Sensitive Ecosystems Inventory: Middle Shuswap River, 2011

Volume 2: Terrestrial Ecosystem and Terrain Mapping and Expanded Legend

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Helen Davis completed the landowner contact and ***Mark Hammerl*** ferried the field crew across to islands in the Shuswap River.

This project has adapted material from the reports for the Coldstream – Vernon Sensitive Ecosystems Inventory[7] (SEI), Central Okanagan SEI[8], and Lake Country SEI[9].

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[1] Iverson & MacKenzie Biological Consulting Ltd.
[2] Polar Geoscience Ltd.
[3] Splatsin First Nation Band, Enderby, B.C.
[4] B.C. Hydro
[5] Makonis Consulting Ltd.
[6] Baseline Geomatics Inc.
[7] Iverson and Shypitka 2003
[8] Iverson et al. 2004
[9] Iverson and Uunila 2006

Introduction

This report presents detailed information on terrain and ecosystems along the Middle Shuswap River. It is the second volume in a series of three volumes.

Volume 2, this report, provides detailed information on terrestrial ecosystem mapping (TEM) methods and gives descriptions of each of the ecosystems that occur within the sensitive ecosystems or other important ecosystems categories described in Volume 1. Appendix B of Volume 1 provides tables that can be used to cross-reference between sensitive and other important ecosystems units and terrestrial ecosystem map units in this report.

This report describes the natural setting of the study area and details methods, results and recommendations for bioterrain mapping and ecosystem mapping. It is intended for use by professionals that require more detailed ecological and terrain information.

Volume 1[10] is intended for people and organizations that need information to help conserve and protect remaining sensitive and important ecosystems in the Middle Shuswap River area and other similar areas. It is also intended to provide information and advice to landowners and developers on how to minimize and avoid possible degradation of sensitive ecosystems due to land use and development activities.

Volume 3[11] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following seven species: Western Toad (*Anaxyrus boreas*), Painted Turtle (*Chrysemis picta*), Northern Rubber Boa (*Charina bottae*), Western Skink (*Plestidon skiltonianus*), Western Screech-owl (*Megascops kennicottii macfarlanei*), Flammulated Owl (*Otus flammeolus*), and American Badger (*Taxidea taxus*). All of these species are considered at risk in the province of B.C. and most are listed under the federal Species at Risk Act. These species provide a cross-section of threatened or endangered amphibians, reptiles, birds, and mammals that depend on a range of different ecosystems in the study area. There are many other threatened and endangered species that likely occur in the study area as well and are listed in Appendix C of Volume 1, and in each ecosystem chapter of Volume 1 in which they are most likely to occur.

Wildlife habitat mapping portrays the potential importance of each ecosystem to specific animal species through a species-habitat model. The model assigns ratings to different ecosystem units from the TEM based on the needs of the species for particular life requisites. These ratings are displayed on the wildlife habitat maps. Volume 3 is intended for professionals who require more detailed information on wildlife habitat values in the study area than Volume 1 provides.

[10] Iverson 2012
[11] Haney 2012

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1 Study Area

The study area (Figure 1) lies within the mid-Shuswap River valley of south-central British Columbia. The boundaries of the study area includes a swath varying from about 200 m to over two kilometres on either side of the 29 km of the Shuswap River between the Wilsey and Sugar Lake (Peers) dams and approximately two kilometres up Cherry, Ferry, and Woodward Creeks, and some areas below Wilsey dam. The area covers 4863 ha and includes private land (including lands owned by BC Hydro), provincial crown land, municipal lands, and a minor amount of federal crown land.

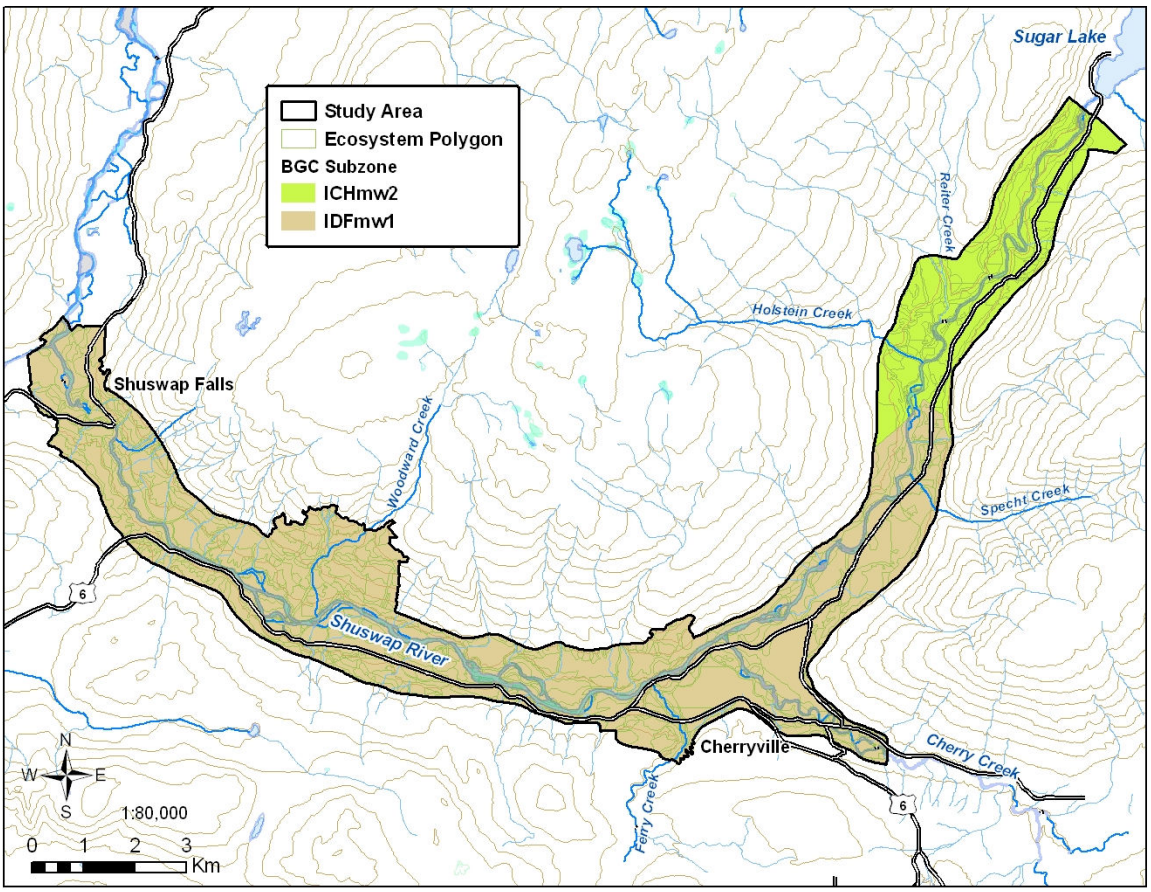

Figure 1. Map of the Middle Shuswap River study area. Study area boundary is shown in black. The two biogeoclimatic (BGC) subzones within the study area are shown in different colours.

1.1 Landscape Setting

The middle Shuswap is characterized by complex terrain at the junction of three physiographic subdivisions, including:

- the Shuswap Highland to the north and west of the Shuswap River;
- the Okanagan Highland to the south of the Shuswap River; and
- the Monashee Mountains to the east of the Shuswap River.

The Shuswap Highland consists of gently sloping plateau areas flanked by moderately steep to steep valley sides. The Okanagan Highland includes rounded mountains and gentle slopes and ridges. The Monashee Mountains are characterized by moderately steep to steep rugged mountains. The Shuswap River has carved a path through a series of terraces and benches that stretch about a kilometre across the valley bottom.[12]

Bedrock Geology

Bedrock geology information is from 1:50,000 scale mapping by Glombick *et al*. (2004) and Thompson *et al*. (2004). The formation of the landscape in the Middle Shuswap area has taken place over several hundred million years resulting in highly varied geology. A wide variety of metamorphic rocks of various ages are the most common and younger plutonic rocks are widely spread throughout the western half of the study area.

The terrain at the outlet of Sugar Lake is underlain by Devonian to Permian-aged metamorphic rocks of the Silver Creek Formation, including schist, quartzite, marble and amphibolite. Proterozoic-aged schist (Tsuius Schist), the oldest rock formation in the study area, is located along the south side of the Shuswap River between Shuswap Falls and west of the junction of Sugar Lake Road and Highway 6.

Black quartzite of Permian age is located on the east side of Shuswap River north of Specht Creek. Devonian-aged calcareous quartzite of the Chase Formation is location on either side of the Shuswap River in the vicinity of lower Reiter Creek.

Mixed metamorphic rocks of the Triassic-aged Slocan Group (including phyllite, argillite, quartzite and tuffaceous rocks) are located on both sides of the Shuswap River from the mouth of Reiter Creek to just west of the junction of Highway 6 and the Sugar Lake Road.

Tertiary-aged plutonic rock of the Ladybird Plutonic Suite (including granite to quartzmonzonite) is located on the north side of the Shuswap River from the edge of the study area in the northwest to just west of the junction of Highway 6 and the Sugar Lake road. These rock types are located on the west side of Shuswap River in the northwest corner of the study area as well.

Characteristics of bedrock, such as structure (ie. strength, joint spacing, presence of bedding) and mineral composition influence the shape and size of clasts and matrix texture of colluvium and till, as well as affecting wildlife habitat and the soil nutrient regime.

Finer-grained metamorphic bedrock of sedimentary origin (ie. schist, argillite, greenstone, and limestone), such as found in the Tsuius Schist, Silver Creek Formation and the Slocan Group, tend to break down into silt and fine sand and consequently result in a sandy silt matrix till. Many of the

[12] Holland 1976

rocks include variable amounts of mica and chlorite. These tend to break into pebble-sized rubble and flaggy slabs and consequently, boulders and blocks are not generally common. Highly foliated and weak bedrock such as phyllite (found in the Slocan Group) can be unstable on gentler slopes than stronger rock types and does not provide a solid foundation for surface structures. Many metasedimentary rock types tend to be nutrient-rich.

Well-jointed plutonic rocks, such as found in the Ladybird Plutonic Suite, break into large blocks and boulders and can produce bouldery tills. On weathering, the rock breaks down into sand and minor silt and consequently, areas of granitic bedrock tend to produce till with a silty sand matrix. These rock types tend to produce soils with low nutrient regimes.

Landscape Evolution

The present physiography dates back two hundred million years ago (early Jurassic) when plate tectonics welded the former Pacific Ocean to the margin of the North American continent. This created ridges of metamorphic and plutonic bedrock orientated in a north-south direction. About 50 million years ago (early Tertiary), plate tectonics caused uplift of the area accompanied by extensive volcanism. A long period of relative stability followed, during which erosion and deposition formed a low-relief landscape with gentle slopes and low hills. During late Tertiary, the area was subject to uplift again, followed by a renewed period of down cutting, with the stream valleys deeply incising into the old erosion surface.

Within the study area, the Quaternary period consisted of alternating glacial and non-glacial episodes[13]. During this time, glaciers effected only relatively minor modifications to the surface of the older topography. Most of the surficial materials found in the study date from the last major glacial episode, known as the Fraser Glaciation, which commenced about 19,000 years ago[14].

At the beginning of the Fraser Glaciation, ice accumulated in the high mountains and then gradually spread to valleys and lowlands. About 14,500 years ago, when the Cordilleran Ice Sheet was thickest and most extensive at the climax of Fraser Glaciation, ice flowed generally southward across the study area[15]. Although the highest peaks in the Monashees to the east of the study area protruded through the ice sheet at the glacial maximum, the rounded ridge tops suggest that the remainder of the region, including the study area, was completely overridden by ice at this time.

Deglaciation occurred between about 14,000 and 11,000 years ago. Deglaciation took place by downwasting so that the uplands emerged from beneath the ice while tongues of ice remained in the valley bottoms[16]. Stagnant ice in the valley bottoms impounded temporary glacial lakes in the valley. Downwasting ice often forms characteristic subglacial and ice-marginal landforms on gentle surfaces, such as, eskers, kames, and meltwater channels.

During post-glacial times, processes have re-worked some glacial sediments and weathered bedrock to redistribute them as colluvium (moved by gravity) and fluvial (moved by water) sediments. Some streams and rivers that have graded to the present day levels have downcut into glacial deposits creating terraces, benches, and steep-sided scarps. Eolian sediments have been transported by wind and may have deposited thin veneers on the gentler slopes. Fine-grained

[13] Fulton, 1975
[14] Fulton, 1975
[15] Fulton 1975
[16] Fulton 1969

sediments have accumulated in depressions due to slope wash. Over time, the glacial and post-glacial sediments, have undergone changes due to physical, chemical and biological processes at work in the upper half metre of the parent material to create soils that support plant communities.

Soils[17]

Soil forms the interface between surficial materials (parent materials) and the ecosystems they support. Ecosystems influence the formation of soils and soil affects what types of plants grow at a given site and the productivity of that site. Soil is defined as "naturally occurring, unconsolidated mineral or organic material at least 10cm thick that occurs at the earth's surface and is capable of supporting plant growth"[18]. The factors affecting soil formation include: parent material, climate, biota (including the vegetation, wildlife and organisms in the soil), topography (for example: slope, aspect, and slope morphology), and time. The following descriptions of the major soil groups present in the study area are derived from The Canadian System of Soils Classification (Soil Classification Working Group 1998). Soil was not mapped in this project.

Chernozemic soils (Brown and Darkbrown Chernozems) have developed in the semi-arid lower valley grassland and open forest communities. These are characterized by the formation of an organic rich (Ah) upper mineral horizon. The Ah horizon forms primarily from the accumulation of organic material from the fine roots of grasses and herbaceous plants. These soils were rare in the study area.

Brunisolic soils occurred throughout the study area. They were common under forested communities. These soils are present on moderately- to rapidly-drained surficial materials that are medium- to coarse-textured. These soils have poorly developed horizons. They may be found in a complex with other soil types including chernozems, luvisols, and gleysols.

Luvisolic soils occur on moderately- to rapidly-drained, clay-rich parent materials such as muddy glaciolacustrine deposits and finer textured tills. The movement of clay particles from the upper horizons to a lower horizon of accumulation (Bt) characterizes these soils. Luvisols are most likely to occur where fine-grained glaciolacustrine sediments were mapped within the study area.

