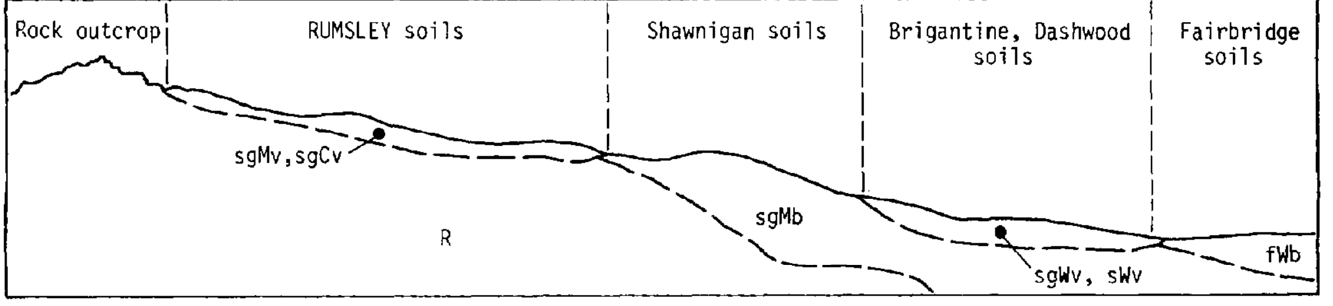
RUMSLEY SOILS (RY)

PLATE 4.33: RUMSLEY SOIL LANDSCAPE

GENERAL COMMENTS

Rumsley soils (4400 ha) have developed on gently to very strongly sloping veneer of coarse-textured colluvium or morainal material. overlying volcanic or intrusive bedrock. These soils occur principally in the Duncan-Crofton and Nanaimo areas. Their classification ranges from **Orthic Dystric Brunisol lithic phase to Orthic Humo-Ferric Podzol; lithic phase.** A high coarse fragment content, shallow soil depth and steep slopes are serious constraints on agricultural use. These soils are considered nonarable. Most Rumsley soils remain under forest cover. Rumsley soils are generally not suitable for urban development because of shallowness to bedrock and steep slopes which seriously effect service installations and effluent disposal.

RUMSLEY SOIL LANDSCAPE CROSS SECTION*

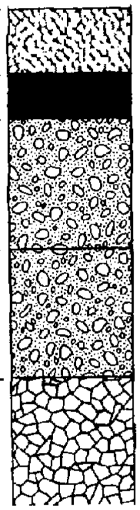


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy gravelly morainal or sandy rubbly colluviual veneers over subdued volcanic or intrusive bedrock
TOPOGRAPHY	:	3-50%; gentle to extreme slopes
ELEVATION RANGE	:	0-250 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	Native vegetation consists mainly of Douglas-fir with minor inclusions of western red cedar, western hemlock, and arbutus. The understory is dominated by salal.

TYPICAL RUMSLEY SOIL PROFILE



DEPTH (cm)	Horizon	Description
4–0	LF	Loose, non-compact litter over a compact fiber; strongly acid.
0–2	Ah	Black (5YR 2.5/1m) sandy loam; moderate, fine granular; friable; medium acid.
2–45	Bf	Reddish brown (5YR 4/4m) gravelly sandy loam; weak, fine subangular blocky; friable; medium acid.
45–70	Bm	Brown (7.5YR 4/5m) very gravelly sandy loam; weak, fine to medium, subangular blocky; friable; medium acid.
70–	R	Bedrock.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: 50-100
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 50-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 50-100; volcanic or intrusive bedrock
ROOTING DEPTH (cm)	: 50-100
COARSE FRAGMENT CLASS	: 3-5
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: rapid
SOIL DRAINAGE	: well to rapid
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly sandy loam, very gravelly loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-bedrock	No. of Samples	
PERMEABILITY (CLASS)		well - rapid		
BULK DENSITY (g/cm^3)	3	1.65 (1.4-2.0)		
AWSC (cm/m)	4	18.1 (12.6-20.6)		
AWSC (corr. for % CF) (cm/m)	4	10.7 (5.5-13.6)		
% COARSE FRAGMENTS >7.5cm	6	5-25		
% COARSE FRAGMENTS <7.5cm	6	10-60		
% PASSING SIEVES # 4	6	60.4 (39.5-83.8)		
% PASSING SIEVES # 40	6	37.9 (20.2-61.9)		
% PASSING SIEVES #200	6	23.3 (10.8-48.9)		
% SAND	7	46.5 (35.4-73.3)		
% CLAY	7	4.9 (3.3-6.2)		

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-bedrock	No. of Samples	
SOIL REACTION (pH) 1:1 H_2O	21	5.6 (5.1-6.1)		
SOIL REACTION (pH) 1:2 $CaCl_2$	21	5.0 (4.5-5.6)		
CONDUCTIVITY mS/cm		N/A		
ORGANIC CARBON (%)	18	2.1 (0.7-4.1)		
NITROGEN (%)	19	0.08 (0.03-0.12)		
EXCHANGE CAPACITY (meq/100g)	19	14.1 (6.3-22.8)		
EXCHANGEABLE CATIONS (meq/100g) - Ca	19	1.4 (0.1-4.7)		
- Mg	19	0.2 (0.1-0.4)		
- Na	19	0.1 (0.1-0.4)		
- K	19	0.1 (0.1-0.2)		
PHOSPHORUS (ppm)	16	26.5 (3.7-55.75)		
SULFUR (ppm)	8	1.5 (0.7-2.9))		
% IRON	17	0.22 (0.06-0.37)		
% ALUMINUM	17	0.54 (0.32-0.80)		

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
RYco	Cobbly phase (>20% cobbles and/or stones).
RYr	Rubbly/blocky phase; contains >50% angular coarse fragments usually derived from local bedrock.
RY13	Very shallow lithic phase; volcanic or intrusive bedrock occurs within 50 cm of the surface.
RY13,r	Very shallow lithic phase; volcanic or intrusive bedrock occurs within 50 cm of the surface. Rubbly/blocky phase; contains >50% angular coarse fragments usually derived from local bedrock.

INFERRED SOIL PROPERTIES
RUMSLEY SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
RY	50-100	GM	A-1-b	NP	NP	.02 - 0.2

SALALAKIM SOILS (SL)

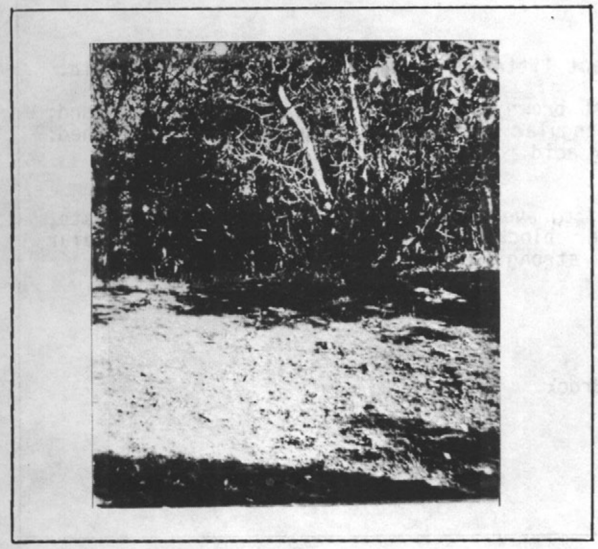
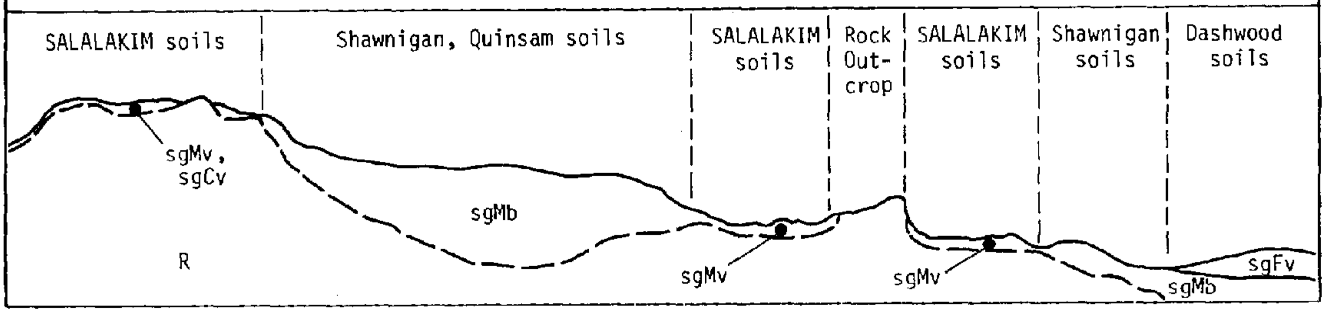


PLATE 4.34: SALALAKIM SOIL LANDSCAPE

GENERAL COMMENTS

Salalakim soils (1365 ha) have developed on a veneer of coarse-textured morainal and colluvial deposits over-lying conglomerate bedrock. The largest areas are north and west of Nanaimo and on the upper slopes of Mount Tsuhalem near Duncan. The classification of these soils range from **Orthic Dystric Brunisol lithic phase to Orthic Humo-Ferric Podzol; lithic phase.** The main limitation to agriculture and other uses are adverse slopes which parallel the hummocky topography of the resistant conglomerate bedrock. Depth to bedrock varies considerably over small distances. Salalakim soils are generally not suitable for urban development because of shallowness to bedrock and steep slopes, all of which seriously affect service installations and effluent disposal.

SALALAKIM SOIL LANDSCAPE CROSS SECTION*



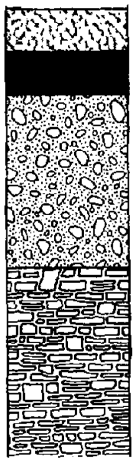
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy gravelly morainal or colluvial veneer over conglomerate bedrock
TOPOGRAPHY	:	10-50%; moderate to extreme slopes
ELEVATION RANGE	:	50-200 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists of Douglas-fir, arbutus, and lodgepole pine.

TYPICAL SALALAKIM SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
5-	LF	Loose, non-compact litter over compact fiber, strongly acid.
0-	Ahe	Very dark grayish brown (10YR 3/2m) very gravelly loamy sand; weak, fine subangular blocky breaking to single grained; loose; strongly acid.
4-	Bm	Brown (7.5YR 4/5m) very gravelly loamy sand; moderate, medium subangular blocky breaking to weak, fine subangular blocky; loose; strongly acid.
60-	R	Conglomerate bedrock.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	:	50-100
HUMUS FORM	:	Moder, Mull
SOLUM DEPTH (cm)	:	50-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	:	50-100; conglomerate bedrock
ROOTING DEPTH (cm)	:	50-100
COARSE FRAGMENT CLASS	:	3-4
DEPTH TO AND TYPE OF WATERTABLE (cm)	:	N/A
PERVIOUSNESS	:	rapid
SOIL DRAINAGE	:	rapid
DEPTH TO SALTS (cm)	:	N/A
SOIL TEXTURE	:	very gravelly loamy sand; very gravelly sandy loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-bedrock
PERMEABILITY (CLASS)		rapid
BULK DENSITY (g/cm^3)	1	1.70
AWSC (cm/m)	1	10.0
AWSC (corr. for % CF) (cm/m)	1	3.5
% COARSE FRAGMENTS >7.5cm	2	0-5
% COARSE FRAGMENTS <7.5cm	2	35-70
% PASSING SIEVES # 4	1	45.1
% PASSING SIEVES # 40	1	15.3
% PASSING SIEVES #200	1	4.2
% SAND	1	77.3
% CLAY	1	8.5

SOIL CHEMICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm) 0-bedrock
SOIL REACTION (pH) 1:1 H_2O	7	5.5 (5.3-5.7)
SOIL REACTION (pH) 1:2 $CaCl_2$	6	4.9 (4.8-5.2)
CONDUCTIVITY mS/cm		N/A
ORGANIC CARBON (%)	6	2.2 (1.0-4.5)
NITROGEN (%)	6	0.08 (0.05-0.13)
EXCHANGE CAPACITY (meq/100g)	6	14.0 (10.5-19.3)
EXCHANGEABLE CATIONS (meq/100g) - Ca	6	0.9 (0.2-1.6)
- Mg	6	0.2 (0.1-0.4)
- Na	6	0.1 (0.1)
- K	6	0.2 (0.1-0.3)
PHOSPHORUS (ppm)	5	43.7 (24.0-56.0)
SULFUR (ppm)	3	0.9 (0.6-1.1)
% IRON	6	0.28 (0.20-0.48)
% ALUMINUM	6	0.55 (0.34-0.76)

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
SLg	Gravelly phase; the solum has lower than usual gravel content (20 to 50%).
SLr	Rubbly/blocky phase; contains >50% angular coarse fragments usually derived from local bedrock.
SL13	Very shallow lithic phase; conglomerate bedrock occurs within 50 cm of the surface.
SL13,r	Very shallow lithic phase; conglomerate bedrock occurs within 50 cm of the surface. Rubbly/blocky phase; contains >50% angular coarse fragments usually derived from local bedrock.