Organic soils develop under wet conditions where decomposition rates are relatively slow and a net accumulation of organic material (peat) occurs. Most organic soils are poor- to very poorly-drained and are saturated for prolonged periods of time and tend to occur under wetland communities in depressions. Organic soils were not encountered within the study area but may occur.

Gleysolic soils develop under moist to wet conditions usually in depressions, toe slopes and on valley bottoms. They are mineral soils formed under periodic, or sustained, reducing conditions caused by saturation, and result in gleyed colours (grey, blue and green). Gleysolic soils are imperfectly to very poorly drained and may occur under moist forest and wetland communities.

Regosolic soils are under-developed soils that lack defined horizonation. They occur on recently deposited parent materials such as landslide and river deposits; recently exposed materials such as landslide scarps and eroded banks; or under conditions that suppress soil formation, for example, extremely dry conditions (very rapidly drained, coarse textured soils on southerly

[17] This section is adapted from Iverson et al. 2004

[18] Soil Classification Working Group 1998

aspects). Regosols are often associated with non-vegetated or early successional plant communities. Regosols were common on floodplains and talus slopes throughout study area.

Solonetzic soils occur on saline parent materials in semiarid to subhumid regions of the British Columbia interior. These soils occur in small non-vegetated or sparsely vegetated pockets in depressions and toe slope positions. These soils are often used as salt licks by wildlife and thus have high wildlife values. They occur in association with chernozemic soils and to a lesser degree with gleysolic and luvisolic soils. This soil type is likely rare or non-existent within the study area.

Climate

The study area is located within a transition between the northern portion of a dry climatic system with warm, dry conditions and a moist climate resulting from the loss of moisture from western air masses passing over the Columbia Highlands[19]. The Coast and Cascade Mountains create a rain shadow effect in the interior of British Columbia, reducing summer and winter precipitation, but the moist Pacific air masses tend to lose their moisture as they rise over the Columbia Highlands. In summers, hot dry air from the Great Basin to the south partially penetrates the area.

Ecoregional and Biogeoclimatic Classification

The study area is located within the Southern Interior Ecoprovince, the northern extension of the Columbia Basin that extends south to Oregon[20], and within the highlands of the Columbia Mountains in the Southern Interior Mountains Ecoprovince. The study area lies west of and partially into the highlands of the Columbia Mountains and east of the Coast and Cascade Mountains. It includes the Northern Okanagan Highland Ecosection (NOH), a cool, moist, transitional mountain area, dominated by a rolling upland and the Shuswap Highland Ecosection (SHH), a moist, rolling upland area.

The Ministry of Forests biogeoclimatic ecosystem classification is a system of classifying vegetation based on climatic and topographic patterns[21]. Two biogeoclimatic variants are represented within the study area: the Shuswap Moist Warm Interior Douglas-fir Variant (IDFmw1), and the Shuswap Moist Warm Interior Cedar – Hemlock Variant (ICHmw2). Figure 1 (above) shows the locations of the subzones within the study area.

The **IDFmw1** has a warm, dry climatic regime (but is moister than the IDFxh1) and a relatively long growing season with summer drought. It occurs in the western three-quarters of the study area. Mature forests are dominated by Douglas-fir with some western redcedar and western larch.

The **ICHmw2** occurs in the north-eastern portion of the study area. It is wetter than the IDFmw1. Mature forests are dominated by western redcedar and western hemlock with Douglas-fir.

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[19] Demarchi 1996

[20] The ecoregional classification system was developed and adapted by the Ministry of Environment, Lands & Parks, Wildlife Branch, to provide a systematic view of the small scale ecological relationships within British Columbia . See Demarchi 1996 for further information.

[21] The Biogeoclimatic Ecosystem Classification system was developed by the Ministry of Forests to provide a basis for natural resource management, particularly forest management and range management. See Pojar et al. 1987 for further information.

1.2 Ecology and Disturbance Processes

Along the Shuswap River, many ecosystems are on floodplains where they are inundated during the early part of the growing season. Low benches are flooded by more powerful flooding for a longer time period (more than a few weeks) than middle benches (less than a few weeks). Both of these continue to receive subirrigation for most of the growing season. These annual flood events cause erosion and sediment deposition resulting in channel movements. Low benches can become middle benches as the site accumulates sediments and become raised higher. As sediments continue to accumulate, benches can become higher until they are eventually isolated from regular flooding[22].

In some floodplain ecosystems, reed canarygrass has established and dominates the understory. This may have resulted from a particularly severe flood event; once the grass was established, it is tenacious[23].

The severity and duration of flooding has been modified by the damming of the Shuswap River, this may have reduced the extent of floodplain communities[24].

Within the upland portion of the Interior Douglas-fir Zone, historical frequent low-intensity surface fires maintained open Douglas-fir, western larch and ponderosa pine forests. A range of mean fire intervals have been recorded for dry to wet interior Douglas-fir forests in B.C. including: 5 to 49 years in the IDFdk3[25], 13 years in the IDFdk1[26], 14 and 19 years for two sites in the IDFdm2[27], and, 6 to 23 years in the IDFww[28]. The mean fire interval for the IDFmw1 is likely within these ranges.

Fires were likely ignited by both lightning and First Nations peoples. First Nations people used fire to improve wildlife habitat, root crops (for example, mariposa lily and balsamroot) and likely to fireproof their villages[29]. Most native grassland plants are well adapted to fire through perennating buds or seeds just at or below the ground surface where fire temperatures are cooler[30]. Figure 2 shows a prescribed fire similar to many historical fires.

Figure 2. Understory fire similar to how most historical fires burned.

Frequent fire maintained forest understories dominated by bunchgrasses and shrubs and promoted nutrient cycling. Most grasses, forbs, shrubs and mature trees survived most fires, but small trees likely often died[31]. Historically, forests were mostly very open with grassy, shrubby

[22] MacKenzie and Moran 2004
[23] W. M. MacKenzie, pers. comm..
[24] MacKenzie and Moran 2004
[25] Iverson et al. 2002
[26] Gray and Riccius 1998
[27] Gray et al. 1998
[28] Gray and Riccius 2000
[29] Turner 1994; Pokotylo and Froese 1983; Daubenmire 1968
[30] Daubenmire 1968
[31] Agee 1993

understories. Moister sites were more productive and likely more closed and shrubby. Fires also contribute to nutrient cycling, releasing nutrients that are otherwise very slowly released through decay processes.

The exclusion of most fires has lead to striking changes in these ecosystems. Tree densities are now much higher in forests. Dense forests with accumulated fuels have lead to declines in grass and shrub productivity, increasing susceptibility to insect and disease outbreaks, and a shift from frequent low-severity fires to larger, more intense crown fires such as the Okanagan Mountain fire in the summer of 2003.

Within the Interior Cedar Hemlock Zone, the ICHwk1 in Glacier National Park was estimated to have a fire cycle of 80-110 years[32]; age class data for the ICHmw2 gave an estimated fire return interval of 129 years[33]. For interior cedar – hemlock forests in the US, upland areas likely had a fire-free interval of 50 to 150 years with moist streamsides having long fire free intervals of greater than 200 years[34]. Fires were both crown fires and surface fires occurring during extreme summer droughts[35]. Cyclic outbreaks of hemlock looper were likely also a major source of disturbance in these forests[36].

Historically, the principal grazing animals were likely deer and elk[37]. Domestic cattle grazing in some grasslands in the study area has reduced cover of the more grazing-sensitive species such as bluebunch wheatgrass, Idaho fescue, and have more cover of grazing-resistant native grasses such as Columbian needlegrass, junegrass and Sandberg's bluegrass[38]. Some grasslands have been overtaken by invasive alien plants such as cheatgrass, an introduced annual brome grass. Pockets of late seral and climax grasslands occur on steeper slopes on crown land in the study area.

We observed that nearly all accessible areas of the study area had been clear-cut or selectively harvested, leaving very few large, old trees.

[32] Johnson et al. 1990
[33] Pollack et al. 1997
[34] Arno and Davis 1980
[35] Arno 1980; Davis et al. 1980
[36] Parfett et al. 1995; Alfaro et al. 1999
[37] Tisdale 1947
[38] Dormaar et al.1989; McLean and Wikeen 1985; Daubenmire 1940

2 Methods and Limitations

This project has used the provincially recognised Terrestrial Ecosystem Mapping standard[39] to map terrain and ecosystems in the study area.

2.1 Terrestrial Ecosystem Mapping

Mapping at a scale of 1:20,000 and survey intensity level four was completed according to the methods in *Standard for Terrestrial Ecosystem Mapping in British Columbia*[40].

In addition to the required map attributes, the following map attributes were also recorded for each polygon:

- stand composition modifiers (e.g., coniferous, mixed or broadleaf stand),
- seral association for grassland and floodplain ecosystems,
- condition of the ecosystem (COND) for sensitive and other important ecosystems, and
- ecological integrity or viability of the ecosystem (VIAB) for sensitive and other important ecosystems,

Preliminary Terrain Mapping

Terrain mapping is a method to categorize, describe and delineate characteristics of surficial materials (the loose materials on top of bedrock), landforms, and geomorphological processes (the active mechanisms that continue to shape the landscape) within the natural landscape[41].

A terrain map is a map of surficial materials; it shows the surficial material type and thickness combined with surface expression or landform type (and geological processes if applicable). Each surficial material type is classified based on its genesis. It has its own characteristics of deposition and physical properties such as texture and consolidation.

Terrain maps are the basis for many kinds of land use planning including terrain stability, ecosystem mapping, planning of urban roads and development, assessment of geological hazards, and aggregate mining. Terrain mapping with an ecological emphasis is called bioterrain mapping. Bioterrain mapping forms the basis of terrestrial ecosystem mapping (TEM) by delineating polygons with similar ecological conditions such as soil moisture, aspect, and vegetation characteristics.

Terrain mapping is based on air photo interpretation, which is then ground-truthed in the field. For this project, terrain mapping followed the standard British Columbia procedures for terrain classification[42], mapping methods[43], and bioterrain mapping methods[44].

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[39] Resources Inventory Committee 1998
[40] Resources Inventory Committee 1998
[41] Ministry of Forests 1999
[42] Howes and Kenk 1997
[43] Resources Inventory Committee 1996
[44] Resources Inventory Committee 1998

Delineation was based on the following characteristics:

- terrain type;
- material depths;
- drainage;
- slope breaks;
- slope position;
- aspect: cool (from 285 to 135°) and warm (from135 to 285°);
- geomorphological processes;
- surface expression and slope morphology (e.g., concave or convex);
- vegetation changes;
- riparian zones and corridors; and
- any other ecologically significant areas such as cliffs, talus slopes, and ponds.

Preliminary terrain mapping was completed in 2007 on colour aerial photographs at a scale of approximately 1: 17 000 (Table 1) by Polly Uunila, P.Geo. The linework was transferred to a digital map base by mono-restitution and the terrain labels were entered into the database. Appendix B: Terrain Legend provides a description of all materials and geomorphological processes mapped. Figure 3 shows an example of a terrain polygon label (although labelled terrain maps were not generated).

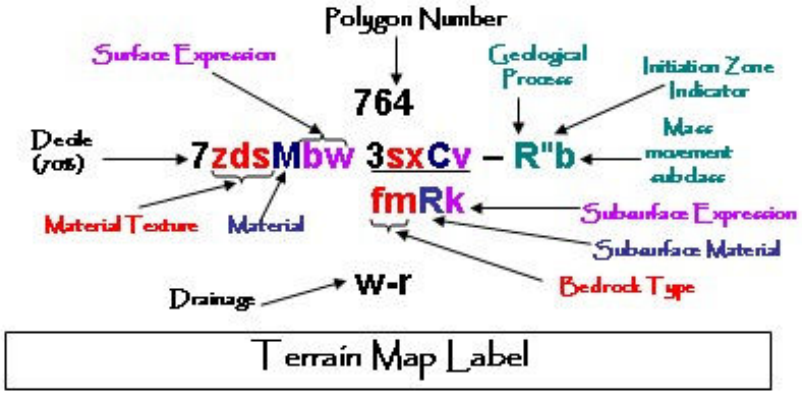

Figure 3. Sample terrain map label.

Table 1. Mapsheets and aerial photographs used for mapping the study area.

TRIM Mapsheets	082L027 082L028 082L038
Flight Line and Air Photo Numbers (from north to south)	BCC94048 #12 – 14 BCC94100 #5 – 7 BCC94098 #135 – 137 BCC94048 #153 – 156, 165 – 167 BCC94043 #201 – 204, 210 – 212 BCC94044 #1 – 6 BCC94049 #22 - 26

Field Sampling

A field-sampling plan was developed using aerial photographs and forest cover maps with the following objectives in mind:

- verify the presence, quality, and condition of sensitive ecosystems
- identify other ecosystems
- verify terrain labels
- verify ecosystems in at least 10% of the polygons
- gather detailed data for unclassified ecosystems

Landowners were contacted prior to fieldwork and many landowners granted us access to sample on their lands. Field sampling took place in June and July 2007. A team of three scientists conducted field sampling: a plant ecologist (Kristi Iverson, R.P.Bio. and John Grods, R.P. Bio.), a terrain and soil specialist (Polly Uunila, P.Geo.), and a wildlife habitat ecologist (Allison Haney and Ken MacKenzie).

Three types of sample plots were used to identify and assess ecosystems and terrain: detailed ecological plots (FS882), ground inspections, and visual inspections (Appendix A: Field Plot Forms). Field sampling procedures for detailed ecological plots and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[45]. We followed guidelines from the *Standard for Terrestrial Ecosystem Mapping* in British Columbia[46] for visual inspection data collection. Additionally, we collected the pertinent information from a site conservation evaluation form developed by the B.C. Conservation Data Centre to evaluate the condition and ecological integrity of all sensitive ecosystems as per the Standard for Mapping Ecosystems at Risk in British Columbia[47].

The location of all ground inspection plots and visual inspections were recorded by GPS. Site locations are shown on the Sensitive Ecosystems Inventory map and are also shown below in Figure 4.

[45] B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998
[46] Resources Inventory Committee 1998
[47] Ministry of Environment Ecosystems Branch 2006

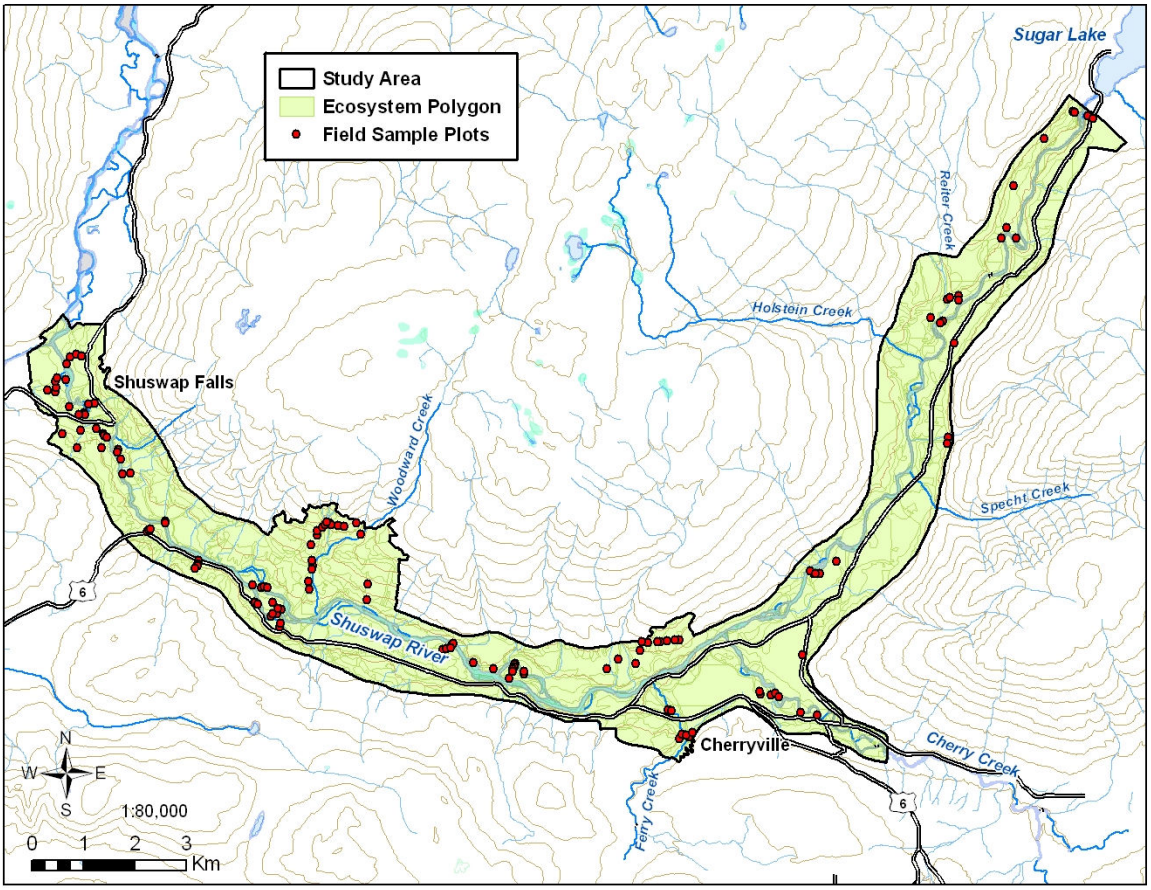

Figure 4. Location of all field plots for the Middle Shuswap River SEI study area.

Forested and grassland ecosystems were identified using existing site series described in *A Field Guide for Site Identification and Interpretation for the Kamloops Forest Region*[48]. Non-forested units such as wetlands and rock outcrops and grassland seral associations were adopted from previous projects: the Coldstream - Vernon SEI[49] and the Central Okanagan SEI[50]. These units were originally described based on field data and units were developed for earlier ecosystem mapping projects in the Okanagan Valley. Additional riparian units mapped are taken from the provincial wetland classification[51].

Approximately 31% of field plots were ground inspections and 69% were visual inspections (Table 2 and Figure 1). We checked a total of 13% of the polygons (TEM Survey Intensity 4, a total of 1014 polygons in 4863 ha[52]). Ground inspections were used to sample sensitive ecosystems, unclassified ecosystems and representative examples of site series. Visuals were primarily used to verify ecosystem units, structural stages, or terrain.

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[48] Lloyd et al. 1990
[49] Iverson and Shypitka 2003
[50] Iverson and Cadrin 2003
[51] MacKenzie and Moran 2004
[52] Survey intensity level 4 has 60-100 hectares per inspection or 15-25% polygon inspection. Although we only checked 13% of polygons, the detailed mapping resulted in a large number of polygons and our hectares per inspection was only 36 hectares (survey intensity level 3).

Table 2. Numbers and types of plots conducted at field sites.

Ground Inspections	Visuals	TOTAL
42	92	134

Final Terrain Mapping

After field verification in the summer of 2011, Polly Uunila, P.Geo. updated terrain attributes in the database based on field observations and air photo interpretation. The database was updated to reflect any changes to polygon labels. A few minor changes to polygon boundaries were made based on observations made in the field. This linework was updated in ArcINFO.

Expanded Legend Development

The expanded legend describes the terrain, soils, and vegetation of each ecosystem mapped in the study area. The vegetation and terrain descriptions in the expanded legend provided information for the wildlife biologists to develop wildlife habitat ratings (Volume 3; Haney 2011).

The expanded legend also provides technical mapping information for each ecosystem unit: the map code, the ecosystem name, the site series number (if applicable), a listing of the assumed modifiers for each unit, and the modifier combinations that were mapped.

Site Series and Site Unit Mapping

Ecosystem units were mapped according to the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[53]. Site series were identified according to Lloyd et al. (1990). Two-letter codes have been assigned to all site series in the master list available at: ftp://ftp.env.gov.bc.ca/dist/wis/tem/mapcodes_jan2003.xls[54]. Non-site series ecosystem units were previously approved by the Ministry of Forests' Regional Ecologist. Sparsely vegetated, non-vegetated and anthropogenic units follow the two-letter codes and descriptions in Table 3.1 of the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[53]. Riparian ecosystems use the codes from the provincial classification[55].

Core polygon attributes collected for all polygons are shown below in Table 3. Site modifiers were also used to describe ecosystems. Up to two site modifiers may be present with each ecosystem unit. Site modifiers represent different site conditions than those of the typical situation, as defined in the master list, for each site series. Each site series has a set of assumed site modifiers under the typical situation. Where a site series is mapped in its typical situation, site modifiers are not included in the map label.

The site series code and site modifier(s) are followed by a structural stage designation, one through seven. Stand composition modifiers indicate the dominant stand composition and were mapped for all forested ecosystems. Seral associations were mapped for grassland and floodplain ecosystems.

[53] Resources Inventory Committee 1998
[54] Resources Inventory Committee 2000a
[55] MacKenzie and Moran 2004

Definitions and descriptions for all site modifiers, structural stages, structural stage modifiers, and stand composition modifiers can be found in the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[56].

Up to three ecosystems units were noted for each polygon. The percentage of each ecosystem unit present is indicated by deciles ranging from 1 to 10 (1=10%; 10=100%; Figure 5). ***A labelled terrestrial ecosystem map was not produced for this project.***

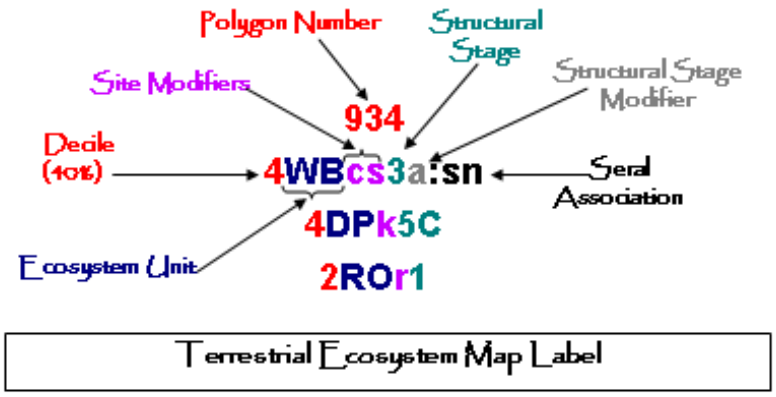

Figure 5. Example of a terrestrial ecosystem map label.

[56] Resources Inventory Committee 1998

Table 3. Core attributes collected for all polygons.

Project- or Mapsheet-Specific Attributes - repeated for all polygons
Project name
Ecosystem mapper
Terrain mapper
Survey intensity level
Polygon-Specific Attributes - unique for each polygon
Record one of each of the following elements or classes per polygon:
Mapsheet number
Polygon number
Data source (photo, ground inspection, or visual inspection)
Ecosection unit
Biogeoclimatic unit (zone, subzone and variant)
Geomorphological processes (when present)
Soil drainages
Record up to three ecosystem and/or terrain units per polygon:
Ecosystem attributes
• Decile
• Site series
• Site modifier(s)
• Structural stage
Terrain attributes
• Decile
• Terrain texture (recorded where field data was collected; record up to three for each component)
• Surficial material (recorded one for each component; could include a surficial subtype)
• Qualifiers (when present, recorded one for each component)
• Geomorphological processes when present
• Soil drainage classes
• Surface expression (recorded up to three for each component)

Data Management

Non-spatial information includes field plot data and polygon attribute data. Spatial data includes polygon linework and locations of field verification sites.

Field Plot Data

Data from field plots were entered into a digital database using Resources Inventory Committee standard software (VENUS Version 5.003). Both manual and electronic quality assurance were completed for the VENUS database. This database was used to sort data into ecosystem units, create the project vegetation species list, and develop the expanded legend. The range of environmental conditions, terrain units, and vegetation communities over which ecosystem units were distributed is described in the expanded legend (Appendix C: Expanded Legend).

Non-spatial Data

We captured the core set of polygon attributes required to meet the provincially accepted *Standard for Terrestrial Ecosystem Mapping (TEM) - Digital Data Capture in British Columbia*[57] (Table 3). Table 4 lists the optional attributes we also applied in this project. We applied two "user-defined" polygon attributes for all occurrences of sensitive and other important ecosystems: condition and viability. We ran quality assurance error checking routines to ensure the attribute databases were free of errors.

Table 4. List of Optional Attributes

Attribute
Stand Appearance
Seral Association (for grasslands and floodplain ecosystems only)
Disturbance Class and Subclass

Spatial Digital Data

Ecosystems were represented visually on maps and the digital data required to produce this representation were maintained according to standards outlined in the TEM Digital Data Capture Standards[58]. The Terrain Resource Information Management (TRIM) was used as the mapping base. The draft linework mapped by the bioterrain and ecosystem specialists was captured through monorestitution. Monorestitution is the digital transfer of features by digitising directly from aerial photos using TRIM control points to georeference the data, and TRIM digital elevation models to correct for slope. The process allows for adjustments in polygon shape and size related to the third dimension. Standard quality assurance routines were applied to ensure accurate mapping.

Final bioterrain and ecosystem mapping included subdividing some polygons. New polygon boundaries were digitized in Google Earth or ArcView with an orthophoto base.

[57] Resources Inventory Committee 2000b
[58] Resources Inventory Committee 2000b

2.2 Mapping Limitations

TEM & SEI Mapping Limitations

The SEI and TEM information is intended for use in alerting local and regional decision-makers of the presence of important ecosystems and ecological features. The SEI and TEM do not replace the need for on-site assessments of areas where land use changes are proposed or contemplated.

The accuracy of polygon boundaries is limited by the scale (1:15,000) and date (1994) of the aerial photographs and orthophotos (2007) on which the sites are delineated. Field data and orthophotos from 2007 were used to update the mapping where urban development had occurred since the date of the aerial photographs. ***Data should not be enlarged beyond the scale of the photos as this may result in unacceptable distortion and faulty registration with other data sets.***

Given the continuing land-uses within the study area, including human settlement and agricultural development, attributes of some polygons may have changed since the date of the orthophotos or field work. Wherever possible, polygons were updated to reflect changes noted at the time of field work.

One of the primary limitations of aerial photograph interpretations is the limited ability to see disturbances such as grazing and invasive plants. The mapper applied information based on extrapolation from adjacent areas or current land use, and based on the tone and texture seen on the aerial photographs. Some grasslands may have been incorrectly assigned to a seral association.

There is limited ability to delineate polygons around small sensitive features or ecosystems. In most cases, these ecosystems are captured as a small component of a larger polygon dominated by another ecosystem. Many polygons are a complex of ecosystems and sensitive ecosystems may only occupy a portion of that polygon.

Field verification was limited by access. Not all private land owners granted permission to sample on their property. Finally, many important wildlife habitat features are difficult to capture in ecosystem maps unless they correlate well with certain ecosystems. It is likely that important habitat features such as snags, tree cavities, and coarse woody debris are present but are not included in TEM polygons.

Terrain Mapping Limitations

As with the TEM and SEI mapping, the ***bioterrain mapping does not replace the need for on-site assessments for areas of proposed development***. The accuracy of polygon boundaries is limited by the scale (1:17,000) and date (1994) of the aerial photographs on which the polygons are delineated. The information and analyses in this report were based on observations of land-surface conditions and the current understanding of terrain. The following factors were not taken into account by this study: subsurface conditions not detectable by airphoto interpretations or surface observations (subsurface hydrologic conditions, for example), events whose time of occurrence and severity cannot be predicted (storm events, for example), management practices, and land-use.

Table 5. The factors affecting the reliability of terrain mapping.