INFERRED SOIL PROPERTIES
SALALAKIM SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
SL	≤100	GM	A-1-a	NP	NP	0.02

SATURNA SOILS (ST)

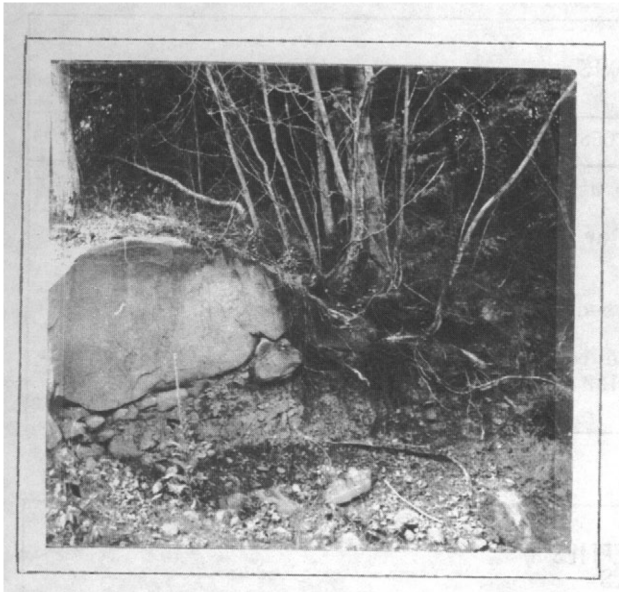
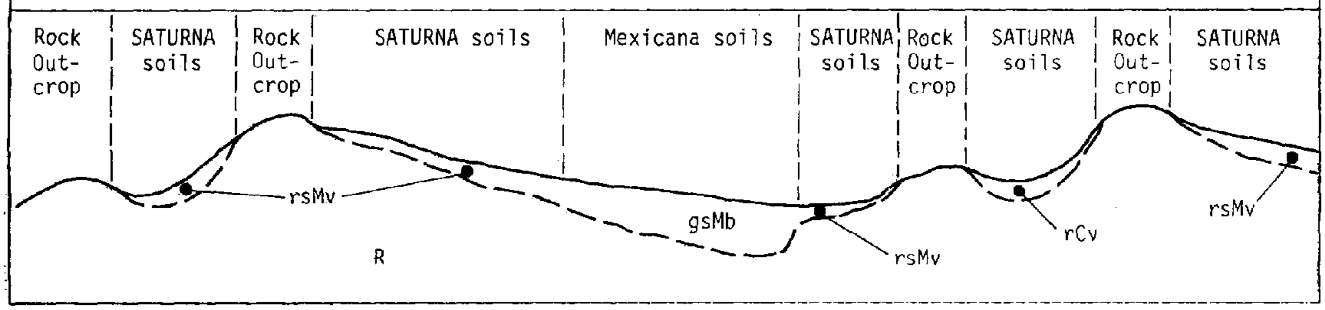


PLATE 4.35: SATURNA SOIL LANDSCAPE

GENERAL COMMENTS

Saturna soils (3955 ha) have developed in a veneer of coarse-textured morainal or colluvial deposits overlying gently to very strongly sloping, ridged sandstone bedrock. These soils occur principally in the Harmac-Yellow Point area and in the Woodley Range east of Ladysmith. They are classified as **Orthic Dystric Brunisols; lithic phase** to **Orthic Humo-Ferric Podzol; lithic phase.** A high coarse fragment content, shallow soil depth, and steep slopes are serious constraints for agricultural use. Most Saturna soils remain under forest cover. Saturna soils are generally not suitable for urban development because of shallowness to bedrock and steep slopes which seriously affect service installations and effluent disposal.

SATURNA SOIL LANDSCAPE CROSS SECTION*



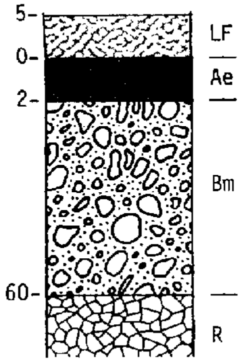
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	:	sandy gravelly morainal on sandy rubbly colluvial veneer over subdued or ridged sandstone bedrock
TOPOGRAPHY	:	5-40%; gentle to very strong slopes
ELEVATION RANGE	:	0-200 m asl
ASPECT	:	all
FLOOD HAZARD	:	no hazard
VEGETATION	:	The native vegetation consists mainly of Douglas-fir, lodgepole pine and occasional arbutus. The understory is dominated by salal.

TYPICAL SATURNA SOIL PROFILE

DEPTH (cm)



Loose, non-compact litter over compact fiber; extremely acid.

Pale brown (10YR 6/3m) very gravelly sandy loam; weak, medium, subangular blocky to single-grained; very friable, slightly sticky, non-plastic; clear, irregular boundary; strongly acid.

Yellowish brown (10YR 5/4m) very gravelly sandy loam; weak, medium, subangular blocky to single-grained; very friable, slightly sticky, non-plastic; abrupt, smooth boundary; strongly acid.

Rock (Sandstone)

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: 50-100
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 50-100
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 50-100; sandstone bedrock
ROOTING DEPTH (cm)	: 50-100
COARSE FRAGMENT CLASS	: 3-5
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: moderate to rapid
SOIL DRAINAGE	: moderately well to rapid
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly sandy loam, very gravelly loamy sand, very gravelly loam

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-40	No. of Samples	40-70
PERMEABILITY (CLASS)		rapid to very rapid		rapid to very rapid
BULK DENSITY (g/cm^3)	1	1.60	Est.	1.75
AWSC (cm/m)	2	13.6 (11.7-15.5)	Est.	10
AWSC (corr. for % CF) (cm/m)	2	8.1 (5.8-10.4)	Est.	5
% COARSE FRAGMENTS >7.5cm	Est.	(5-10)	Est.	(5-10)
% COARSE FRAGMENTS <7.5cm	Est.	(25-45)	Est.	(25-45)
% PASSING SIEVES # 4	2	64.6 (51.2-77.9)		
% PASSING SIEVES # 40	2	52.2 (50.2-54.2)		
% PASSING SIEVES #200	2	26.9 (26.2-27.5)		
% SAND	3	65.9 (64.5-68.3)		
% CLAY	3	11.6 (8.9-13.4)		

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-40	No. of Samples	40-70
SOIL REACTION (pH) 1:1 H_2O	7	5.4 (4.8-5.7)	2	5.5
SOIL REACTION (pH) 1:2 $CaCl_2$	8	4.8 (4.2-5.4)	2	4.7
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	7	2.3 (1.2-4.4)	1	1.4
NITROGEN (%)	7	0.09 (0.04-0.15)	2	0.06 (0.05-0.07)
EXCHANGE CAPACITY (meq/100g)	7	20.1 (12.8-24.3)	2	13.5 (13.3-13.7)
EXCHANGEABLE CATIONS (meq/100g) - Ca	7	3.5 (1.1-7.5)	2	0.4
- Mg	7	0.6 (0.2-1.5)	2	0.1
- Na	7	0.1 (0.1-0.3)	2	0.2 (0.2-0.3)
- K	7	0.2 (0.2-0.3)	2	0.2
PHOSPHORUS (ppm)	2	5.8 (5.0-6.5)	2	11.2 (5.9-16.5)
SULFUR (ppm)	7	2.4 (0.4-7.4)	2	8 (6.8-9.2)
% IRON	5	0.31 (0.17-0.55)	1	0.24
% ALUMINUM	5	0.66 (0.38-1.01)	1	0.51

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
ST13	Very shallow lithic phase; sandstone bedrock occurs within 50 cm of the surface.
STr	Rubbly/blocky phase; contains >50% of angular coarse fragments usually derived from local bedrock.
ST13,r	Very shallow lithic phase; sandstone bedrock occurs within 50 cm of the surface. Rubbly/blocky phase; contains >50% of angular coarse fragments usually derived from local bedrock.

INFERRED SOIL PROPERTIES SATURNA SOILS						
SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
ST	≤100	GM	A-2-4	NP	NP	0.02

SHAWNIGAN SOILS (SH)

PLATE 4.36: SHAWNIGAN SOIL LANDSCAPE

GENERAL COMMENTS

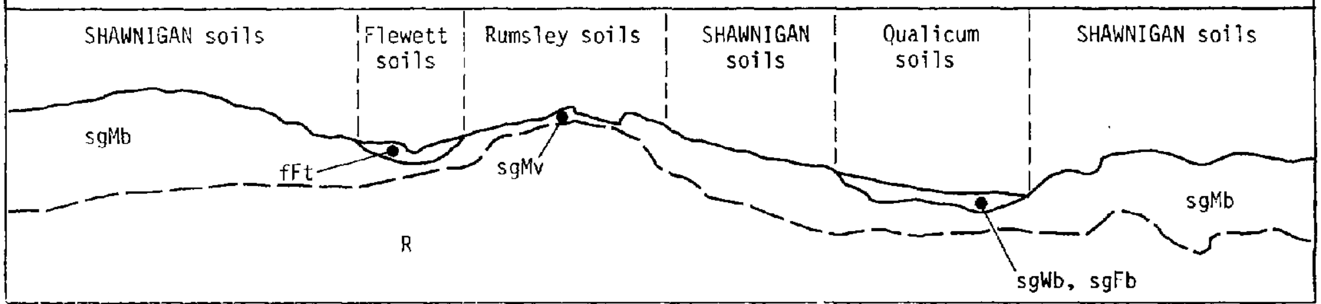
Shawnigan soils (11,465 ha) occur on gentle to very strong slopes near or above 100 m elevation. The most extensive areas are adjacent to the mountain slopes where they are associated with Quinsam soils and shallow soils over bedrock such as Rumsley or Saturna. They are moderately well drained with some lateral water movement during rainy periods. They have developed in sandy gravelly morainal materials and are often very stony.

The upper horizons are yellowish brown, very friable and have gravelly sandy loam textures. These grade into a mottled and strongly cemented horizon at 70 to 100 cm depth. Shawnigan soils are classified as **Duric Dystric Brunisols.**

Most Shawnigan soils are under forest cover but some have been converted into pasture and hay production. Aridity, stoniness and slopes are the main restrictions to agricultural use. Where climate and aspect are suitable these soils have potential for tree fruits.

Shawnigan soils have high bearing strengths but septic tank effluent disposal is impeded as a result of the relatively shallow depth to cemented horizons.