Factors	Notes on this study
Skill and experience of the mapper	Pretyping, bioterrain, and project completion by Polly Uunila who has completed several terrain mapping projects locally and numerous projects throughout the province.
Number of mappers	One mapper
Continuity	Good.
Quality control	Spot checked by Kristi Iverson
Vegetation cover	In general, large areas of open forest and agricultural land allowed the mapper a good view of landform features while mapping. Areas covered by thick forest tend to obscure subtle surface features.
Complexity of the landscape	Variable. The rock-controlled portion of the landscape was predictable and fairly straightforward. The thick valley fill on the lower slopes was more complex. Many of the smaller riparian corridors were not mapped.
Quality and scale of the airphotos	Colour photos. Appropriate photo scale for the scale of the final mapping. Generally of good quality, however many steep, the air photos were 17 years old at the time of project completion.
Distribution of field checking	Much of the study area was private land, and access to many properties was denied. Overall, the project team was able to check a representation of most ecosystems throughout the study area. Many steeper slopes were inaccessible.
Terrain Survey Intensity Level (TSIL)	TSIL D[59]/C[60] completed for project which is appropriate for mapping landforms and ecosystems.
Quality of the topographic base	Good.
Transfer of linework into digital format	Good. Checked during data entry.
Transfer of terrain symbols into digital format	The database is free of terrain coding errors. As every polygon was not checked against the original mapping on the airphotos, it is possible that data entry errors occurred. Spot-checking indicated that errors are not common.
Edit of final maps	No stand-alone bioterrain map was created so no final edit was done.

[59] TSIL D is defined as 1 - 20% of polygons inspected or 0 to 0.1 checks/ha

[60] TSIL C is defined as 20 - 50% of polygons inspected or 0.5 to 1.0 checks/ha

3 Results

3.1 Terrestrial Ecosystem Mapping Results

Table 6 and Table 7 below list the ecosystems mapped in the study area for each subzone, the area they covered, the percentage of the subzone, and the percentage of the study area landbase. Appendix C: Expanded Legend provides a complete description of each ecosystem.

Table 6. Ecosystem Units mapped in the IDFmw1, their area, their percent of the IDFmw1 and their percent of the study area. Red-listed ecological communities are shown in red type; blue-listed ecological communities are shown in blue type[61].

IDFmw1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFmw1	% of study area
CB /00	cutbank	0.8	0.02	0.02
CF /00	cultivated field	745	19.2	15.3
DF /01	Douglas-fir / western redcedar – falsebox – prince's pine	717	18.5	14,7
DP /04	Douglas-fir – pinegrass – feathermoss	1144	29.5	23.5
DS /02	Douglas-fir / ponderosa pine – snowberry – bluebunch wheatgrass	309	8.0	6.4
ES /00	exposed soil	4.3	0.11	0.09
Fl01	mountain alder – common horsetail low bench	38	1.0	0.8
Fm02	cottonwood – spruce – red-osier dogwood middle bench	130	3.4	2.7
FW /00	Idaho fescue – bluebunch wheatgrass	0.7	0.02	0.01
GB /00	gravel bar	40	1.0	0.8
GC /00	golf course	9.0	0.2	0.2
GP /00	gravel pit	3.3	0.08	0.07
OW /00	shallow open water	11	0.3	0.2
PP /03	Douglas-fir – penstemon – pinegrass	98	2.5	2.0
RE /00	reservoir	5.5	0.1	0.1
RF /00	prairie rose – Idaho fescue	5.7	0.2	0.1
RI /00	river	151	3.9	3.1
RO /00	rock outcrop	2.7	0.07	0.06
RR /05	western redcedar / Douglas-fir – dogwood	180	4.6	3.7
RW /00	rural	119	3.1	2.4
RZ /00	road surface	44	1.2	0.9
SE /00	sedge meadow or marsh	5.2	0.1	0.1
SO /00	saskatoon – mock orange talus	3.9	0.1	0.08
UR /00	urban	14	0.4	0.3
WB /00	bluebunch wheatgrass – balsamroot	93	2.4	1.9
TOTAL		**3874**	**100**	**79.7**

[61] **Red-list**: The list of British Columbia's flora, fauna, and ecological communities that are rare and endangered. **Blue-list**: The list of British Columbia's flora, fauna and ecological communities that are at risk because of low or declining numbers.

Table 7. Ecosystem Units mapped in the ICHmw2, their area, their percent of the ICHmw2 and their percent of the study area. Red-listed ecological communities are shown in red type; blue-listed ecological communities are shown in blue type[62].

ICHmw2				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of ICHmw2	% of study area
BJ /08	bluejoint – glow moss[63]	1.7	0.2	0.04
CB /00	cutbank	0.3	0.03	0.01
CF /00	cultivated field	31	3.1	0.6
DF /02	Douglas-fir/western redcedar – falsebox – prince's pine	25	2.6	0.5
ES /00	exposed soil	5.1	0.5	0.11
Fl01	mountain alder – common horsetail low bench	7.5	0.8	0.15
Fm02	cottonwood – spruce – red-osier dogwood middle bench	18	1.8	0.4
GB /00	gravel bar	0.6	0.06	0.01
HF /01	western hemlock/western redcedar – falsebox – feathermoss	492	49.8	10.1
HO /04	western redcedar/western hemlock – oak fern - foamflower	25	2.5	0.5
OW /00	shallow open water	1.7	0.2	0.04
RD /05	western redcedar/western hemlock – devil's club – sarsaparilla	15	1.5	0.3
RE /00	reservoir	0.6	0.06	0.01
RF /03	western redcedar/Douglas-fir – falsebox	292	29.6	6.0
RH /06	western redcedar/western hemlock – horsetail	0.3	0.03	0.01
RI /00	river	33	3.3	0.7
RO /00	rock outcrop	5.0	0.5	0.1
RW /00	rural	9.3	0.9	0.2
RZ /00	road surface	22.5	2.3	0.5
TA /00	talus	1.6	0.2	0.03
UR /00	urban/suburban (Sugar Lake dam)	0.2	0.02	0.005
TOTAL		**989**	**100**	**20.3**

3.2 Terrain Results

This section provides a brief description of the presence and distribution of the common surficial materials within the study area. Appendix B provides a more detailed description of each surficial material and geomorphological process mapped within the study area.

The study area consists of an approximately 1 km wide corridor along the mid-reach of the Shuswap River. With the exception of the area around Shuswap falls and north of the mouth of Reiter Creek, the Shuswap River forms a several hundred metre wide floodplain. Many of the large tributary creeks have deposited large fans along the margins of the Shuswap River floodplain, including Reiter, Holstein, Schunter, Specht, Sauff, Cherry, Ferry, Woodward, Buchanan

[62] **Red-list**: The list of British Columbia's flora, fauna, and ecological communities that are rare and endangered. **Blue-list**: The list of British Columbia's flora, fauna and ecological communities that are at risk because of low or declining numbers.

[63] The status of this ecological community has not been assessed by the B.C. Conservation Data Centre.

and Bessette Creeks. As a result, the most common surficial material type within the study area is fluvial deposits.

The modern Shuswap River floodplain has downcut through thick glacial deposits leaving benches of materials on either side of the valley. The most common material here is glaciolacustrine sediments. Discontinuous terraces of glaciolacustrine sediments are found along the length of the study area below about 625 m elevation. This suggests that during deglaciation and downwasting of the glacial ice, ice likely remained downstream in the Lumby valley impounding a temporary lake within the study area[64].

Remnant terraces of glaciofluvial sediments are found within and at the margins of the glaciolucustrine sediments. These were deposited as kame terraces, outwash sediments and at the mouths of larger tributary creeks and valleys.

Till, which was deposited by glacial ice, forms a discontinuous blanket along the lower valley sides. Steeper slopes tend to have thinner till and bedrock outcrops.

Colluvium is mapped along the flanks of many of the steep slopes and at the mouths of steep gullies throughout the study area.

[64] Ryder 1991

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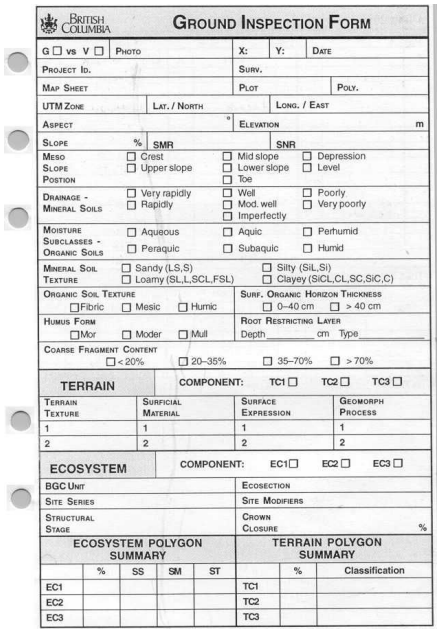
Appendix A: Field Plot Forms



BRITISH COLUMBIA

GROUND INSPECTION FORM

G ☐ VS V ☐	PHOTO	X:	Y:	DATE
PROJECT ID.		SURV.		
MAP SHEET		PLOT		POLY.
UTM ZONE	LAT. / NORTH	LONG. / EAST		
ASPECT °		ELEVATION		m
SLOPE %	SMR	SNR		

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level	
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly	
MOISTURE SUBCLASSES - ORGANIC SOILS	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid	
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)		
ORGANIC SOIL TEXTURE	☐ Fibric ☐ Mesic ☐ Humic	SURF. ORGANIC HORIZON THICKNESS	☐ 0–40 cm ☐ > 40 cm	
HUMUS FORM	☐ Mor ☐ Moder ☐ Mull	ROOT RESTRICTING LAYER	Depth_____ cm Type_____	
COARSE FRAGMENT CONTENT	☐ < 20%	☐ 20–35%	☐ 35–70%	☐ > 70%

TERRAIN — COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1	1	1	1
2	2	2	2

ECOSYSTEM — COMPONENT: EC1 ☐ EC2 ☐ EC3 ☐

BGC UNIT	ECOSECTION
SITE SERIES	SITE MODIFIERS
STRUCTURAL STAGE	CROWN CLOSURE %

ECOSYSTEM POLYGON SUMMARY					TERRAIN POLYGON SUMMARY		
	%	SS	SM	ST		%	Classification
EC1					TC1		
EC2					TC2		
EC3					TC3		

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A:	B:	C:	D:

L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%

COMPLETE ☐ PARTIAL ☐

Tree Mensuration

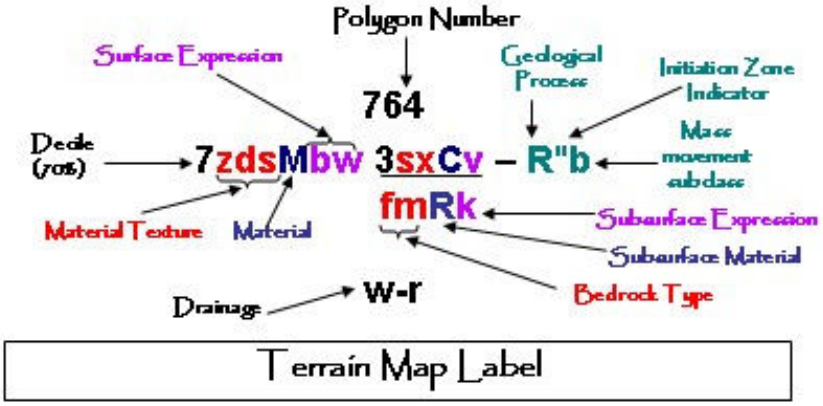
Spp.	DBH	Ht. Calculation to DBH						Ht. to DBH	Total HT	BH Age	Path Y/N
		Top	Bot	SD	SL	HD	HT				

NOTES (site diagram, exposure, gleying, etc.)

CONSERVATION EVALUATION FORM			
PROJECT IDENTIFICATION		**DATE:**	
PROJECT ID:		**PLOT #:**	
POLY #:	**SEI CLASS:SUBCLASS:**		
ECOLOGICAL COMMUNITY			
CONSERVATION INFORMATION			
OWNER/JURISDICTION:			
DISTURBANCE:		**KNOWN THREATS:**	
ADJACENT LAND USE:		**OTHER FACTORS:**	
ALIEN SPP.:			
SUCCESS. STATUS:		**EST. SIZE COMM:**	**(ha)**
FRAGMENTATION OF ECOLOGICAL COMMUNITY			
❒ < 5% FRAGMENTED ❒ 5 - 25 % FRAGMENTED ❒ > 25% FRAGMENTED			
EVALUATION SUMMARY			
LANDSCAPE CONTEXT:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
ECOLOGICAL INTEGRITY:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
CONDITION:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
NOTES(AT-RISK SPECIES, WILDLIFE OBSV., ACCURACY INFO, ETC)			
OBSERVER	NAME:		
ADDRESS:			
EMAIL:		PHONE/FAX:	
SUBMIT DATA			
B.C. Conservation Data Centre **P.O. Box 9358, Stn. Prov. Gov't, Victoria, BC. V8W 9M2** Include: FS882 or GIF or VENUS file ❒ air photos with polygon marked ❒ map product(s) ❒ ground photos ❒			

Appendix B: Terrain Legend

Terrain Polygon Symbols



Note: one or more letters may be used to describe any characteristic other than surficial material, or letters may be omitted if information is lacking.

Composite Units: Two or three groups of letters are used to indicate that two or three kinds of terrain are present within a map unit.

e.g., 7Mv 3Rs indicates that the polygons contains approximately 70% "Mv" and 30%"Rs".

e.g., 6Mb 3Cv 1Rs indicates that the polygons contains approximately 60% "Mb" , 30%"Cv", and 10% “Rs”.

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock: e.g., Mv / Rr indicates that "Mv" overlies "Rr".

Material	
Code	**Name**
A	Anthropogenic
C	Colluvium
C1	Slope wash
D	Weathered bedrock
E	Eolian
F	Fluvial materials
FA	"Active" fluvial materials
FG	Glaciofluvial materials
L	Lacustrine sediments
LG	Glaciolacustrine sediments
M	Till
O	Organic materials
R	Bedrock
U	Undifferentiated materials

Texture	
Code	**Name**
c	clay
z	silt
s	sand
p	pebbles
k	cobbles
b	boulders
a	blocks
d	mixed fragments
g	gravel
r	rubble
x	angular fragments
m	mud
y	shells
e	fibric
u	mesic
h	humic

Surface Expression	
Code	**Name**
a	moderate slope(s)
b	blanket (>1m thick)
c	cone
d	depression
f	fan
h	hummocky
j	gentle slope(s) (5-27%)
k	moderately steep slope (49-70%)
m	rolling topography
p	plain (0-5%)
r	ridges
s	steep slope(s) (>70%)
t	terrace(s)
u	undulating topography
v	veneer (≤1m thick)
w	mantle of variable thickness
x	thin veneer (10-25cm)

Detailed Descriptions of Surficial Materials

Anthropogenic Material (A)

Anthropogenic materials are deposits that are sufficiently reworked or redistributed by human activities that their original character is lost. Examples include gravel pits and fill used for roads and other construction.

Colluvium (C)

Colluvium accumulated during post-glacial times as a result of gravity-induced slope movement, for example, rock fall and soil creep. The physical characteristics of colluvium are closely related to its source and mode of accumulation. Four processes generally create colluvial deposits; (1) rockfall from bedrock bluffs, (2) soil creep in weathered bedrock, (3) mass movement processes in surficial materials (debris flows and debris slides), and (4) rockslides and rock slumps.

Rockfall from bedrock bluffs typically forms talus slopes (Ck). Talus is loosely packed rubble or blocks with little interstitial silt and sand near the surface, and is rapidly drained. Within the study area talus is scattered throughout flanking bedrock cliffs.

Colluvial veneers (Cv) and blankets (Cb) develop where weathered bedrock or surficial materials have been loosened and moved downslope by gravitational processes such as soil creep. It is loosely packed and usually rapidly drained. Colluvial veneers and very thin veneers are most common on upper, moderately steep and steep gradient slopes and as discontinuous, very thin veneers on bedrock-controlled terrain. The matrix texture of the colluvium reflects the bedrock or surficial materials it is derived from.

Colluvial fans (Cf) and cones (Cc) form at the base of steep gullies due to deposition by debris flows (-Rd). These deposits are generally compact, and sorting may range from poorly sorted to well sorted. The deposit may or may not be matrix supported, and the matrix is usually sand. Colluvial cones and fans are common at the mouths of the large single gullies.

Deep-seated slumps in bedrock and surficial materials result in hummocky, irregular colluvial deposits (Chu). Rock slumps contain blocks and rubble with little or no interstitial silt and sand. Rotational slumps have developed in some portions of the plateau basalt cliffs due to failure along vertical joints and horizontal weak layers. A large slump is located upslope from Deep Lake.

Slope Wash (C1)

Slope wash is a result of rainfall events in which non-channellized overland flow carries surface material from a steeper area to a gentler area down slope. The material is generally derived from eolian sediments. Slope wash generally does not travel far and comes to rest on gentler slopes of 0 to 15 %. In the study area, it was commonly found as a partial veneer overlying till, fluvial or lacustrine deposits. The typical texture is silty sand or sandy silt with generally less than 5 % coarse fragments. It commonly includes some imperfect drainage as it accumulates in receiving sites.

Weathered Bedrock (D)

Weathered bedrock has been modified *in situ* by mechanical and chemical weathering and the matrix texture reflects the bedrock that it was derived from. The material is typically loosely packed

and well drained. In the study area, weathered bedrock is found as a discontinuous very thin veneer (Dx) overlying gently sloping or undulating bedrock outcrops.

Eolian Sediments (E)

Eolian sediments were transported and deposited by wind. This process is rare in the study area and was not mapped during the current project, however it may be found in locations as described hereafter. Eolian sediments occur as a thin cap (Ev) over other materials. These deposits typically consist of silt and fine sand and often form the Ah horizon in Chernozemic soils.

Fluvial Materials (F, F^A)

Fluvial materials were deposited in post-glacial time by streams. Fluvial materials consist of loosely packed, non-cohesive sands and silt with some gravel. Fluvial materials are generally mapped as floodplains (Fp, F^Ap) or gentle fluvial areas (Fj) with imperfect to poor drainage. Modern-day floodplains are located along major valley bottom streams in the study area, including the Shuswap River, Cherry Creek, and Bessette Creek. Post-glacial fans are common at the mouths of the many gullies throughout the study area.

Glaciofluvial Materials (F^G)

Glaciofluvial materials were deposited by glacial meltwater streams at the end of the Fraser Glaciation. Sands and gravels accumulated along ice margins and on top of melting ice (FGu) and downstream of melting ice (FGf and FGp). In some areas, rivers were made and quickly abandoned depositing blankets of sands and gravels over top of till (FGb). In a few areas, postglacial streams have incised into outwash plains and fans transforming them into terraces (FGt) and creating erosional slopes (FGk). In general, glaciofluvial materials created well-drained and relatively dry sites due to the highly porous and permeable sands and gravels. The material is non-cohesive and therefore susceptible to erosion, and will tend to ravel when exposed on steep slopes and road cuts. Glaciofluvial sands and gravels are potential sources of aggregate.

In the study area, glaciofluvial materials consisted of gravely sands with minor amounts of silt. These deposits ranged from well stratified to unstratified and well-sorted to moderately-sorted. Deposits of glaciofluvial sediments are present along the valley bottom throughout the length of the study area.

Glaciolacustrine (L^G)

Glaciolacustrine materials were deposited from glacial or ice-dammed lakes that were present during and shortly after glaciation. Glaciolacustrine materials generally consist of well to moderately well stratified fine sand, silt, or clay with occasional lenses of till or glaciofluvial material.

Glaciolacustrine materials are generally only slowly permeable, and so the presence of even a thin layer of this material is sufficient to cause impeded drainage, perched water tables, and surface seepage. These conditions may promote instability in some situations. These fine-textured materials are also susceptible to surface erosion by running water. In the study area, remnants of glaciolacustrine sediments are present along the valley bottom scattered along the length of the study area.

Till (M)

Till is deposited directly by glacier ice and usually exists as a veneer (Mv), blanket (Mb), or mantle of variable thickness (Mw) over the underlying bedrock surface. It typically consists of a fine-grained matrix (particles <2 mm) that surrounds and supports clasts (particles >2 mm) of a variety of sizes, shapes and rock types. Till characteristics, such as texture (particle sizes) and consolidation (or bulk density), vary according to specific processes of deposition by glacier ice (e.g., subglacial vs. supraglacial tills). These deposits can be highly variable and gradations in texture and consolidation can vary over short distances. Over the last 12,000 years, the upper half metre to one metre of these deposits has been weathered by pedogenic processes creating loose, permeable soils.

Basal till (subglacial till) is deposited at the base of a glacier creating highly consolidated material. As a result, basal till has a relatively low permeability and commonly acts like an impermeable layer. It tends to be the strongest of all surficial materials. The commonly found matrix texture is predominantly sandy with a low percentage of silt (dzs, zds). Angular to subrounded clasts comprise 20 to 40% of the material. The till parent material is typically slighty to moderately consolidated and sometimes slightly cohesive. Till slopes are typically well to moderately-well drained.

Ablation till (supraglacial till) consists of debris that melts out on top of a glacier during deglaciation. It is usually coarse-textured and unconsolidated. As a result, it is often highly permeable, but may also contain lenses of other types of glacial drift, including glaciofluvial sand and gravel and glaciolacustrine sands, silts and clays.

Organics (O)

Organic materials form where decaying plant material accumulates in poorly or very poorly drained areas. Organic materials were not mapped in the study area.

Undifferentiated Material (U)

This material type is used to describe material that is too complex to be represented by the usual terrain symbols. Undifferentiated material is a layered sequence of surficial materials that have been exposed on an erosional slope. There is usually a sequence of three or more layers. In the study area, this symbol is used to map thick sequences of surficial materials in various valley bottom locations (for example along scattered reaches of the Shuswap River bank).

Bedrock (R)

Bedrock was mapped where it outcrops at the surface. Polygons mapped with thin or very thin material (Cv, Dx, Mv, Mx), may also have a small proportion of bedrock outcrops. Bedrock outcrops are scattered throughout the study area.

Geological Processes	
Code	**Name**
-E	Glacial meltwater channels
-F	Slow mass movement (failing, slumps)
-F"	Slow mass movement initiation zone
-Fk	Tension cracks
-Fm	Slump in bedrock
-Fp	Lateral Spread in Bedrock
-H	Kettled
-L	Surface seepage
-P	Piping
-R	Rapid mass movement (slides and falls)
-R"	Rapid mass movement initiation zone
-Rb	Rockfall
-Rd	Debris flow
-Rs	Debris slide
-U	Inundation
-V	Gully Erosion

Drainage	
Code	**Name**
x	very rapidly drained
r	rapidly drained
w	well drained
m	moderately well drained
i	imperfectly drained
p	poorly drained
v	very poorly drained

Where two drainage classes are shown:

- if the symbols are separated by a comma, e.g., "w,i", then no intermediate classes are present;
- if the symbols are separated by a dash, e.g., "w-i", then all intermediate classes are present.

Description of Geological Processes

Channeled by Meltwater (-E, -EV)

Meltwater channels form alongside, beneath, or in front of a glacier or ice sheet. Glacial meltwater channels are typically sinuous in plan, flat-floored, and steep-sided in cross-section. The floors of the meltwater channel may contain glaciofluvial sediments, indicative of the water flow that once took place here.

Slow Mass Movement (-F, -F"k, -F"m, -F"c)

Slow mass movement refers to slope failures where movement occurs slowly or where the displaced material moves only a short distance downslope. The double prime symbol (") indicates the initiation zone of slow mass movement. Tension cracks are indicated by the subclass "k" (-Fk). Failures occurring in bedrock are indicated by the subclass "m" (e.g. –Fm). Failures occurring in thick surficial materials are indicated by the subclass 'u' (e.g. -Fu).

Tension cracks (-Fk) are open fissures commonly located near ridge tops. They indicate slow slope spreading, and may be the precursor to catastrophic slope failure.

A slump in bedrock (-Fm) refers to a rotational slump where portions of the slide mass remains internally cohesive. Lateral Spread in Bedrock (-Fp) refers to lateral spread in a fractured mass of bedrock. Rotational slumps and lateral spread develop due to failure along vertical joints and horizontal weak layers.

Soil creep (-F"c) refers to the slow movement of the upper half metre of soil downslope.

Surface Seepage (-L)

Seepage is mapped where relatively wet soils are widespread in a polygon. This commonly occurs where soils are on slowly permeable materials such as till, where thin surficial materials overlie

bedrock, and on lower slopes where shallow subsurface water is received from a relatively large catchment area further upslope. They may also occur where groundwater is concentrated at the surface by a physical conduit such as a geological fault.

Rapid Mass Movement (-R, -R”b, -R”d, -R”s)

Rapid mass movement refers to downslope movement by falling, rolling or sliding of debris derived from surficial material or bedrock. Where a double prime symbol (**”**) is used with a mass movement process (e.g., -R”s), slope failure has initiated within the polygon. Mass movement symbols without the double prime symbol (e.g., **-**Rb) indicate a polygon that contains the transport or deposition zone of rapid mass movement. Transportation zones are generally not recognized as areas where landslides initiate; they may contribute additional volume of transported material to a failure. Transport and deposition zones represent hazardous areas downslope of slides or rockfall.

Rockfall (-Rb, -R”b) occurs when either a single block or a mass of bedrock falls, bounces and rolls downslope. In the study area, rockfall from local outcrops created talus slopes, colluvial veneers and blankets. Polygons with rockfall were scattered throughout the study area in association with local bedrock outcrops.

Debris flows (-Rd) initiate in steep gullies and debris slides (-Rd) initiate on steep hillsides. They occur when a mass of surficial material slides rapidly downslope often as a result of the loss of soil strength due to high pore water pressure. Debris slides (non-channelized movement of debris) and debris flows (channelized movement of debris) are initiated on steep slopes where material slides along a shear plane. The shear plane often coincides with the boundary between more permeable and less permeable material (e.g., between weathered and unweathered material or between surficial material and bedrock). Debris flows and debris slides are triggered by heavy rain, water from snow melt, or rain on snow events, and result from loss of soil strength due to high pore water pressure. During wet conditions, slides are also triggered by wind stress on trees, tree throw, impact of falling rocks from up slope, and vibrations due to earthquakes or human activity. In logged areas, debris slides that occur several years after logging can be due to the loss of soil strength that results from root decay. Diverted drainage from roads commonly triggers failure of sidecast material and may initiate landslides some distance downslope. A debris flow may move downslope for several hundred metres or more before it is arrested by gentler terrain or by de-watering, or it may enter a trunk stream. Debris flows are effective agents of erosion, commonly increasing the volume of material as it progresses downslope. Debris slides and debris flows are significant potential sources of stream sediment and a hazard to activities or structures (roads, culverts) located in runout zones.

In the study area, debris slides and flows are not common. These processes tend to occur on steep slopes, including gullies. The presence of colluvial fans and cones at the mouths of gullies indicate post-glacial mass movement.

Inundation (-U)

Inundation refers to areas that are seasonally flooded, for example back channels along the Shuswap River.

Gully Erosion (-V)

Gullies are small ravines with V-shaped cross sections that can form in either glacial drift or bedrock. Gully erosion is mapped in two kinds of terrain: (i) slopes with several parallel shallow gullies in drift materials (dissected slope) and (ii) single gullies where streams have exploited joints in bedrock or have cut down into thick drift. Gullied terrain is an indicator of either former or active erosion, and the symbol serves to identify material that is potentially subject to erosion or mass movement (e.g., Uk-V). Gully side slopes and steep headwalls are common sites of slope failures. In the study area, gully erosion was mapped in polygons scattered throughout the study area.

Appendix C: Expanded Legend

MIDDLE SHUSWAP RIVER EXPANDED LEGEND – IDFmw1

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CB	**Cutbank**	**IDFmw1**	**N/A**
Part of a road corridor which is created by excavation or erosion of the hillside.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CF	**Cultivated Field**	**IDFmw1**	**N/A**
These are agricultural fields with tilled soils and planted crops or ground cover. Mapped units: CFa – Cultivated fields that may flood seasonally. These are riparian ecosystems adjacent to Shuswap River that have been converted to fields. CFt – cultivated fields on terraces. Some may be river terraces but they no longer flood.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DF	**Douglas-fir/Western Redcedar – Falsebox – Prince's pine**	**IDFmw1**	**01**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with mesic gently sloping sites. Mature forests have an overstory dominated by Douglas-fir and western redcedar with some paper birch and an understory with scattered shrubs, forbs, and patches of feather mosses. The fluvial terrace (**$ft**) seral association was used where this unit was mapped on a fluvial terrace.