SHAWNIGAN SOIL LANDSCAPE CROSS SECTION*



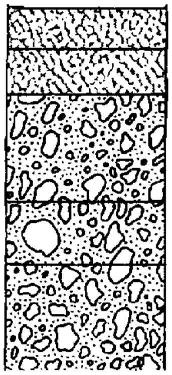
*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL :	sandy gravelly morainal blanket
TOPOGRAPHY :	5-40%; gentle to very strong slopes
ELEVATION RANGE :	100+ m asl, minor areas below 100 m
ASPECT :	all
FLOOD HAZARD :	no hazard
VEGETATION :	The native vegetation consists mainly of Douglas-fir with minor inclusion of western red cedar, grand fir, maple, red alder including an understory dominated by salal.

TYPICAL SHAWNIGAN SOIL PROFILE

DEPTH (cm)



Depth (cm)	Horizon	Description
6-	L-F-H	Loose, non-compact litter and fiber over compact friable humus; medium acid.
0-	Ae	Very thin, pale brown (10YR 7/3m) sandy loam; strongly acid.
1-	Bm_1	Dark yellowish brown (10YR 4/6m) gravelly sandy loam; weak, fine to medium subangular blocky; very friable; medium acid.
60-	Bm_2	Yellowish brown (10YR 5/4m) very gravelly sandy loam; weak, moderate subangular blocky; very friable; strongly acid.
80-	BCc	Yellowish brown (10YR 5/4m) and light olive gray (5Y6/2m) very gravelly sandy loam; massive; very firm; strongly acid; strongly cemented.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mor
SOLUM DEPTH (cm)	: 100-200
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 70-110; 30-60; duric horizon
ROOTING DEPTH (cm)	: 70-110
COARSE FRAGMENT CLASS	: 3-5
DEPTH TO AND TYPE OF WATERTABLE (cm)	: N/A
PERVIOUSNESS	: slow
SOIL DRAINAGE	: moderately well to well
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: very gravelly sandy loam, very gravelly loamy sand

SOIL PHYSICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-80	No. of Samples	80-110
PERMEABILITY (CLASS)		moderate		slow
BULK DENSITY (g/cm^3)	1	1.7	1	2.0
AWSC (cm/m)	2	15.0 (13.4-16.5)	1	12.5
AWSC (corr. for % CF) (cm/m)	2	8.0 (7.4-9.1)	1	5.6
% COARSE FRAGMENTS >7.5cm	Est	5-30	Est	5-30
% COARSE FRAGMENTS <7.5cm	Est	40-55	Est	45-50
% PASSING SIEVES # 4	1	60.5	1	51.9
% PASSING SIEVES # 40	1	39.3	1	39.2
% PASSING SIEVES #200	1	23.9	1	25.5
% SAND	23	56.4 (39.3-72.3)	5	62.3 (52.5-73.6)
% CLAY	23	9.6 (1.3-18.1)	5	6.6 (1.4-18.8)

SOIL CHEMICAL PROPERTIES	SOIL DEPTHS (cm)			
	No. of Samples	0-80	No. of Samples	80-110
SOIL REACTION (pH) 1:1 H_2O	16	5.8 (5.2-6.5)	6	5.9 (5.6-6.2)
SOIL REACTION (pH) 1:2 $CaCl_2$	34	5.2 (4.6-5.8)	11	5.1 (4.6-5.6)
CONDUCTIVITY mS/cm		N/A		N/A
ORGANIC CARBON (%)	29	1.1 (0.3-1.6)	3	0.3 (0.1-0.4)
NITROGEN (%)	14	0.04 (0.01-0.09)	6	0.02 (0.01-0.03)
EXCHANGE CAPACITY (meq/100g)	14	10.2 (6.1-14.0)	6	8.9 (6.1-12.0)
EXCHANGEABLE CATIONS (meq/100g) - Ca	14	1.5 (0.2-4.2)	6	1.5 (0.1-1.5)
- Mg	14	0.3 (0.1-0.5)	6	0.5 (0.1-1.5)
- Na	14	0.1 (0.1-0.2)	6	0.2 (0.1-0.3)
- K	14	0.1 (0.1)	6	0.1 (0.0-0.2)
PHOSPHORUS (ppm)	13	19.8 (9.6-44.3)	5	31.5 (8.4-72.7)
SULFUR (ppm)	10	3.5 (0.3-9.7)	5	2.8 (1.9-5.7)
% IRON	33	0.16 (0.04-0.30)	5	0.09 (0.04-0.15)
% ALUMINUM	33	0.28 (0.15-0.41)	5	0.20 (0.07-0.35)

SOIL PHASES/VARIANTS

SOIL SYMBOL	SOIL DESCRIPTION
SHco	Cobbly phase; the upper horizons contain >20% by volume cobbles and/or stones.
SHg	Gravelly phase; the upper horizons contain between 20 and 50% coarse fragments by volume. The usual condition of this soil is coarse fragment contents in excess of 50%.
SHid	Imperfectly drained variant; occurs in seepage sites where drainage is restricted. Soil classification is Duric Dystric Brunisol.
SHlo	Loamy phase; loam textured surface 20 to 50 cm thick.
SHg, lo	Loamy variant, gravelly phase; loam textured surface 20 to 50 cm thick and the upper horizon contain between 20 and 50% coarse fragments by volume.

INFERRED SOIL PROPERTIES SHAWNIGAN SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
SH	0-100	GM	A-1-b	NP	NP	0.1 - 0.25

TOLMIE SOILS (TL)

PLATE 4.37: TOLMIE SOIL LANDSCAPE

GENERAL COMMENTS

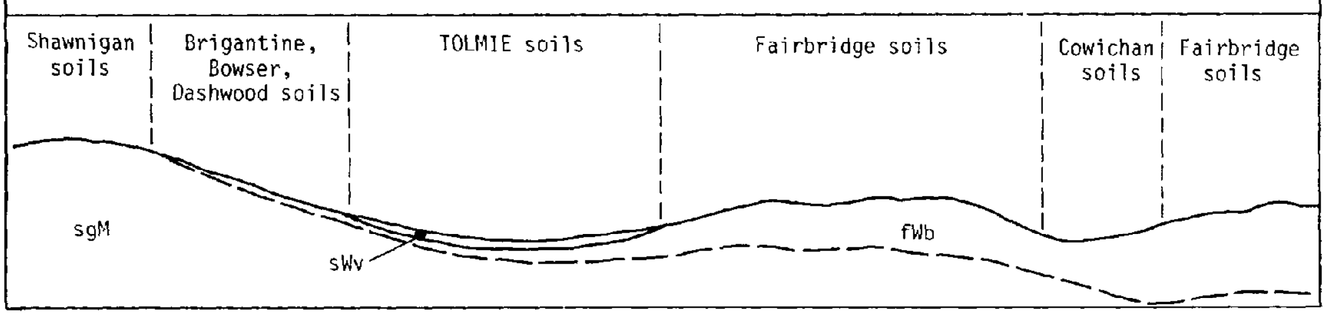
Tolmie soils (210 ha) are found in depressional areas of marine landscapes in association with Brigantine, Bowser, Cowichan and Fairbridge soils. They are minor in extent but are scattered throughout the surveyed area. They are poorly drained with seasonal perched watertables at 15 to 100 cm depth. The have developed in non-stony, sandy fluvial or sandy marine material that is underlain by silty marine material. They often have thin sandy layers at depth as well. Tolmie soils are distinguished from Parksville soils by a thinner (<30 cm) sandy overlay and usually having sandy layers at depth.

Characteristically, they have a dark brown organic matter-enriched surface horizon which grades into a lighter brown to grey prominantly mottled silt loam at depth. These soils are classified as **Orthic Humic Gleysols.**

Present land use is mainly hay and pasture as spring planting of other crops is often impractical due to wet soil conditions. With drainage and irrigation Tolmie soils can be used for growing a wide range of crops. Closely spaced drainage lines are required due to slow soil permeability.

Urban and related uses are not recommended due to flooding and winter ponding.

TOLMIE SOIL LANDSCAPE CROSS SECTION*

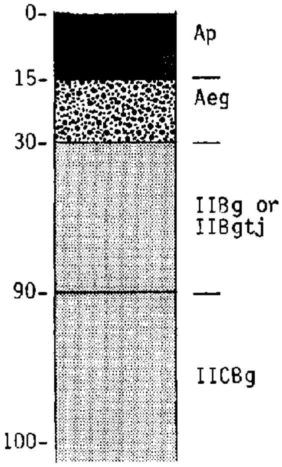


*see Table 3.1 for explanation of terrain symbols

LANDSCAPE CHARACTERISTICS

PARENT MATERIAL	: sandy marine or fluvial overlying fine marine
TOPOGRAPHY	: level to very gently sloping
ELEVATION RANGE	: less than 100 m
ASPECT	: N/A
FLOOD HAZARD	: may be expected
VEGETATION	: Uncleared areas support red alder, willow, maple, western red cedar and western hemlock, including an understory of moisture loving plants such as skunk cabbage.

TYPICAL TOLMIE SOIL PROFILE



Ap: Very dark grayish brown (10YR 3/2d) sandy loam; moderate fine granular; very friable; medium acid.

Aeg: Light brownish gray (10YR 6/2m) sandy loam; weak, medium platy; very friable; slightly acid.

IIBg or IIBgtj: Brown (10YR 5/3m) silt loam; many, fine, prominant, strong brown (7.5YR 4/5m) mottles; weak, medium prismatic breaking to moderate, coarse angular blocky; firm; medium acid.

IICBg: Light olive brown (2.5Y5/4m) silt loam; many, fine, prominant, brown (7.5YR 4/4 m) mottles; massive breaking to moderate, medium to coarse pseudo-angular blocky; firm; slightly acid.

SOIL CHARACTERISTICS

DEPTH TO BEDROCK (cm)	: N/A
HUMUS FORM	: Mull
SOLUM DEPTH (cm)	: 100+
DEPTH, THICKNESS AND TYPE OF RESTRICTING LAYER (cm)	: 80; compact subsoil
ROOTING DEPTH (cm)	: 100+
COARSE FRAGMENT CLASS	: 0
DEPTH TO AND TYPE OF WATERTABLE (cm)	: 15-100; seasonal perched
PERVIOUSNESS	: slow
SOIL DRAINAGE	: poor
DEPTH TO SALTS (cm)	: N/A
SOIL TEXTURE	: sandy loam or loam over silt loam

SOIL PHYSICAL PROPERTIES	No. of Samples	SOIL DEPTHS (cm)	No. of Samples	30-70	No. of Samples	70-100
PERMEABILITY (CLASS)				slow		slow
BULK DENSITY (g/cm^3)				1.51	1	1.37
AWSC (cm/m)				21.0 (16-27)	1	20.0
AWSC (corr. for % C.F) (cm/m)	1			21.0 (16-27)	1	20.0
% COARSE FRAGMENTS >7.5cm	Est.	0	Est.	0	Est.	0
% COARSE FRAGMENTS <7.5cm	Est.	0	Est.	0	Est.	0
% PASSING SIEVES # 4	Est.	98.0	Est.	98.0	Est.	98.0
% PASSING SIEVES # 40	Est.	80.0	Est.	95.0	Est.	95.0
% PASSING SIEVES #200		5.0		92.0		92.0
% SAND	6	34.0 (16.3-66.4)	3	13.2 (3.7-20.2)	2	11.9 (2.5-21.4)
% CLAY	6	23.6 (9.5-37.7)	3	25.8 (15.7-22.7)	2	23.5 (22.5-24.5)

SOIL CHEMICAL PROPERTIES	No. of Samples	0-30	No. of Samples	30-70	No. of Samples	70-100
SOIL REACTION (pH) 1:1 H_2O	2	6.2 (6.1-6.4)	2	5.7	1	6.1
SOIL REACTION (pH) 1:2 $CaCl_2$	2	5.6 (5.6)	2	5.2	1	5.6
CONDUCTIVITY mS/cm		N/A				
ORGANIC CARBON (%)	2	0.5 (0.4-0.7)		ND		ND
NITROGEN (%)	2	0.04 (0.04)	2	0.03 (0.02-0.03)	1	0.02
EXCHANGE CAPACITY (meq/100g)	2	10.1 (6.3-13.8)	2	14.3 (14.2-14.4)	1	15.9
EXCHANGEABLE CATIONS (meq/100g) - Ca	2	7.2 (4.9-9.4)	2	7.9	1	7.4
- Mg	2	1.4 (0.6-2.3)	2	3.8 (3.5-4.1)	1	5.4
- Na	2	0.1 (0.1)	2	0.1 (-)	1	0.5
- K	2	0.1 (0.1)	2	0.1 (-)	1	0.1
PHOSPHORUS (ppm)	2	8.4 (7.4-9.5)	2	12.1 (10.4-13.9)	1	11.5
SULFUR (ppm)	2	[illegible] (7.6)	2	16.2 (11.4-21.1)	1	11.4

SOIL PHASES/VARIANTS	
SOIL SYMBOL	SOIL DESCRIPTION
TLg	Gravelly phase; the coarse textured surface veneer contains 20 to 50% gravel.

INFERRED SOIL PROPERTIES
TOLMIE SOILS

SOIL NAME SYMBOL	SOIL DEPTH (cm)	UNIFIED TEXTURE SYMBOL	AASHO TEXTURE SYMBOL	LIQUID LIMIT	PLASTICITY INDEX	SOIL ERODIBILITY K FACTOR
TL	0-30	SM	A-4	20.5	1.3	0.3
	30-70	CL	A-4	30.8	9.8	0.5
	70-100	ML-CL	A-6	37.8	13.5	0.55

MISCELLANEOUS LAND TYPES

Miscellaneous land types consist of naturally occuring or man-made components of the landscape but are considered not to be "soil" as defined in this report. They, however, are mappable and five different land types are classified in the map area.

Active Coastal Beaches (CB): The Coastal Beach land type consists of sandy and gravelly beach areas.

Eroded Scarp (ER): The Eroded Scarp land type consists of unconsolidated parent material on steep erosional scarps.

Made Land (MD): The Made Land type consists of areas which are man-made or so severely man-modified that the original characteristics of the soil have been destroyed. Made land areas have been separated into seven categories, (MD_1 to MD_7) as defined below.

Urban and Transportation (MD_1): Housing, pavement, airports permanently restricted to existing or similar uses.

Gravel Pits (MD_2): Large quantities of unconsolidated material have been removed from the site - may be suitable for other uses after gravel resource is exhausted.

Open Pit Mines and Quarries (MD_3): Large quantities of bedrock have been removed from the site - may be suitable for other uses after mining ceases - major reclamation project probably required.

Waste Rock Dumps (MD_4): Waste rock or slag from mining activities has been deposited - may be suitable for other uses after mining ceases.

Woodwaste (MD_5): Sawdust and woodwaste areas.

Land Filling, Levelling (MD_6): Material has been redistributed and/or brought in from other sites to create a suitable landscape for the designated use - housing, paving, etc. is minor.

Garbage Dumps ((MD_7): Deposition of dominantly artificial materials - may be suitable for other uses after extensive filling and reclamation.

Recent Alluvium (RA): The Recent Alluvium land type is composed of gravel and sand bars, spits and other similar deposits in or adjacent to rivers and streams. They are usually inundated except during low water and are generally unvegetated. Their shape, size and location may be altered from year to year by erosion and subsequent redeposition.

Rock Outcrop (RO): The Rock Outcrop land type is common in the map area, particularly at the higher elevations. It consists of areas of exposed bedrock or bedrock areas with less than 10 cm of mineral or organic soil on the rock surface. Topographically, Rock Outcrop areas are usually very to extremely sloping or hilly to very hilly; slope gradients are mostly greater than 30 percent. Rock Outcrops are separated into five categories (RO_1, to RO_5) as defined below.

Sandstone (RO_1): Associated with Saturna and Bellhouse soils.

Siltstone, Shale (RO_2): Associated with Galiano soil.

Conglomerate (RO_3): Associated with Salalakim soil.

Volcanics (RO_4): Associated with Rumsley soil.

Intrusives (RO_5): Associated with Rumsley soil.

Table 4.1
Brief Synopsis of the Soils

NAME	MOST COMMON SOIL TAXONOMY	DESCRIPTION
Arrowsmith (AR)	Typic Mesisol	Deep, moderately decomposed organic soils with dark brown mesic material in the middle and bottom tiers.
Beddis (BD)	Orthic Dystric Brunisol	Formally included in Kye soils*. Rapidly-drained, yellowish brown soils developed in coarse-textured (sandy), fluvial, marine, and/or eolian deposits. Minor inclusions of Orthic Sombric Brunisol (cultivated fields).
Bellhouse (BH)	Sombric Humo-Ferric Podzol; lithic phase (Orthic Sombric Brunisol; lithic phase)	Rapidly-drained, shallow soils with dark coloured surface horizons which overlie sedimentary bedrock.
Bowser (BO)	Gleyed Humo-Ferric Podzol	Imperfectly-drained, brown to reddish brown soils developed in coarse-textured, fluvial or marine deposits which are underlain by medium-textured marine materials. Minor areas of Gleyed Sombric Humo-Ferric Podzol.
Brigantine (BE)	Gleyed Dystric Brunisol	Imperfectly-drained soils developed in coarse-textured fluvial, fluvio-glacial and/or marine deposits overlying medium-textured marine materials - occurs in gently sloping positions. Includes some Gleyed Sombric Brunisol (cultivated areas).
Cassidy (CA)	Cumulic Regosol (Orthic Dystric Brunisol)	Rapidly-drained soils developed on very coarse textured relatively recent fluvial deposits. Includes some weakly developed Orthic Dystric Brunisol soils on higher terraces.
Chemainus (CH)	Orthic Dystric Brunisol (Cumulic Regosol)	Moderately well drained, dark yellowish brown soils developed on medium-textured, deep, fluvial deposits. Includes some Orthic Regosols and Orthic Humic Regosols and Orthic Sombric Brunisols.
Comiaken (CN)	Cumulic Regosol (Orthic Dystric Brunisol)	Rapidly-drained, sandy soils developed in coarse-textured, relatively recent fluvial deposits. Inclusions of Cumulic Humic Regosols, Orthic Regosols and Orthic Humic Regosols also occur.
Corydon (CR)	Rego Humic Gleysol; saline phase	Poorly drained soils developed in medium-textured fluvial deposits which are underlain at variable depths by gravels. Includes saline phases of Orthic Humic Gleysols and Orthic Gleysols. Occurs in the tidal zone of estuaries.

*Day _et al._, 1959

Table 4.1 (Continued)

NAME	MOST COMMON SOIL TAXONOMY	DESCRIPTION
Cowichan (CO)	Humic Luvic Gleysol	Poorly drained soils with dark coloured surface horizons and mottled and gleyed subsurfaces developed in deep deposits of marine silts. Includes minor areas of Orthic Humic Gleysols and Orthic Gleysols. Occurs below 100 m elevation in level to depressional areas.
Crofton (CF)	Orthic Humic Gleysol (Rego Humic Gleysol)	Poorly-drained soils developed in medium-textured fluvial deposits underlain at variable depths by coarse gravels. Includes small areas of Orthic Humic Gleysols, Orthic Gleysols and Rego Gleysols.
Dashwood (DW)	Duric Dystric Brunisol (Duric Humo-Ferric Podzol)	Well drained, yellowish brown soils developed in very coarse textured (gravelly) fluvial, fluvioglacial, or marine deposits underlain by morainal materials usually at depths between 50 and 100 cm. An induated horizon is present in the upper part of the moraine deposit. May include minor areas of Duric Sombric Brunisol.
Deerholme (DE)	Duric Dystric Brunisol (Duric Humo-Ferric Podzol)	Well-drained, yellowish brown soils developed in very coarse textured (sandy), fluvial or fluvioglacial deposits underlain by morainal materials at depths between 50 and 100 cm. An indurated horizon is present in the upper part of the morainal material.
Denman Island (DA)	Orthic Humic Gleysol	Poorly drained soils developed in deep, sandy deposits of various origin. Normally found in seepage locations where underlying impermeable morainal material restrict percolation. Denman Island soils are very minor in extent.
Dougan (DN)	Orthic Dystric Brunisol	Moderately well drained soils with dark yellowish brown surface horizons developed in medium-textured marine material which overlies coarse-textured marine, fluvial or morainal deposits. Usually occurs on east-facing, slightly sloping sites. Discontinuous weak to moderate cementation occurs in the subsoil.
Fairbridge (FB)	Gleyed Eluviated Dystric Brunisol (Gleyed Dystric Brunisol)	Imperfectly drained soils developed in medium-textured, undulating marine deposits below 100 cm elevation. The soils have strong brown to light yellowish brown coloured surfaces and distinct to prominant mottling at depths between 50 and 100 cm.

Table 4.1 (Continued)

NAME	MOST COMMON SOIL TAXONOMY	DESCRIPTION
Flewett (FT)	Orthic Dystric Brunisol (Orthic Humo-Ferric Podzol)	Well drained, medium-textured soils with dark yellowish brown surfaces developed on fluvial terraces. Generally Flewett soils do not have fluctuating water tables near the surface. Textures usually become coarser with depth.
Galiano (GA)	Orthic Dystric Brunisol; lithic phase	Moderately well drained, medium textured soils with yellowish brown coloured surfaces developed in shallow morainal or colluvial deposits overlying siltstone or shale bedrock.
Hillbank (HT)	Orthic Dystric Brunisol (Eluviated Dystric Brunisol)	Moderately well drained soils with yellowish brown surfaces developed in silty marine deposits. Faint mottles at depths between 50-100 cm. Hillbank soils usually occur in association with Fairbridge soils and occurs on hilltops, ridges and other well drained locations.
Hollings (HO)	Orthic Dystric Brunisol (Duric Dystric Brunisol)	Well to rapidly drained soils with yellowish brown surfaces, developed in morainal deposits overlying fluvial or gravelly marine deposits. A minor soil which occurs in association with Shawnigan soils.
Kaptara (KP)	Orthic Humic Gleysol	Poorly drained soils of minor extent that have developed in coarse textured (gravelly) fluvial, fluvioglacial and marine deposits. Normally found in seepage locations where underlying impermeable layers restricts percolation.
Koksilah (KH)	Orthic Humic Gleysol	Poorly drained, very dark brown to black soils developed in deep, coarse-textured morainal materials. They are very minor in extent and occupy depressional sites in the rolling landscape. Percolation is restricted by the compact subsoil.
Kulleet (KT)	Gleyed Dystric Brunisol	Imperfectly drained soils with yellowish brown surface horizons developed in fine marine deposits overlying coarse-textured marine and/or fluvial materials.
Maple Bay (MY)	Orthic Dystric Brunisol (Eluviated Dystric Brunisol)	Moderately well to well drained medium-textured soils with yellowish brown surface horizons developed in silty marine parent material that overlie siltstone or shale at depths of less than 1 m. A paralithic contact to siltstone or shale occur within 1 m from the surface. The topography is undulating to hummocky.
Metchosin (MT)	Typic Humisol	Deep, well-decomposed organic soils with dark brown to black humic material in the middle and bottom tiers.