List of mapped units:

DFa	active floodplain of the Shuswap River, may flood seasonally	DFgw	gully, warm aspect, slope >25%
DFc	coarse-textured soils	DFk	cool aspect, slope >25%
DFck	coarse-textured soils (glaciofluvial); cool aspect, slope >25%	DFn	fan deposit
DFct	coarse-textured soils, terrace	DFt	glaciofluvial or fluvial terrace
DFg	gully, usually on a slope	DFw	warm aspect (often SE or NW), slope >25%

SITE INFORMATION

Common Terrain Types:

- deep morainal, glaciofluvial, and glaciolacustrine materials on level and gentle slopes
- moderate to steep cool aspect morainal and colluvial slopes

Slope position:	lower to middle
Slope (%):	0-30; steeper on cool aspects
Aspect:	all
Soil Moisture Regime:	mesic – submesic
Soil Nutrient Regime:	medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DF	Douglas-fir/Western Redcedar – Falsebox – Prince's pine	IDFmw1	01

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	***	***	***	****	***	western redcedar
	Pseudotsuga menziesii var. *glauca*			**	***	***	Douglas-fir
	Betula papyrifera	**	**	**	**	*	paper birch
Shrubs	*Corylus cornuta*	**	*	**	***	***	beaked hazelnut
	Acer glabrum	**	*	**	***	***	Douglas maple
	Mahonia aquifolium	***	*	**	**	**	tall Oregon-grape
	Rubus parviflorus	**	**	**	**	*	thimbleberry
Herbs	*Epilobium angustifolium*	****	*				fireweed
	Aralia nudicaulis	***	*	**	**	**	wild sarsaparilla
	Clintonia uniflora	*	*	**	**	**	queen's cup
	Prosartes trachycarpa	**	*	**	**	**	rough-fruited fairybells
Mosses	*Pleurozium shreberi*		*	**	***	***	red-stemmed feathermoss
	Rhytidiadelphus triquetrus	*	**	***	***	**	electrified cat's-tail moss
PLOTS				MS-V09	MS-G06, MS-G08		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	**Douglas-fir – Pinegrass – Feathermoss**	**IDFmw1**	**04**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is common on warm aspects, coarse-textured glaciofluvial soils and other shedding sites. The overstory is dominated by Douglas-fir sometimes with a few ponderosa pine or western larch and the understory is dominated by pinegrass with showy aster, snowberry and other scattered shrubs and forbs.

List of mapped units:

DPc	coarse-textured soils (generally glaciofluvial)	DPks	cool aspect, slope >25%, shallow soils (50-100cm)
DPck	coarse-textured soils; cool aspect (NNW or ESE), slope >25%	DPn	fan deposit
DPcn	coarse-textured soils; fan deposit	DPs	shallow soils (50-100cm)
DPct	coarse-textured soils, glaciofluvial terrace	DPsw	shallow soils (50-100cm); warm aspect, slope >25%
DPcw	coarse-textured soils, warm aspect (usually SE or WNW)	DPt	glaciofluvial terrace
DPk	cool aspect, slope >25%	DPw	warm aspect, slope >25%

SITE INFORMATION

Common Terrain Types:

- deep morainal or glaciolacustrine materials on moderate warm aspect slope or steeper or shallow cool aspects

Slope position:	middle and upper
Slope (%):	35 – 85
Aspect:	southeast to west
Soil Moisture Regime:	subxeric to submesic
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	Douglas-fir – Pinegrass – Feathermoss	IDFmw1	04

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	***	***	***	Douglas-fir
Shrubs	*Symphoricarpos albus*	****	*	**	**	**	common snowberry
	Spirea betulifolia	***	*	**	***	***	birch-leaved spirea
	Mahonia aquifolium	***	*	**	**	**	tall Oregon-grape
Grasses	*Calamagrostis rubescens*	***	**	***	***	****	pinegrass
Herbs	*Aster conspicuus*	***	**	***	***	***	showy aster
Mosses	*Rhytidiadelphus triquetrus*	*	**	***	***	**	electrified cat's-tail moss
	Pleurozium shreberi		*	**	**	**	red-stemmed feathermoss
PLOTS			MS-G25	MS-G05, MS-G09, MS-V05	MS-G17		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	**Douglas-fir/Ponderosa pine – Snowberry – Bluebunch wheatgrass**	**IDFmw1**	**02**

The assumed situation is gentle slopes with deep, medium textured soils on ridges or crests (d, j, m and r are assumed modifiers). However, in this area, this ecosystem most often occurred on **steep warm aspects** (w modifier, **slopes usually >40%**), sometimes with shallow soils (s modifier).

List of mapped units:

DScw	coarse-textured soils, warm aspect	DSw	warm aspect, slope >25%
DSks	cool aspect (usually NNW or ESE), shallow soils (50-100cm deep), slope >25%	DSz	very steep warm aspect, slope >70%
DSsw	shallow soils (50-100 cm deep), warm aspect, slope >25%		

SITE INFORMATION

Common Terrain Types:

- deep or shallow till, glaciofluvial slopes and colluvial slopes

Slope position:	middle, upper
Slope (%):	40 – 60+
Aspect:	usually warm
Soil Moisture Regime:	xeric
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	**Douglas-fir/Ponderosa pine – Snowberry – Bluebunch wheatgrass**	**IDFmw1**	**02**

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	****	***	***	Douglas-fir
	Pinus ponderosa	*	***	***	***	***	ponderosa pine
Shrubs	*Amelanchier alnifolia*	*	*	*	**	**	saskatoon
	Symphoricarpos albus	****	*	***	***	***	common snowberry
	Spirea betulifolia	***	*	**	**	**	birch-leaved spirea
	Mahonia aquifolium	**	*	**	**	**	tall Oregon-grape
Grasses	*Pseudoroegneria spicata*	**		**	**	**	bluebunch wheatgrass
	Calamagrostis rubescens	**	*	**	**	**	pinegrass
Herbs	*Lupinus sericeus*	***	**	***	***	***	silky lupine
	Achillea millefolium	**	*	**	**	**	yarrow
Mosses	*Brachythecium* spp.	**	*	**	**	**	ragged mosses
Plots				MS-G03, \MS-G18, MS-G41	MS-G07, MS-G21		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
ES	**Exposed Soil**	**IDFmw1**	**N/A**
These are areas of exposed soils either from natural erosion or removal of vegetation.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FI01	**Mountain Alder – Common Horsetail Low Bench**	**IDFmw1**	**FI01**

Typic unit occurs on low-bench floodplains (a, c, and j are assumed modifiers). They typically have short floods during annual spring flooding. This unit is from the provincial wetland and riparian classification (MacKenzie and Moran 2004).

This shrubby ecosystem occurs on low-bench active floodplains. They are dominated by mountain alder with a sparse understory or with reed canarygrass (seral association $cg). Sites with little or no reed canarygrass tend to have a more diverse understory. Most sites had only a sparse cover of horsetail. No sites without reed canarygrass were sampled, but it was assumed they occurred.

SITE INFORMATION

Common Terrain Types:

- active fluvial deposits

Slope position:	level
Slope (%):	0 – 2
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FI01	**Mountain Alder – Common Horsetail Low Bench**	**IDFmw1**	**FI01**

	Structural Stage	3	3 $cg	4 $cg	
Trees	*Populus balsamifera* ssp. *trichocarpa*			****	black cottonwood
Shrubs	*Alnus incana* ssp. *tenuifolia*	****	****	***	mountain alder
Herbs	*Phalaris arundinacea*	**	****	***	reed canarygrass
	Solidago canadensis	**		*	Canada goldenrod
	Leucanthemum vulgare	*		*	oxeye daisy
Plots			MS-G12, MS-V26, MS-V79	MS-G37, MS-G40	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Fm02	**Cottonwood – Spruce – Red-osier Dogwood Middle Bench**	**IDFmw1**	**Fm02**

Typic unit occurs on mid-bench floodplains (a, c, and j are assumed modifiers). They typically have short floods followed by continual subirrigation. This unit is from the provincial wetland and riparian classification (MacKenzie and Moran 2004).

This diverse ecosystem has a mixed overstory of black cottonwood, and hybrid white spruce. Some areas where reed canarygrass has established have a thick understory of reed canarygrass with scattered shrubs and few other plants ($cg), moist pockets with reed canarygrass and small-flowered bulrush were mapped as the seral association $sr. Other sites have a diverse shrubby understory and often have variable moisture with small moist pockets on lower sites with sedges and other wetland plants.

SITE INFORMATION

Common Terrain Types:

- active fluvial deposits

Slope position:	level
Slope (%):	0 – 2
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Fm02	Cottonwood – Spruce – Red-osier Dogwood Middle Bench	IDFmw1	Fm02

	Structural Stage	3	4	5	6	7	$cg	$sr	
Trees	*Populus balsamifera* ssp. *trichocarpa*	**	****	****	***	***	***	***	black cottonwood
	Picea engelmannii x glauca	**	***	***	**	**			hybrid white spruce
	Betula papyrifera	**	**	**	*	*	**	**	paper birch
	Thuja plicata	**	*	**	**	*			western redcedar
Shrubs	*Alnus incana* ssp. *tenuifolia*						****		mountain alder
	Symphoricarpos albus	***	*	**	****	****			common snowberry
	Corylus cornuta	**	**	**	***	***			beaked hazelnut
	Cornus stolonifera	**	*	**	**	**			red-osier dogwood
Herbs	*Phalaris arundinacea*						*****	***	reed canarygrass
	Scirpus microcarpus							***	small-flowered bulrush
	Aralia nudicaulus	**	*	*	*	**			wild sarsaparilla
	Athyrium filix-femina	**	**	**	**	**			lady fern
	Equisetum arvense	**	*	**	**	**			common horsetail
Mosses	*Mnium* or *Plagiomnium* spp.			*	**	**			leafy mosses
	Brachythecium sp.	*	*	*	**	**			
Plots					MS-G04, MS-G14, MS-G24, MS-G26, MS-G39	MS-G10, MS-G11	MS-G13, MS-V25	MS-G15	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	**Idaho fescue – Bluebunch wheatgrass**	**IDFmw1**	**00**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, m)

This grassland ecosystem occurs on cool aspects. A mixture of Idaho fescue and bluebunch wheatgrass with balsamroot and other herbs dominates late seral sites, but it is unknown what seral stage(s) or levels of disturbance occurred in the study area. Soils are typically dark brown or black chernozems.

List of mapped units:

FWks cool aspect, shallow soils (20-100cm)

SITE INFORMATION

Common Terrain Types:

- morainal and glaciofluvial blankets, often with an eolian veneer

Slope position:	lower to upper
Slope (%):	>25% (up to 60% on cool aspects
Aspect:	all
Soil Moisture Regime:	mesic
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	Idaho fescue – Bluebunch wheatgrass	IDFmw1	00

	Structural Stage Seral Association	2 FW	
Grasses	*Festuca idahoensis*	****	Idaho fescue
	Pseudoroegneria spicata	***	bluebunch wheatgrass
	Koeleria macrantha	**	junegrass
	Bromus tectorum or *Bromus japonicus*	*	cheatgrass or Japanese brome
Herbs	*Balsamorhiza sagittata*	***	arrowleaf balsamroot
	Lupinus sericeus	**	silky lupine
	Eriogonum heracleoides	**	parsnip-flowered buckwheat
	Erigeron speciosus	**	showy daisy
	Potentilla recta	*	sulphur cinquefoil
Mosses and Lichens	*Cladonia* spp.	**	clad lichens
	Tortula ruralis	**	sidewalk moss
	Peltigera rufescens or *Peltigera ponojensis*	**	felt pelt felt pelt
PLOTS		none	

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GB	**Gravel Bar**	**IDFmw1**	**N/A**
These are areas of sands and gravels along major creeks and the Shuswap River that are exposed later in the year.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GC	**Golf Course**	**IDFmw1**	**N/A**
Areas of grass used for playing golf. May occur on active fluvial terraces ("a" modifier) or inactive fluvial terraces ("t" modifier).			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GP	**Gravel Pit**	**IDFmw1**	**N/A**
These are areas of used for extraction of gravel and sand.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
OW	**Shallow Open Water**	**IDFmw1**	**N/A**
These are areas of permanent open water that are less than 2m deep. Open water often occurs in back channels that are flooded in the spring but have only pockets of water by late summer (OWa) or may be dry by the end of summer (OWax).			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PP	**Douglas-fir – Penstemon – Pinegrass**	**IDFmw1**	**03**

Typic unit occurs on significant warm slopes with deep, medium textured soils (d, m, and w are assumed modifiers), but occurred on very shallow soils within the study area ('v' modifier).

This forest ecosystem is characterized by an open Douglas-fir canopy with a mixed pinegrass – shrub – forb understory.

List of mapped units:

PPjv	very shallow soils (<20cm deep), often pockets of exposed bedrock	PPrv	ridge or crest, very shallow soils (<20cm deep), pockets of bedrock
PPkv	cool aspect, slope >25%, very shallow soils (<20cm deep), often pockets of exposed bedrock	PPv	very shallow soils (<20cm deep), pockets of bedrock
PPqv	very steep cool aspect (slope >70%), very shallow soils (<20cm deep), pockets of bedrock		

SITE INFORMATION

Common Terrain Types:

- moderate to steeply sloping very shallow till and colluvium

Slope position:	middle and upper
Slope (%):	20-70+
Aspect:	all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	medium, poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PP	Douglas-fir – Penstemon – Pinegrass	IDFmw1	03

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	**	****	***	***	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Spirea betulifolia*	***	*	***	***	***	birch-leaved spirea
	Symphoricarpos albus	**	*	***	***	***	common snowberry
	Holodiscus discolour	**	*	**	**	**	ocean spray
Grasses	*Calamagrostis rubescens*	***	**	***	****	****	pinegrass
	Pseudoroegneria spicata	**		*	*	**	bluebunch wheatgrass
Herbs	*Arctostaphylos uva-ursi*	**	*	**	**	**	kinnikinnick
	Aster conspicuous	**	*	**	**	**	showy aster
Mosses and Lichens	*Cladonia* and *Cladina* spp.	*	*	*	**	**	reindeer lichens
	Pleurozium shreberi	*	****	***	**	**	red-stemmed feathermoss
	Dicranum sp.	*	*	*	*	*	heron's bill moss
PLOTS			MS-V12		MS-G35		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RE	**Reservoir**	**IDFmw1**	**N/A**
An artificial basin created by the impoundment of water behind a human-made structure such as a dam, berm, dyke, or wall.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Prairie Rose – Idaho fescue**	**IDFmw1**	**00**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, and m)

This shrubland ecosystem commonly occurs in moisture collecting depressions, seepage slopes and swales in grassland areas. This unit sometimes occurs as patches on grassland slopes. These sites are dominated by shrubs, primarily snowberry and roses. Forbs and grasses are scattered in openings between shrubs. Soils are very rich black chernozems. (Photo from IDFxh1)

List of mapped units:

RFsw shallow soils (usually 50-100cm), warm aspect, slope >25% RFw warm aspect, slope >25%

SITE INFORMATION

Common Terrain Types:

- morainal blankets

Slope position:	mid, toe, depression
Slope (%):	0-25
Aspect:	none, variable
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Prairie Rose – Idaho fescue**	**IDFmw1**	**00**

	Structural stage	**3**	
Shrubs	*Symphoricarpos albus*	*****	common snowberry
	Rosa acicularis	***	prickly rose
	Spirea betulifolia	**	birch-leaved spirea
Forbs	*Lupinus sericeus*	**	silky lupine
	Fritillaria affinis	**	chocolate lily
PLOTS		no data	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RI	**River**	**IDFmw1**	**N/A**
A watercourse formed when water flows between continuous, definable banks. Includes the Shuswap River and its major tributaries.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RO	**Rock Outcrop**	**IDFmw1**	**N/A**
These are areas of exposed bedrock with less than 10% vegetation cover. On sites with fractured bedrock, some plants may be growing out of rock cracks.			
List of mapped units:			
ROq	very steep cool aspect, slope >70%	ROz	very steep warm aspect, slope >70%

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RR	**Western redcedar/Douglas-fir – Dogwood**	**IDFmw1**	**05**

Typic unit occurs on gentle to level lower slopes, receiving sites with deep, medium textured soils (d, j and m are assumed modifiers).

This moist forest ecosystem is found on fluvial terraces, floodplains and adjacent to small creeks. It has a mixed deciduous and coniferous overstory with scattered shrubs and forbs. It is generally less shrubby than the typic Fm02. The seral association fluvial terrace **($ft**) was used where this unit was mapped on an active fluvial terrace. The orchard grass seral association **($og**) was mapped in one polygon where the understory was very disturbed and was dominated by agronomic grasses.

List of mapped units:

RRa	occurs on an active floodplain	RRn	occurs on a fluvial fan
RRc	coarse textured soils	RRt	occurs on a fluvial terrace
RRg	occurs in a gully, usually adjacent to a stream		

SITE INFORMATION

Common Terrain Types:

- fluvial fans, plains, terraces and till

Slope position:	level, toe
Slope (%):	0 – 20
Aspect:	none, all
Soil Moisture Regime:	subhygric (hygric)
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RR	**Western redcedar/Douglas-fir – Dogwood**	**IDFmw1**	**05**

	Structural Stage	3	4	5	6	7	
Trees	*Populus balsamifera ssp. trichocarpa*	**	****	****	***	***	black cottonwood
	Thuja plicata	**	***	**	**	**	Western redcedar
	Betula papyrifera	**	***	**	**	**	paper birch
	Picea engelmannii x glauca	*	**	**	**	**	hybrid white spruce
Shrubs	*Rubus parviflorus*	****	***	****	*****	*****	thimbleberry
	Symphoricarpos albus	***	*	**	***	***	common snowberry
	Corylus cornuta	***	*	**	**	**	beaked hazelnut
	Mahonia aquifolium	***	*	**	***	***	tall Oregon-grape
Grasses	*Elymus glaucus*	**	*	**	**	**	blue wildrye
Herbs	*Aralia nudicaulis*	*	*	**	**	**	wild sarsaparilla
	Maianthemum stellatum	***		**	**	**	star-flowered false Solomon's seal
	Galium triflorum	**	*	**	**	**	sweet-scented bedstraw
	Equisetum arvense	*	*	*	*	*	common horsetail
Mosses	*Rhytidiadelphus triquetrus*		*	**	**	**	leafy mosses
	Brachythecium sp.	**	*	*	**	**	electrified cat's-tail moss
PLOTS				MS-G01	MS-G02, MS-G22, MS-G23, MS-G27, MS-G42	MS-G16	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RW	**Rural**	**IDFmw1**	**N/A**
Rural areas of human settlement with scattered houses intermingled with native vegetation or cultivated areas.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RZ	**Road Surface**	**IDFmw1**	**N/A**
A gravel or paved road used for vehicular travel.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SE	**Sedge Meadow**	**IDFmw1**	**00**

Typic unit occurs on level sites with deep, organic soils (d, j and p are assumed modifiers). This is a generalized wetland ecosystem that has variable site conditions and plant composition. Vegetation is dominated by sedges, small-flowered bulrush and leafy mosses. Sites on active floodplains are highly variable, often with hummocks and depressions and small pockets of open water.

List of mapped units:

SEa occurs on an active floodplain, flooded part of the year

SITE INFORMATION

Common Terrain Types:

- Fluvial, Organic veneer

Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric – hydric
Soil Nutrient Regime:	medium – rich

	Structural stage	3	
Shrubs	*Alnus incana* ssp. *tenuifolia*	***	mountain alder
Sedges	*Carex utriculata*	***	beaked sedge
Rushes	*Scirpus microcarpus*	**	small-flowered bulrush
Forbs	*Cicuta douglasii*	**	Douglas' water hemlock
	Galium trifidum	**	small bedstraw
Mosses	*Mnium spp.*	**	leafy mosses
PLOTS		MS-G38 MS-G43 MS-V46 MS-V81	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**IDFmw1**	**00**

Typic unit occurs on both warm and cool steep slopes with deep, coarse textured soils (blocky) (c and d are assumed modifiers).

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is an uncommon unit in the study area. Scattered trees (Douglas-fir or aspen) and scattered shrubs (snowberry, saskatoon) grow in soil pockets between blocks. Often cliff ferns (a very characteristic species) and scattered grasses are found growing in soil pockets. Vegetation cover is generally higher on sites with smaller blocks and more soil. Cool aspects more commonly have trees on them. Sites that are dominated by shrubs will not necessarily develop into a forested structural stage.

List of mapped units:

SOsw warm aspect; slope 60-70%, shallow soils (generally 50-100cm deep) SOw warm aspect; slope 60-70%

SITE INFORMATION

Common Terrain Types:

- rubbly colluvial slopes

Slope position:	lower to upper
Slope (%):	60 – 70%
Aspect:	all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**IDFmw1**	**00**

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*		**	**	**	***	Douglas-fir
Shrubs	*Holodiscus discolour*	**	**	**	**	**	oceanspray
	Symphoricarpos albus	**	**	**	**	**	common snowberry
	Philadelphus lewisii	***	*	**	**	**	mock orange
Herbs	*Woodsia scopulorum*	*	*	*	*	*	cliff fern
	Calamagrostis rubescens	**	**	**	**	**	pinegrass
PLOTS		MS-V38					

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
UR	**Urban**	**IDFmw1**	**N/A**
Used for dam structures and urban areas.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	**Bluebunch wheatgrass – Balsamroot**	**IDFmw1**	**00**

Typic unit occurs on warm aspects with deep, medium-textured soils (assumed modifiers are d, m, and w)

This grassland ecosystem commonly occurs on moderately steep to steep warm slopes. Often surface soils are actively ravelling on steeper slopes. Bluebunch wheatgrass and balsamroot dominate these sites. Bunchgrasses are more widely spaced than on gentler slopes. Many of these sites are highly disturbed and some have a significant component of weeds. These are described below.

WB:cg *$Cheatgrass seral association*
This is an early seral association dominated by cheatgrass, sulphur cinquefoil, and native forbs.

List of mapped units:

WBks	cool aspect (NNW or ESE), slope >25%; shallow soils (20-100cm deep)	WBs	shallow soils (20-100cm deep)

SITE INFORMATION

Common Terrain Types:

- morainal blankets and veneers and colluvial veneers

Slope position:	middle, upper, crest
Slope (%):	25 – 65%
Aspect:	south, southwest, west
Soil Moisture Regime:	subxeric – submesic
Soil Nutrient Regime:	medium – poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	Bluebunch wheatgrass – Balsamroot	IDFmw1	00

	Structural Stage Seral Association	2 WB	2 WB:cg	3	
Shrubs	*Rhus glabra*			***	smooth sumac
Grasses	*Pseudoroegneria spicata*	***	*	**	bluebunch wheatgrass
	Koeleria macrantha	**	*	*	junegrass
	Festuca idahoensis	*		*	Idaho fescue
	Bromus tectorum	*	****	***	cheatgrass
Herbs	*Lithospermum ruderale*	*	*	*	silky lupine
	Eriogonum heracleoides	*	*	*	parsnip-flowered buckwheat
	Potentilla recta	*	***	**	sulphur cinquefoil
	Artemisia frigida	*	*	*	pasture sage
Mosses	*Cladonia* spp.	**		*	clad lichens
Lichens	*Tortula ruralis*	**		*	sidewalk moss
PLOTS		MS-G19 MS-G29	MS-G36	MS-V67	

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

MIDDLE SHUSWAP RIVER EXPANDED LEGEND – ICHmw2

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BJ	**Bluejoint – Glow Moss**	**ICHmw2**	**08**

Typic unit occurs on level sites with deep, medium-textured soils (d, j and m are assumed modifiers). This is a generalized wetland ecosystem that has variable site conditions and plant composition. Vegetation is dominated by sedges, small-flowered bulrush and leafy mosses. Sites on active floodplains are highly variable, often with hummocks and depressions and small pockets of open water. Photo from the IDFmw1 (SE unit).

List of mapped units:

BJa occurs on an active floodplain, flooded part of the year

SITE INFORMATION

Common Terrain Types:

- Fluvial, Organic veneer

Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric – hydric
Soil Nutrient Regime:	medium – rich

	Structural stage	**3**	
Shrubs	*Alnus incana* ssp. *tenuifolia*	***	mountain alder
Sedges	*Carex utriculata*	***	beaked sedge
Rushes	*Scirpus microcarpus*	**	small-flowered bulrush
Forbs	*Cicuta douglasii*	**	Douglas' water hemlock
	Galium trifidum	**	small bedstraw
Mosses	*Mnium spp.*	**	leafy mosses
PLOTS		no data	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CB	**Cutbank**	**IDFxh1**	**N/A**
Part of a road corridor which is created by excavation or erosion of the hillside.			
List of mapped units:			
CBw	warm aspect, slope >25%		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CF	**Cultivated Field**	**IDFxh1**	**N/A**
These are agricultural fields with tilled soils and planted crops or ground cover.			
List of mapped units:			
CFc	coarse-textured soils	CFn	fan deposit
CFt	occurs on a fluvial or glaciofluvial terrace		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DF	**Douglas-fir/Western Redcedar – Falsebox – Prince's pine**	**ICHmw2**	**02**

Typic unit occurs on warm aspects with deep, medium textured soils (d, j and w are assumed modifiers).

This forest ecosystem is commonly associated with steep warms slopes on sandy, gravely glaciofluvial deposits (c modifier). It also occurs on very shallow soils with pockets of bedrock (v modifier). Mature forests have an overstory dominated by Douglas-fir and western redcedar with some paper birch and an understory with scattered shrubs, forbs, and patches of feather mosses.

List of mapped units:

DFc	coarse-textured soils	DFkv	cool aspect, slope >25%, very shallow soils (20-50cm deep)
DFks	cool aspect, slope >25%, shallow soils	DFv	very shallow soils (20-50cm deep)

SITE INFORMATION

Common Terrain Types:

- deep glaciofluvial on steep slopes
- moderate to steep very shallow morainal and colluvial slopes

Slope position:	lower to middle
Slope (%):	0-70; gentle only for very shallow soils
Aspect:	warm, all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DF	Douglas-fir/Western Redcedar – Falsebox – Prince's pine	ICHmw2	02

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	***	***	***	***	***	Douglas-fir
	Betula papyrifera	**	**	**	**	*	paper birch
	Thuja plicata		*	*	**	**	western redcedar
Shrubs	*Shepherdia canadensis*	**	*	**	**	**	soopollalie
	Mahonia aquifolium	***	*	**	**	**	tall Oregon-grape
	Spirea betulifolia	**	*	**	**	**	birch-leaved spirea
Grasses	*Calamagrostis rubescens*	***	*	**	**	**	pinegrass
Herbs	*Arctostaphylos uva-ursi*	***	*	**	**	**	kinnikinnick
	Aralia nudicaulis	***	*	**	**	**	wild sarsaparilla
	Clintonia uniflora	*	*	**	**	**	queen's cup
	Prosartes trachycarpa	**	*	**	**	**	rough-fruited fairybells
Mosses and Lichens	*Pleurozium shreberi*		*	**	***	***	red-stemmed feathermoss
	Rhytidiadelphus triquetrus	*	**	***	***	**	electrified cat's-tail moss
	Cladonia and *Cladina* spp.	**	*	**	**	**	reindeer lichens
PLOTS			MS-G34				

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
ES	**Exposed Soil**	**ICHmw2**	**N/A**
These are areas of exposed soils and typically include recent disturbances such as soil erosion.			
List of mapped units:			
ESk cool aspect		ESw warm aspect	

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FI01	**Mountain Alder – Common Horsetail Low Bench**	**ICHmw2**	**FI01**

Typic unit occurs on low-bench floodplains (a, c, and j are assumed modifiers). They typically have short floods during annual spring flooding. This unit is from the provincial wetland and riparian classification (MacKenzie and Moran 2004).

This shrubby ecosystem occurs on low-bench active floodplains. They are dominated by mountain alder with a sparse understory with scattered forbs or horsetail. Photo from the IDFmw1.