Table 4.1 (Continued)

NAME	MOST COMMON SOIL TAXONOMY	DESCRIPTION
Mexicana (ME)	Orthic Dystric Brunisol (Orthic Humo-Ferric Podzol)	Well drained, yellowish brown soils developed in deep deposits of medium to coarse-textured morainal material. Discontinuous, weakly cemented horizons are present in the subsoil.
Mill Bay (MB)	Duric Dystric Brunisol	Moderately well to imperfectly drained, medium textured soils with yellowish brown coloured upper horizons. Parent material consists of 50 to 100 cm of medium textured marine materials overlying morainal deposits. The upper part of the morainal material is indurated.
Parksville (PA)	Orthic Humic Gleysol	Poorly drained soils developed in coarse-textured (sandy), fluvial, fluvioglacial and/or marine materials, 30 to 100 cm thick, that overlie silty marine deposits. Includes minor areas of Orthic Gleysols.
Qualicum (QU)	Orthic Dystric Brunisol (Orthic Humo-Ferric Podzol)	Rapidly-drained, yellowish brown soils developed in very coarse-textured (gravelly), deep (at least 150 cm), fluvial, fluvioglacial, and/or marine materials. They may contain discontinuous, weakly cemented subsoil horizons. Minor inclusions of Orthic Sombric Brunisols occur where the soils are cultivated.
Quennell (QL)	Orthic Humo-Ferric Podzol	Rapidly-drained, reddish brown soils developed in very coarse textured (gravelly), deep (at least 150 cm), fluvial, fluvioglacial, and/or marine materials. May contain discontinuous weakly cemented horizons. Minor inclusions of Sombric Humo-Ferric Podzols occur where the soils are cultivated.
Quinsam (QN)	Duric Humo-Ferric Podzol	Moderately well drained, brown to reddish brown soils developed in deep, coarse-textured morainal deposits. Found on rolling to steeply sloping terrain at the higher elevations of the climatically wetter portions of the report area. A duric horizon usually occurs between 50 and 100 cm of the surface.
Royston (RN)	Gleyed Dystric Brunisol	Imperfectly drained, yellowish brown soils developed in deep, medium-textured compact morainal deposits associated with shale and/or siltstone bedrock areas.

Table 4.1 (Continued)

NAME	MOST COMMON SOIL TAXONOMY	DESCRIPTION
Rumsley (RY)	Orthic Dystric Brunisol; lithic phase (Orthic Humo-Ferric Podzol; lithic phase)	Well drained soils with reddish brown surface horizons developed in shallow (10 to 100 cm thick) morainal or colluvial deposits overlying bedrock.
Salalakim (SL)	Orthic Dystric Brunisol; lithic phase (Orthic Humo-Ferric Podzol; lithic phase)	Rapidly drained soils with light coloured horizons developed in shallow (10 to 100 cm thick) colluvial or morainal deposits overlying conglomerate bedrock.
Saturna (ST)	Orthic Dystric Brunisol (Orthic Humo-Ferric Podzol)	Rapidly drained soils with yellowish brown surface horizons developed in shallow colluvial, morainal (10 to 100 cm thick) and to a minor extent, marine deposits overlying sandstone bedrock.
Shawnigan (SH)	Duric Dystric Brunisol	Moderately well to well drained yellowish brown soils developed in deep, coarse-textured, compact morainal deposits. Rolling to undulating topography. An indurated horizon occurs between 50 and 100 cm of the surface.
Tolmie (TL)	Orthic Humic Gleysol	Poorly drained, very dark brown to black soils developed in shallow (10 to 30 cm thick), sandy veneers overlying medium-textured marine materials. Occurs mainly in level to depressional locations. Includes minor areas of Orthic Gleysols. Thin sandy lenses may occur in the subsoil at various depths.

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GLOSSARY

AASHO, classification, soil engineering - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

aeolian - Material deposited by wind; includes loess and dune sand.

acid soil - A soil material having a pH of less than 7.0.

aggregate - Sand, gravel and other similar mineral material suitable for use in construction (i.e. for road surfaces, concrete, pavement).

aggregate, soil - A group of soil particles cohering, in such a way that they behave mechanically as a unit.

alluvium - A general term for all deposits of rivers and streams.

anthropogenic - Man-made, or strongly man-modified, soil materials.

ancient marine landscapes - Lands that reemerged from the ocean after being depressed below sea level during glaciation.

arable soil - Soil suitable for plowing and cultivation.

aspect - A measure of orientation of a slope by means of compass points.

association, soil - A sequence of soils of about the same age, derived from similar parent materials, and occuring under similar climatic conditions but having different characertistics due to variation in relief and in drainage.

Atterberg Limits (Plastic Limits) - The range of water content over which a soil exhibits plastic behaviour. The Lower Atterberg Limit is the water content at which the soil is not plastic when worked and crumbles on application of pressure. The Upper Atterberg Limit is the water content at which the soil changes from plastic to flow behaviour.

available nutrient - The portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

available soil water - The portion of water in a soil that can be readily absorbed by plant roots; generally considered to be the water held in the soil up to approximately 15 atmospheres tension.

bar - A unit of pressure equal to one million dynes per square centimeter.

base saturation - The extent to which the adsorption complex of a soil is saturated with exchangeable cations other than hydrogen and aluminum. It is expressed as a percentage of the total cation exchange capacity.

beach deposits - Sediments that are modified in their degree of sorting, or surface relief, or both, by the action of waves in forming beaches.

bearing capacity - The average load per unit area that is required to rupture a supporting soil mass.

bedrock - The solid rock that underlies soil and the regolith, or that is exposed at the surface.

blanket - A mantle of unconsolidated material thick enough to mask minor irregularities in the underlying rock or other deposits, but which still conforms to the general underlying topography.

bog - An area covered, or filled with, peat material which generally consists of undecomposed to moderately deccomposed mosses.

boulders - Rock fragments over 60 cm (2 ft) in diameter. In engineering practice boulders are greater than 20 cm (8 inches) in diameter.

bulk density, soil - The mass of dry soil per unit bulk volume is determined before the soil is dried to constant weight at 105°C.

capability class, soil - A rating that indicates the general capability of a soil for some use such as agriculture, forestry, recreation, or wildlife. It is a grouping of subclasses that have the same relative degree of limitation or hazard. The limitation or hazard becomes progressively greater from Class 1 to Class 7.

capability subclass, soil - A grouping of soils that have similar kinds of limitations and hazards. It provides information on the kind of management difficulty, conservation problem or limitation. The class and subclass together provide information about the degree and kind of limitation for land-use planning, and for the assessment of conservation needs.

carbon-nitrogen ratio (C/N ratio) - The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in an organic material.

category - A grouping of related soils defined at approximately the same level of abstraction. In the Canadian soil classification the categories are order, great group, subgroup, family, and series.

cation exchange - The interchange of a cation in solution and another cation on the surface of any surface-active material such as clay colloid or organic colloid.

cation exchange capacity (CEC) - A measure of the total amount of exchangeable cations that can be held by a soil. It is expressed in milliequivalents per 100 g of soil.

cemented-indurated - Having a hard, brittle consistence because the particles are held together by cementing substances such as humus, calcium carbonate, or the oxides of silicon, iron, and aluminum. The hardness and brittleness persist even when the soil is wet.

channelled (ridge and swale) - Characteristic ridge and swale topography (0-10% slopes common). Often a pattern or series of closely spaced curvilinear ridges and swales. A poorly integrated drainage pattern may be evident connecting swales.

chroma - The relative purity, strength, or saturation of a colour. It is directly related to the dominance of the determining wavelength of light. It is one of the three variables of colour. See also **Munsell colour system; hue;** and **value, colour.**

classification, soil - The systematic arrangement of soils into categories on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

clay - (i) As a particle term: a size fraction less than 0.002 mm in equivalent diameter, or some other limit (geologist and engineers). (ii) As a rock term: a natural, earthy, fine grained material that developes plasticity with a small amount of water. (iii) As a soil term: a textural class in which the soil materials contain 40 percent or more of clay. (iv) As a soil separate: a material usually consisting largely of clay material but commonly also of amorphous free oxides and primary minerals.

clay films (skins) - Coatings of oriented clays on the surface of soil peds and mineral grains.

clay loam - Soil material that contains 27% to 40% clay and 20% to 45% sand.

clay mineral - Finely crystaline hydrous aluminum silicates and hydrous magnesium silicates with phyllosilicate structure.

clayey - Containing large amounts of clay, or having properties similar to those of clay.

climatic moisture deficit - The negative difference between precipitation and the potential evapotranspiration from May 1st to September 30th.

climatic moisture surplus - The positive difference between precipitation and the potential evapotranspiration from May 1st to September 30th.

climax - A plant community of the most advanced type capable of development under, and in dynamic equilibrium with, the prevailing environment.

clod - A compact, coherent mass of soil produced by digging or plowing. Clods usually slake easily with repeated wetting and drying.

coarse fragments - Rock or mineral particles greater than 2.0 mm in diameter.

coarse texture - The texture exhibited by sands, loamy sand, and sandy loams except very fine sandy loam. A soil containing large quantities of these textural classes.

cobble - Rounded or partially rounded rock or minieral fragment 7.5 to 25 cm (3 to 10 inches) in diameter. In engineering practice, cobbles are greater than 7.5 cm (3 inches) but less than 20 cm (8 inches) in diameter.

colluvium - Loose material accumulated on and at the foot of slopes by the various processes of mass movement (gravity). Highly variable textures depending on source material (often boulder-sized material). Unsorted to crudely stratified.

colour, soil - Soil colours are compared with a Munsell colour chart. The Munsell system specifies the relative degrees of the three simple variables of colour; hue, value and chroma. For example: 10YR 6/4 means a hue 10YR, a value of 6, and a chroma of 4. See also **Munsell colour system; hue;** and **value, colour.**

complex, soil - A mapping unit used in detailed and reconnaissance soil surveys where two or more defined soil units are so intimately intermixed geographically that it is impractical, because of the scale used, to separate them.

compaction soil - The packing together of soil particles by forces exerted at the soil surface resulting in increased soil density.

concretion - A mass or 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, found in soil and in rock. The term is sometimes restricted to concentrations having concentric fabric. The composition of some concretions is unlike that of the surrounding material.

conductivity, electrical - A physical quantity that measures the readiness with which a medium transmits electricity. It is expressed as the reciprocal of the electric resistance (ohms) or mS per cm at 25°C of a conductor which is one cm long with a cross sectional area of one square cm. It is used to express the concentration of salt in irrigation water or soil extracts.

consistence - (i) The resistance of a material to deformation or rupture. (ii) The degree of cohesion or adhesion of the soil mass. Terms used for describing consistence at various soil mositure contents are:

- wet soil - nonsticky, slightly sticky, sticky, and very sticky; nonplastic, slightly plastic, plastic, and very plastic.
- moist soil - loose, very friable, friable, firm, and very firm; compact, very compact, and extremely compact.
- dry soil - loose, soft, slightly hard, hard, very hard, and extremely hard.
- cementation - weakly cemented, strongly cemented, and indurated.

creep, soil - The slow, continuous downslope movement of mantle materials as the result of long-term application of gravitational stress. It occurs in varying degrees in association with most other types of soil mass movements but dominates as a major process in itself on slopes covered with deep, cohesive soils.

degradation, soil - The changing of soil to a more highly leached and more highly weathered condition, usually accompanied by morphological changes such as the development of an eluviated, light-coloured (Ae) horizon.

delta - A fluvial or glaciofluvial deposit which is a relatively level (0-25% slopes) usually triangular shaped form occurring at the mouth of a stream as it enters a lake or ocean. May have numerous presently occupied or abandoned channels which appear as an integrated drainage pattern.

deposit - Material left in a new position by a natural transporting agent such as water, wind, ice, or gravity, or by the activity of man.

drainage, soil - (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, it refers to the frequency and duration of periods when the soil is free of saturation.

dunes - Wind-built ridges and hills of sand.

duric - A soil horizon that is strongly cemented and usually has an abrupt upper boundary and a diffuse lower boundary. Cementation is usually strongest near the upper boundary. Air-dried clods do not slake when immersed in water.

ecology - The study of the relationship between living organisms and their environment.

eluviation - The transportation of soil material in suspension or in solution within the soil by the downward or lateral movement of water.

eolian deposit - Sand, or silt, or both, deposited by the wind, See also loess and dunes.

erosion - The group of processes whereby surficial or rock materials are loosened, or dissolved and removed from any part of the earth's surface. It includes the processes of weathering, solution, corrosion and transportation.

evapotranspiration - The combined loss of soil water from a given area during a specific period of time by evaporation from the soil surface and transpiration from plants.

exchange capacity - The total ionic charge of the adsorption complex that is active in the adsorption of ions.

fan - Fluvial deposits which are level to steeply sloping (0-50%) fan-like form occurring where a stream runs out onto a level plain or meets a slower stream. Fans are often marked by variegated current scars, abandoned and presently occupied channels. Noticeable slope towards the fan toe or apron.

fen - An area covered by peat material which generally consists of well to moderately decomposed sedge and reed vegetation.

fertility, soil - The status of a soil with respect to the amount and availability of elements necessary for plant growth.

fibric layer - A layer of organic soil material containing large amounts of weakly decomposed fiber whose botanical origin is readily identifiable.

field capacity - The percentage of water remaining in the soil 2 or 3 days after the soil has been saturated and free drainage has practically ceased. The percentage may be expressed in terms of weight or volume.

fine texture - Consisting of or containing large quantities of the fine fractions, particularly of silt and clay. It includes all the textural classes of clay loams and clays: clay loam, sandy clay loam, silty clay loam, sandy clay, silty clay, and clay. Sometimes it is subdivided into clayey texture and moderately fine texture.

firm - A term describing the consistence of a moist soil that offers distinctly noticeable resistance to crushing, but can be crushed with moderate pressure between the thumb and forefinger.

floodplain - The land bordering a stream or river built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

fluted - Level to gently irregular topography (0-25% slopes) marked by shallow, straight parallel troughs.

fluvial, deposits - Materials laid down by recent streams and rivers. Variable textures (few boulders or coarse fragments). Moderately well to well sorted and moderately well to well stratified.

fluvioglacial, deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.

friable - Soil aggregates that are soft and easily crushed between thumb and forefinger.

genesis, soil - The mode of origin of the soil, especially the processes or soil-forming factors responsible for the development of the solum from unconsolidated parent material.

geomorphology - The study of landforms as they relate to geologic composition and history.

glacial till (ablation) - Materials deposited directly by ice with some modification and transportation by glacial meltwater. Variable textures (often stony and bouldery). Poorly sorted and partially stratified.

glacial till (basal) - Materials deposited by ice directly without intervening transportation by water. Variable textures (most often heterogeneous mixture of sands, silts and clays - some often stony and bouldery). Unsorted and unstratified.

gleyed soil - An imperfectly or poorly drained soil in which the material has been modified by reduction or alternating reduction and oxidation. These soils have lower chromas or more prominent mottling or both in some horizons than the associated well-drained soils.

gleysation - A soil-forming process, operating under poor drainage conditions, which results in the reduction of iron and other elements and in gray colours, and mottles.

Gleysolic - An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons.

gravel - Rock fragments 2 mm to 7.5 cm in diameter.

gravelly - Containing appreciable or significant amounts of gravel. The term is used to describe soils or lands.

great group - A category in the Canadian system of soil classification. It is a taxonomic group of soils having certain morphological features in common and a similar pedogenic environment.

groundwater - Water that is passing through or standing in the soil and the underlying strata. It is free to move by gravity.

horizon, soil - A layer of soil or soil material approximately parallel to the land surface, it differs from adjacent genetically related layers in properties such as colour, structure, texture, consistence, and chemical, biological and mineralogical composition. A list of the designations and properties of soil horizons may be found in the Canadian System of Soil Classification, 1978.

organic horizons - May be found at the surface of mineral soils or at any depth beneath the surface in buried soils or overlying geologic deposits. They contain more than 30% organic matter. Two groups of these layers are recognized:

O - An organic layer or layers developed under poorly drained conditions, or under conditions of being saturated most of the year or on wet soils that have been artificially drained.

Of - Fibric layer. An orgnic layer which is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that is readily identifiable as to botanical origin.

Om - Mesic layer. An organic layer which is intermediate in decomposition between the less decomposed fibric and the more decomposed humic materials. This material has intermediate values for fiber content, bulk density and water content. The material is partly altered both physically and biochemically.

Oh - Humic layer. An organic layer which is the most decomposed of all the organic soil materials. It has least amount of plant fiber, the highest bulk density values and the lowest saturated water content. This material is relatively stable having undergone considerable change from the fibric state primarily because of oxidation and humification.

L, F, and H - These are organic horizons that developed primarily from the accumulation of leaves, twigs, and woody materials with or without a minor component of mosses. Usually they are not saturated with water for prolonged periods.

L - An organic layer characterized by the accumulation of partly decomposed organic matter.

F - An organic layer characterized by the accumulation of partly decomposed organic matter. The original structures are discernible with difficulty. Fungi mycelia are often present.

H - An organic layer characterized by an accumulation of decomposed matter in which the original structures are indiscernible.

master mineral horizons and layers - Mineral horizons are those that contain less than 30 percent organic matter.

A - A mineral horizon formed at or near the surface in the zone of removal of materials in solution and suspension and/or maximum accumulation of organic matter. Included are: (1) horizons in which organic matter has accumulted as a result of biologic activity (Ah); (2) horizons that have been eluviated of clay, iron, aluminum, and/or organic matter (Ae); (3) horizons having characteristics of (1) and (2) above but transitional to underlying B or C (AB or A and B); (4) horizons markedly disturbed by cultivation or pasture (Ap).

B - A mineral horizon or horizons characterized by one or more of the following: An enrichment in silicate clay, iron, aluminum or humus, alone or in combination (Bt, Bf, Bhf and Bh); Significant accumuations of exchangeable sodium (Bn), relative uniform browing due to oxidation of iron (Bm), and mottling and gleying of structurally altered material associated with periodic reduction (Bg).

C - A mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (1) the process of gleying, and (2) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca, Csa, Cg and C).

R - Underlying unconsolidated bedrock, such as granite, sandstone, limestone, etc. The boundary between the R layer and any overlying unconsolidated material is called a lithic contact.

lower case suffixes

b - Buried soil horizon.

c - A cemented (irreversible) pedogenic horizon.

ca - A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than four inches thick and if it has a $CaCO_3$ equivalent of less than 15%, it should have at least 5% $CaCO_3$ equivalent than the parent material. If it has more than 15% $CaCO_3$ equivalent, it should have 1/3 more $CaCO_3$ equivalent than IC.

cc - Cemented (irreversible) pedogenic concretions.

e - A horizon enriched with hydrated iron. It usually has a chroma of 3 or more. It is higher in colour value by one or more units when dry than an underlying B horizon.

f - A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5YR near the upper boundary and becomes yellower with depth. When moist the chroma is higher than 3 or the value is 3 or less. It contains at least 0.6% pyrophosphate-extractable Al + Fe in textures finer than sand and 0.4% in sands (coarse sand, sand, fine sand, and very fine sand). The ratio of pyrophosphate-extractable Al +Fe to clay (<0.002 mm) is more than 0.005 and organic C exceeds 0.5%. Pyrophosphate-extractable Fe is at least 0.3%, or the ratio of organic C to pyrophosphate-extractable Fe is less than 20, or both are true. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. These criteria do not apply to Bgf horizons, The following f horizons are differentiated on the basis of the organic C content:

Bf - 0.5-5% organic C

Bhf - more than 5% organic C.

No minimum thickness is specified for a Bf or a Bhf horizon, Thin Bf and Bhf horizons do not qualify as podzolic B horizons as defined later in this chapter.

Some Ah and Ap horizons contain sufficient pyrophosphate-extractable Al + Fe to satisfy this criterion of f but are designated Ah or Ap.

g - A horizon characterized by gray colours and/or prominent mottling indicative of permanent or periodic intense reduction. Chromas of the matrix are generally one or less.

h - A horizon enriched with organic matter. When used with A alone, (Ah) it refers to the accumulation of organic matter and must contain less than 30% organic matter. It must show one Munsell unit of value darker than the horizon immediately below or have one percent more organic matter than the IC. When used with A and e it refers to an Ah horizon which has been degraded as evidenced, under natural conditions, by streaks and plotches and often by platy structure.

j - Used as a modifier of e, g, n and t to denote an expression of, but failure to meet the specified limits to the suffix it modifies.

k - Presence of carbonate as indicated by visible effervescence with dilute HCL.

m - A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in colour or structure, or both. It has:

1) Soil structure rather than rock structure comprising more than half the volume of all subhorizons.

2) Some weatherable minerals.

3) Evidence of alteration in one of the following forms:
   a) Stronger chromas and redder hues than the underlying horizons.
   b) Evidence of the removal of carbonates.

4) Illuviation, if evident, is too slight to meet the requirements of a textural B or a podzolic B.

5) No cementation or induration and lacks a brittle consistence when moist.

p - A layer disturbed by man's activities, i.e. by cultivation and/or pasturing. To be used only with A.

s - A horizon with salts including gypsum which may be detected as crystals or veins, or as surface crusts of salt crystals, or by stressed crop growth, or by the presence of salt tolerant plants.

sa - A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates; the concentration of salts exceeds that present in the unenriched parent material. The horizon is 10 cm or more thick. 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.

t - A horizon enriched with silicate clay. It is used with B alone (Bt, Btg, etc.).

horizon boundary - Horizon boundaries are indicated by distinctness and form. The distinctness of a horizon boundary depends partly on the degree of contrast with the adjacent lower horizon and partly on the thickness of any transition zone between them.

hue - The aspect of colour that is determined by the wavelengths of light, and changes with the wavelength. Munsell hue notations indicate the visual relationship of a colour to red, yellow, green, blue, or purple, or an intermediate of these hues. See also **Munsell colour system, chroma,** and **value, colour.**

humus - That more or less stable fraction of the soil organic matter remaining after most of the added plant and animal residues have decomposed.

humus form - A group of soil horizons located at or near the surface of a pedon, which have formed from organic residues, either separate from, or intermixed with mineral materials. See also mull; moder; and mor.

ice contact - Fluvioglacial deposits laid down along the margins of glaciers.

igneous rock - Rock formed by the cooling and solidification of magma. It has not been changed appreciably since its formation.

illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension.

illuviation - The process of depositing soil material removed from one horizon in the soil to another, usually from an upper to a lower horizon in the soil profile. Illuviated substances include silicate clay, hydrous oxides of iron and aluminum, and organic matter.

impeded drainage - A condition that hinders the movement of water by gravity through soils.

impervious - Resistant to penetration by fluids or roots.

inclusion - Soil types found within a mapping unit which are not extensive enough to be mapped separately or as part of a soil complex.

indurated layer - A soil layer that has become hardened, generally by cementation of soil particles.

infiltration - The downward ~~entry~~ of water into the soil.

infiltration rate - A soil characteristic determining or describing the maximum rate at which water can enter the soil under specified conditions, including the presence of excess water.

inorganic soil - A soil made up mainly of mineral particles; a soil containing less than 17% organic carbon.

irrigation - The artificial application of water to the soil for the benefit of growing crops.

kame - An irregular ridge or hill of stratified glacial drift deposited by glacial meltwater.

Kettle - Depression left after the melting of a mass of glacier ice buried in drift.

lacustrine deposits - Sediments that have settled from suspension in bodies of standing fresh water and are later exposed by lowering the water level or by up-lifting of the land.

land - The solid part of the earth's surface or any part thereof. A tract of land is defined geographically as a specific area of the earth's surface. Its characteristics embrace all reasonably stable, or predictably cyclic, attributes of the biosphere vertically above and below this area, including those of the atmosphere, the soil, and the underlying geology, the hydrology, the plant and animal populations, and the results of past and present human activity, to the extent that these attributes exert a significant influence on the present and future use of land by man.

land classification - The arrangement of land units into various categories based on the properties of the land or its suitability for some particular purpose.

landforms - The various shapes of the land surface resulting from a variety of actions such as deposition or sedimentation (eskers, lacustrine basins), erosion (gullies, canyons), and earth crust movements (mountains).

landscape - All features such as fields, hills, forests, and water that distinguish one part of the earth's surface from another part. Usually it is the portion of land or territory that the eye can see in a single view, including all its natural characteristics.

leaching - The removal from the soil of materials in solution.

levee - A natural or artificial embankment along a river or stream.

liquid limit (upper plastic limit, Attenberg limit) - The water content corresponding to an arbitrary limit between the liquid and plastic states of consistence of a soil. The water content at which a pat of soil cut by a groove of standard dimensions will flow together for a distance of 12 mm under the impact of 25 blows in a standard liquid limit apparatus.

lithic layer - Bedrock under the control section of a soil. In Organic soils, bedrock occurring within a depth of between 10 cm and 160 cm from the surface, while in mineral soils it occurs between 10 and 100 cm of the surface.

loamy - Intermediate in texture and properties between fine-textured and coarse-textured soils. It includes all textural classes having "loam" or "loamy" as a part of the class name, such as clay loam or loamy sand.

loess - Material transported and deposited by wind and consisting of predominantly silt sized particles.

Luvisolic - An order of soils that have eluvial (Ae) horizons, and illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest or forest-grassland transition in a moderate to cool climate.

map, soil - A map showing the distribution of soil mapping units related to the prominent physical and cultural features of the earth's surface.

mapping unit, soil - Any delineated area shown on a soil map that is identified by a letter, symbol or number. A mapping unit may be a soil unit, a miscellaneous land type, or a complex of soil units.

marine limit - The boundary between marine influenced areas of land and those which were not submerged below sea level.

medium texture - Intermediate between fine-textured and coarse-textured soils. It includes the following textural classes: very fine sandy loam, loam, silt loam, and silt.

meltwater channel - An incised flat bottomed channel often appearing over-sized for the present stream which occupies it - sidewalls (10-60% slopes); channel bottom (0-10%).

mesic layer - A layer of organic material at a stage of decomposition between that of the fibric and humic layers.

metamorphic rock - Rock derived from pre-existing rocks, but differing from them in physical, chemical, and mineralogical properties as a result of natural geological processes, principally heat and pressure, originating within the earth. The pre-existing rocks may have been igneous, sedimentary, or another form of metamorphic rock.

milliequivalent (me) - One thousandth of the weight of clay or organic colloid that has a combining power equal to 1 gram-atomic weight of hydrogen. The atomic or formula weight divided by valence/1000.

mineral soils - A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter. It contains less than 17% organic carbon except that an organic surface layer if present may be up to 40 cm thick.

miscellaneous land type - A mapping unit for areas of land that have little or no natural soil.

moder - A zoogenous forest humus form made up of plant remains partly disintegrated by the soil fauna (F layer), but not matted as in raw humus. It is transitional to a zone of spherical or cylindrical microejections of arthropods that is permeated by loose mineral particles in its lower part and often throughout. Incorporation of organic matter is shallow and the mixing of organic and mineral particles is purely mechanical.

moderately coarse texture - Consisting predominantly of coarse particles. In soil textural classification, it includes all the sandy loams exept very fine sandy loam.

moderately fine texture - Consisting predominantly of intermediate-sized soil particles with or without small amounts of fine or coarse particles. In soil textural classification, it includes clay loam, sandy clay loam, and silty clay loam.

moraine (glacial till) - The materials transported beneath, beside, on, within and in front of a glacier; deposited directly from the glacier and usually not modified by any intermediate agent.

mor - This humus form (also known as "raw humus") is non-zoogenous and is comprised of Of, Om, Oh, or L, F, and H horizons sharply delineated from the mineral soil. It is usually strongly matted or compacted and often interwoven with fungal hyphae. Mors commonly occur on a variety of parent materials in coniferous forests where climatic and edaphic conditions prevent rapid decomposition of organic matter and development of an active population of soil microfauna. They also occur in mixed or hardwood stands, and in wetland areas (excluding Organics).

morphology, soil - (i) The physical constitution, particularly the structural properties, of a soil profile and exhibited by the kinds, thickness, and arrangement of the horizons in the profile, and by the texture, structure, consistence, and porosity of each horizon. (ii) The structural characteristics of the soil or any of its parts.

mottles - Spots or streaks, apparent in soil matrix. Colours are usually yellow, red, or orange. They are described in terms of abundance (few, common, many), size (fine, medium, coarse) and contrast (faint, distinct, prominent). Mottling in soils indicates poor aeration and lack of good drainage.

mottling - Formation of presence of mottles in the soil.

mull - A zoogenous forest humus form consisting of an intimate mixture of well-humified organic matter and mineral soil that makes a gradual transition to the horizon underneath. It is distinguished by its crumb or granular structure, and because of the activity of the burrowing microfauna, partly decomposed organic debris does not accumulate as a distinct layer (F layer) as in mor and moder.

Munsell colour system - A colour designation system specifying the relative degrees of the three simple variables of colour: hue, value, and chroma.

Order, soil - The highest category in the Canadian system of soil classification. All the soils of Canada have been divided into nine orders: Chernozemic, Solonetzic, Luvisolic, Podzolic, Brunisolic, Regosolic, Gleysolic, Organic, and Cryosolic. All the soils within an order have one or more characteristics in common.

Organic - An order of soils that have developed dominantly from organic deposits. The majority of Organic soils are saturated for most of the year, unless artificially drained, but some of them are not usually saturated for more than a few days. They contain 17% or more organic carbon.

organic matter, soil - The organic fraction of the soil; including plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

ortstein - (i) An indurated layer in the B horizon of Podzols in which the cementing material consists of illuviated sesquioxides and organic matter. (ii) As a subgroup of Podzolic soils, Ortstein indicates a Bhfc or Bfc horizon that is strongly cemented, occurs over at least one-third of the exposure, and is at least 2.5 cm thick.

outwash, glacial - Sediments washed out by flowing water beyond a glacier and laid down in thin forset beds as stratified drift. Particle size may range from boulders to silt.

pans - Horizons or layers in soils that are strongly compacted, indurated, or very high in clay content.

parent material - The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

peat - Unconsolidated soil material consisting largely of undecomposed, or only slightly decomposed, organic matter.

ped - A unit of soil strucure such as a prism, block, or granule, which is formed by natural processes, in contrast with a clod, which is formed artificially.

pedogenic - Of or referring to the genesis (formation and development) of soil; used mainly when discussing the kind, strength and distribution of soil horizons in a soil profile.

pedology - Those aspects of soil science dealing with the origin, morphology, genesis, distribution, mapping, and taxonomy of soils, and classification in terms of their use.

perched water table - A water table due to the "perching" of water on a relatively impermeable layer at some depth within the soil. The soil within or below the impermeable layer is not saturated with water.

percolation (of soil water) - The downward movement of water through soil.

permeability, soil - The ease with which gases and liquids penetrate or pass through a bulk mass of soil or a layer of soil. Because different soil horizons vary in permeability, the specific horizon should be designated.

perviousness - The potential of a soil to transmit water internally, as inferred from soil characteristics.

pH, soil - The intensity of acidity or alkalinity, expressed as the logarithm of the reciprocal of the H^+ ion concentration. pH 7 is neutral, lower values indicate acidity and higher values alkalinity.

phase, soil - A subdivision of a soil type of other unit of classification having characteristics that affect the use and management of the soil, but that do not vary sufficently to differentiate it as a separate type.

plain - A flat to gently undulating surface form (0-10% slopes). Slopes are most often simple and have variable drainage pattern depending on texture of material.

plastic limit (Attenberg limit) - (I) The water content corresponding to an arbitrary limit between the plastic and semi-solid states of consistency of a soil. (II) The water content at which a soil will just begin to crumble when rolled into a thread approximately 3 mm in diameter.

plasticity index - The numerical difference betwen the liquid and the plastic limit. The plasticity index gives the range of moisture contents within which a soil exhibits plastic properties.

platy - Consisting of soil aggregates that have developed predominantly along the horizontal axes; laminated; flaky.

Podzolic - An order of soils having podzolic B horizons (Bh, Bhf, or Bf) in which amorphous combinations of organic matter (dominantly fulvic acid), Al, and usually Fe are accumulated. The sola are acid and the B horizons have a high pH-dependent charge. The great groups in the order are Humic Podzol, Ferro-Humic Podzol, and Humo-Ferric Podzol.

pore space - The total space not occupied by soil particles in a bulk volume of soil.

profile, soil - A verticle section of the soil through all its horizons and extending into the parent material.

reaction, soil - The degree of acidity or alkalinity of a soil, which is usually expressed as a pH value.

regolith - The unconsolidated mantle of weathered rock and soil material overlying solid rock.

Regosolic - An order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other soil orders.

relief - The difference in elevations or irregularities of the land surface when considered collectively.

runoff - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

saline - A nonalkali soil that contains enough soluble salts to interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 mS/cm, the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5.

sand - a soil particle between 0.05 and 2.0 mm in diameter. The textural class name for any soil containing 87% or more of sand and not more than 10% of clay.

scarp - A steep, precipitous slope of some extent along the margin of a plateau, mesa, terrace, or bench.

sedimentary rock - A rock formed from materials deposited from suspension or precipitated from solution and usually more or less consolidated. The principal sedimentary rocks are sandstones, shales, limestones, and conglomerates.

seepage - (i) The escape of water downward through the soil. (ii) The emergence of water from the soil along an extensive line of surface in contrast to a spring where the water emerges from a local spot.

series, soil - The second category in the Canadian system of soil classification. This is the basic unit of soil classification, consisting of soils which are essentially alike in all major profile characteristics except the texture of the surface.

silt - Soil mineral particles ranging between 0.05 and 0.002 mm in equivalent diameter. Soils of the silt textural class contain 80% silt and less than 12% clay.

site - In ecology, an area described or defined by its biotic, climatic and soil conditions as related to its capacity to produce vegetation. An area sufficiently uniform in biotic, climatic, and soil conditions to produce a particular kind of vegetation.

slump - A deep-seated, slow moving rotational failure occurring in plastic materials resulting in vertical and lateral displacement.

soil - The unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Soil has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effect), macro and micro organisms, and topography, all acting over a period of time.

soil forming factors - The variable, usually interrelated natural agencies that are responsible for the formation of soil. The factors are: parent material, climate, organisms, relief, and time.

soil texture - The relative proportions of the various soil separates in a soil as described by the classes of soil texture. The names of textural soil classes may be modified by adding suitable adjectives when coarse fragments are present in substantial amounts.

solum - The upper horizons of a soil in which the parent material has been modified and within which most plant roots are confined. It consists usually of A and B horizons.

stones - Rock fragments 25 cm in diameter if rounded, and 38 cm along the greater axis if flat.

stratified materials - Unconsolidated gravels, sand, silt and clay arranged in strata or layers.

structure, soil - The combination or arrangement of primary soil particles into secondary particles, units, or peds. The peds are characterized and classified on the basis of size, shape, and degrees of distinctness into classes, types and grades.

subgroup, soil - A category in the Canadian system of soil classification. These are subdivisions of the soil great groups.

subsoil - A general term for the layer of soil (or surficial geologic deposit) which, in the context of this report, underlies the surface and subsurface soil layers. It begins about 50 cm below the surface and continues downward for about 75 to 100 cm.

subsurface soil - A general term used in this report for the approximately 20 to 30 cm thick layer of soil underlying the surface soil.

surface soil - The uppermost part of the soil that is ordinarily moved in tillage, or its equivalent in uncultivated soils in this report if refers to the upper 15 to 20 cm of the soil.

telluric seepage - Seepage moving through the soil on a plane more or less parallel to the land surface and often above a restricting area; the waters are usually oxygenated.

terrace - Relatively level (0-5% slopes) flat surface which is terminated by an abrupt change in slopes on one or more sides. Often occurs in sequence on valley walls or paired on opposite sides of a valley.

terric layer - An unconsolidated mineral substratum underlying organic soil material.

tidal flats - Areas of nearly flat, often barren mud periodically covered by tidal waters. Normally these materials have an excess of soluble salt. A miscellaneous land type.

till - See glacial till.

topography - The shape of the ground surface such as hills, mountains or plains. The soil slopes may be smooth or irregular. The slope classes are defined in Chapter 3.1.3.

type, soil - A unit in the natural system of soil classification; a subdivision of a soil series consisting of or describing soils that are alike in all characteristics including the texture of the A horizon.

Unified soil classification system (engineering) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit. It is employed in schemes to predict soil behavior as an engineering construction material.

value, colour - The relative lightness of colour, which is approximately a function of the square root of the total amount of light.

variant, soil - A soil whose properties are believed to be sufficiently different from other known soils to justify a new name, but comprising such a limited geographic area that creation of a new named soil is not justified.

water holding capacity - The ability of a soil to hold water. The water-holding capacity of sandy soils is usually considered to be low, while that of clayey soils is high.

water table - Elevation at which the pressure in the water is zero with respect to atmospheric pressure.

weathering - The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

APPENDIX A
CLIMATE DATA

(from Environment Canada)

Table 4.2
Temperature and Precipitation Means for Selected Stations

MONTH	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
DUNCAN													
DAILY TEMP. (°C)	2.1	4.1	6.1	9.4	13.5	15.9	18.6	18.2	15.3	10.4	5.9	3.6	10.2
TOTAL PRECP.(mm)	180	119	86	60	34	33	22	22	44	106	159	176	992
NANAIMO AIRPORT													
DAILY TEMP. (°C)	1.5	3.5	4.7	7.8	11.7	14.8	17.1	16.7	13.9	9.2	5.1	2.9	9.1
TOTAL PRECP.(mm)	162	111	101	64	37	39	23	26	44	106	154	180	1048
COWICHAN BAY													
DAILY TEMP. (°C)	2.2	4.3	5.6	8.4	11.9	14.8	17.3	17.0	14.4	9.9	5.7	3.4	9.6
TOTAL PRECP.(mm)	157	107	82	52	37	33	22	25	39	98	144	183	961
SHAWNIGAN LAKE													
DAILY TEMP. (°C)	1.6	3.7	5.1	7.9	11.8	14.7	17.2	17.0	14.3	9.7	5.4	2.9	9.3
TOTAL PRECP.(mm)	202	136	109	63	36	35	22	25	46	117	176	211	1116

(from Environment Canada)

Table 4.3
Frost Free Days for Selected Stations

STATION	PERIOD OF RECORD (YR)	FROST FREE DAYS
Cowichan Bay	30	218
Duncan	18	167
Nanaimo Airport	24	157
Shawnigan Lake	30	174

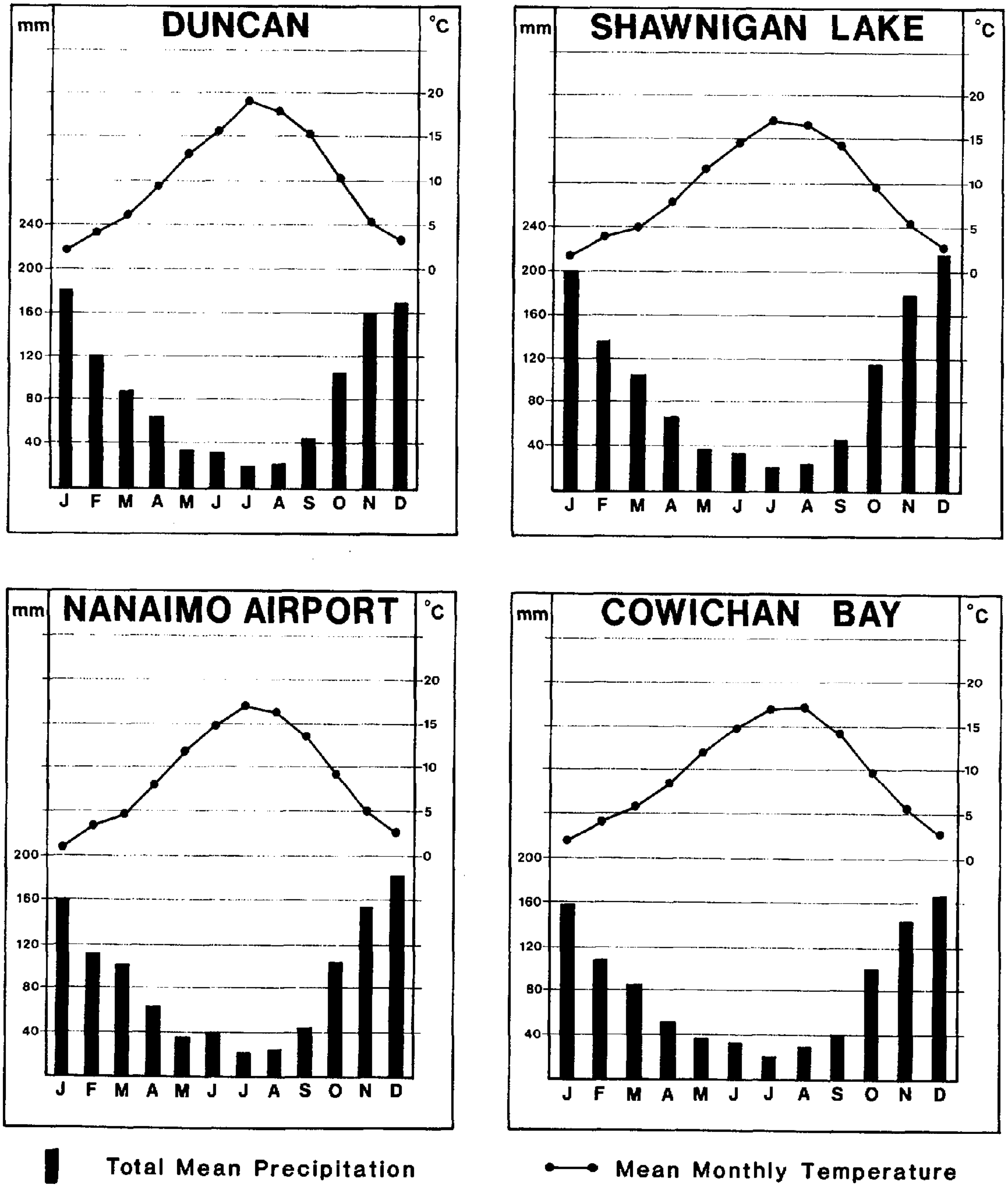
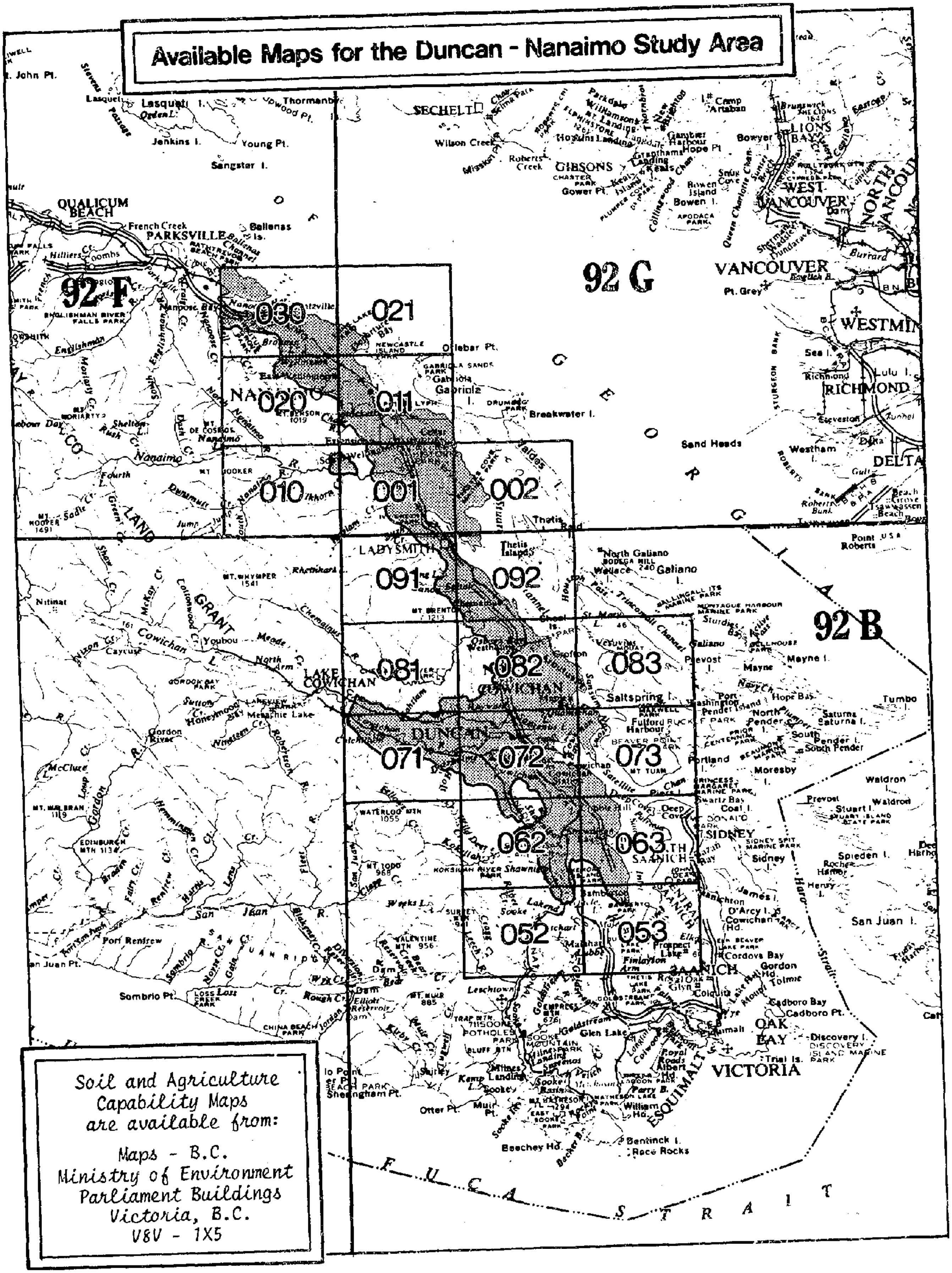


Figure 4.1 Mean monthly temperatures and precipitation for four selected stations.

Available Maps for the Duncan - Nanaimo Study Area



Soil and Agriculture
Capability Maps
are available from:

Maps - B.C.
Ministry of Environment
Parliament Buildings
Victoria, B.C.
V8V - 1X5

M28 2637