SITE INFORMATION	
Common Terrain Types: • active fluvial deposits	
Slope position:	level
Slope (%):	0 – 2
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FI01	**Mountain Alder – Common Horsetail Low Bench**	**ICHmw2**	**FI01**

	Structural Stage	3	4	
Trees	*Populus balsamifera* ssp. *trichocarpa*		****	black cottonwood
Shrubs	*Alnus incana* ssp. *tenuifolia*	****	***	mountain alder
Herbs	*Phalaris arundinacea*	**	**	reed canarygrass
	Solidago canadensis	**	*	Canada goldenrod
	Leucanthemum vulgare	*	*	oxeye daisy
Plots		no data		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Fm02	**Cottonwood – Spruce – Red-osier Dogwood Middle Bench**	**ICHmw2**	**Fm02**

Typic unit occurs on mid-bench floodplains (a, c, and j are assumed modifiers). They typically have short floods followed by continual subirrigation. This unit is from the provincial wetland and riparian classification (MacKenzie and Moran 2004).

This diverse ecosystem has a mixed overstory of black cottonwood, and hybrid white spruce. Most sites have a diverse shrubby understory and often have variable moisture with small moist pockets on lower sites with sedges and other wetland plants. Photo from the IDFmw1.

SITE INFORMATION	
Common Terrain Types: • active fluvial deposits	
Slope position:	level
Slope (%):	0 – 2
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Fm02	Cottonwood – Spruce – Red-osier Dogwood Middle Bench	ICHmw2	Fm02

	Structural Stage	3	4	5	6	7	
Trees	*Populus balsamifera* ssp. *trichocarpa*	**	****	****	***	***	black cottonwood
	Picea engelmannii x glauca	**	***	***	**	**	hybrid white spruce
	Betula papyrifera	**	**	**	*	*	paper birch
	Thuja plicata	**	*	**	**	*	western redcedar
Shrubs	*Alnus incana* ssp. *tenuifolia*	***	**	**	**	**	mountain alder
	Symphoricarpos albus	***	*	**	****	****	common snowberry
	Corylus cornuta	**	**	**	***	***	beaked hazelnut
	Cornus stolonifera	**	*	**	**	**	red-osier dogwood
Herbs	*Aralia nudicaulus*	**	*	*	*	**	wild sarsaparilla
	Athyrium filix-femina	**	**	**	**	**	lady fern
	Gymnocarpium dryopteris	*	**	**	***	***	oak fern
	Equisetum arvense	**	*	**	**	**	common horsetail
Mosses	*Mnium* or *Plagiomnium* spp.			*	**	**	leafy mosses
	Brachythecium sp.	*	*	*	**	**	
Plots	No data						

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GB	**Gravel Bar**	**ICHmw2**	**N/A**
These are areas of sands and gravels along major creeks and the Shuswap River that are exposed later in the year.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
HF	**Western redcedar/Douglas-fir – Feathermoss**	**ICHmw2**	**01**

Typic unit occurs on gentle slopes to level sites on deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is found on till and high fluvial terraces (**$ft** seral association). It has a mixed deciduous and coniferous overstory with scattered shrubs and forbs.

List of mapped units:

HFa	occurs on an active floodplain	HFk	cool aspect, slope >25%
HFc	coarse textured soils	HFn	fan deposit
HFck	coarse textured soils, cool aspect, slope >25%	HFt	fluvial or glaciofluvial terrace
HFct	coarse textured soils, glaciofluvial or fluvial terrace	HFw	warm aspect, usually SSE or WNW, slope >25%

SITE INFORMATION

Common Terrain Types:

- till, glaciofluvial and fluvial terraces

Slope position:	level, middle
Slope (%):	0 – 40
Aspect:	none, all
Soil Moisture Regime:	mesic – submesic
Soil Nutrient Regime:	medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
HF	Western Redcedar/Douglas-fir – Feathermoss	ICHmw2	01

	Structural Stage	3	4	5	6	7	
Trees	*Tsuga heterophylla*	*	**	***	***	***	hybrid white spruce
	Thuja plicata	***	***	***	***	***	Western redcedar
	Betula papyrifera	**	***	**	**	**	paper birch
	Pseudotsuga menziesii var. *glauca*	**	***	**	**	**	interior Douglas-fir
Shrubs	*Vaccinium membranaceum*	***	*	**	***	***	black huckleberry
	Corylus cornuta	***	*	**	**	**	beaked hazelnut
	Rosa gymnocarpa	**	*	**	**	**	baldhip rose
Herbs	*Clintonia uniflora*	*	*	**	**	**	queen's cup
	Aralia nudicaulis	*	*	**	**	**	wild sarsaparilla
	Chimaphila umbellata	**	*	**	**	**	prince's pine
	Cornus canadensis	*	*	**	**	**	bunchberry
	Linnaea borealis		*	**	**	**	twinflower
Mosses	*Pleurozium shreberi*	*	*	***	***	***	red-stemmed feathermoss
	Rhytidiadelphus triquetrus		*	**	**	**	leafy mosses
	Hylocomium splendens	*	*	**	**	**	step moss
PLOTS				MS-G29 MS-G32			

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
HO	**Western Redcedar/Western Hemlock – Oakfern – Foamflower**	**ICHmw2**	**04**

Typic unit occurs on gentle to level lower slopes, receiving sites with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is found on till and high fluvial terraces. It has a mixed deciduous and coniferous overstory with scattered shrubs and forbs.

List of mapped units:

HOc	coarse textured soils	HOt	high fluvial terrace
HOg	occurs in a gully		

SITE INFORMATION

Common Terrain Types:

- till, fluvial terraces

Slope position:	level, toe
Slope (%):	0 – 40
Aspect:	none, all
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
HO	**Western Redcedar/Western Hemlock – Oakfern – Foamflower**	**ICHmw2**	**04**

	Structural Stage	3	4	5	6	7	
Trees	*Tsuga heterophylla*	*	**	***	***	***	hybrid white spruce
	Thuja plicata	***	***	***	***	***	Western redcedar
	Betula papyrifera	**	***	**	**	**	paper birch
	Pseudotsuga menziesii var. *glauca*	**	***	**	**	**	interior Douglas-fir
Shrubs	*Vaccinium membranaceum*	***	*	**	***	***	black huckleberry
	Corylus cornuta	***	*	**	**	**	beaked hazelnut
	Rosa gymnocarpa	**	*	**	**	**	baldhip rose
Herbs	*Gymnocarpium dryopteris*	*	*	***	****	****	oak fern
	Cornus canadensis	**	*	**	**	**	bunchberry
	Clintonia uniflora	*	*	**	**	**	queen's cup
	Aralia nudicaulis	*	*	**	**	**	wild sarsaparilla
	Linnaea borealis		*	**	**	**	twinflower
Mosses	*Pleurozium shreberi*	*	*	***	***	***	red-stemmed feathermoss
	Rhytidiadelphus triquetrus		*	**	**	**	leafy mosses
PLOTS				no data			

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
OW	**Shallow Open Water**	**ICHmw2**	**N/A**

These are areas of permanent open water that are less than 2m deep. There is less than 10% emergent vegetation but floating aquatics such as bladderwort are often present. Shallow open water commonly occurs in association with marsh ecosystems.
OWa – occurs in back channels of the Shuswap river, ponds of water in summer, may be flooded in spring.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RD	**Western Redcedar/Western Hemlock – Devil's Club - Sarsaparilla**	**ICHmw2**	**05**

Typic unit occurs on gentle to level lower slopes, receiving sites with deep, medium textured soils (d, j and m are assumed modifiers).

This moist forest ecosystem is found on fluvial terraces, floodplains and adjacent to small creeks. It has a mixed deciduous and coniferous overstory with scattered shrubs and forbs.

List of mapped units:

RDa occurs on an active floodplain

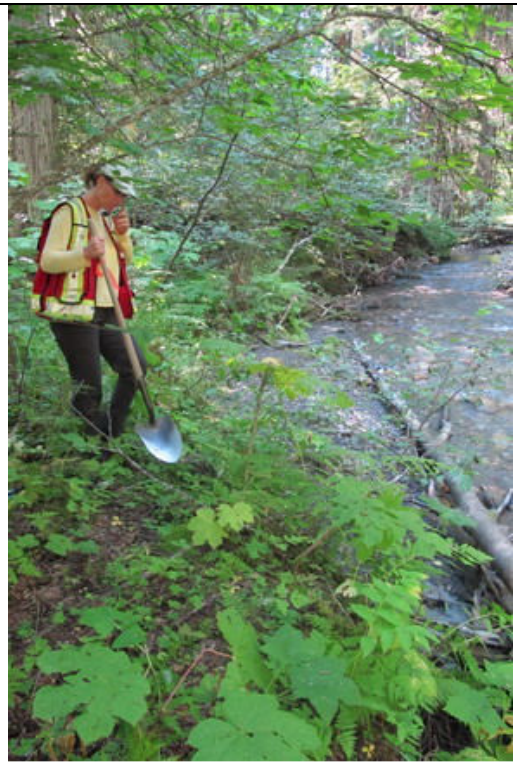
RDt occurs on a fluvial terrace

SITE INFORMATION

Common Terrain Types:

- fluvial fans, plains, terraces and till

Slope position:	level, toe
Slope (%):	0 – 20
Aspect:	none, all
Soil Moisture Regime:	subhygric (hygric)
Soil Nutrient Regime:	rich



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RD	**Western Redcedar/Western Hemlock – Devil's Club - Sarsaparilla**	**ICHmw2**	**05**

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	***	***	**	***	***	Western redcedar
	Betula papyrifera	**	***	**	**	**	paper birch
	Populus balsamifera ssp. trichocarpa	**	**	**	**	**	black cottonwood
	Picea engelmannii x glauca	*	**	**	**	**	hybrid white spruce
Shrubs	*Rubus parviflorus*	**	*	**	**	**	thimbleberry
	Symphoricarpos albus	***	*	**	***	***	common snowberry
	Corylus cornuta	***	*	**	**	**	beaked hazelnut
	Oplopanax horridus	*	*	**	**	**	devil's club
Grasses	*Elymus glaucus*	**	*	**	**	**	blue wildrye
Herbs	*Gymnocarpium dryopteris*	*	*	**	***	***	oak fern
	Athyrium filix-femina		*	**	**	**	lady fern
	Tiarella trifoliate	**	*	**	**	**	three-leaved foamflower
	Equisetum arvense	*	*	*	*	*	common horsetail
Mosses	*Rhytidiadelphus triquetrus*		*	**	**	**	electrified cat's-tail moss
	Brachythecium sp.	**	*	*	**	**	ragged mosses
PLOTS				MS-G30			

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RE	**Reservoir**	**ICHmw2**	**N/A**
An artificial basin created by the impoundment of water behind a human-made structure such as a dam, berm, dyke, or wall.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Western Redcedar/Douglas-fir – Falsebox**	**ICHmw2**	**03**

Typic unit occurs on cool aspects with deep, medium textured soils (d, j and k are assumed modifiers).

This dry forest ecosystem is found on coarse soils and moderate to steep slopes.

List of mapped units:

RFc	coarse textured soils	RFcw	coarse textured soils, warm aspect (moderate slope)
RFcj	gentles slope, coarse textured soils	RFs	shallow soils (50-100cm)
RFcr	coarse textured soils, ridge	RFsw	shallow soils (50-100cm), warm aspect (moderate slope)
RFct	coarse textured soils, glaciofluvial terrace	RFw	warm aspect, slope >25%

SITE INFORMATION

Common Terrain Types:

- glaciofluvial terraces, till and colluvial slopes

Slope position:	level, middle, upper
Slope (%):	0 – 40
Aspect:	none, all
Soil Moisture Regime:	submesic to subxeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	Western Redcedar/Douglas-fir – Falsebox	ICHmw2	03

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	***	***	***	***	***	Douglas-fir
	Betula papyrifera	**	**	**	**	*	paper birch
	Thuja plicata	*	**	**	**	**	western redcedar
Shrubs	*Acer glabrum*	**	*	**	**	**	Douglas maple
	Mahonia aquifolium	***	*	**	**	**	tall Oregon-grape
	Spirea betulifolia	**	*	**	**	**	birch-leaved spirea
Herbs	*Chimaphila umbellata*	**	**	***	***	***	prince's pine
	Linnaea borealis	*	*	**	**	**	twinflower
	Prosartes trachycarpa	**	*	**	**	**	rough-fruited fairybells
	Clintonia uniflora	*	*	**	**	**	queen's cup
Mosses and Lichens	*Peligera aphthosa*		*	**	**	**	freckle pelt
	Rhytidiadelphus triquetrus	*	**	***	**	**	electrified cat's-tail moss
	Brachythecium spp.	**	*	**	**	**	ragged mosses
PLOTS				MS-G31	MS-G33		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RH	**Western Redcedar/Western Hemlock – Horsetail**	**ICHmw2**	**06**

Typic unit occurs on toe slopes, high water-table sites with deep, fine textured soils (d, f and j are assumed modifiers).

This moist forest ecosystem is found in depressions on active fluvial terraces.

List of mapped units:

RHa occurs on an active floodplain

SITE INFORMATION

Common Terrain Types:

- fluvial fans, plains, terraces and till

Slope position:	level, depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric – subhydric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RH	Western Redcedar/Western Hemlock – Horsetail	ICHmw2	06

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	***	***	**	***	***	Western redcedar
	Betula papyrifera	**	***	**	**	**	paper birch
	Populus balsamifera ssp. trichocarpa	**	**	**	**	**	black cottonwood
	Picea engelmannii x glauca	*	**	**	**	**	hybrid white spruce
Shrubs	*Rubus parviflorus*	**	*	**	**	**	thimbleberry
	Cornus stolonifera	***	*	**	***	***	red-osier dogwood
	Oplopanax horridus	*	*	**	**	**	devil's club
Sedges	*Carex disperma*	**	*	**	**	**	soft-leaved sedge
Herbs	*Equisetum arvense*	***	***	****	****	****	common horsetail
	Athyrium filix-femina		*	**	**	**	lady fern
	Equisetum scirpoides	**	**	**	**	**	dwarf scouring-rush
Mosses	*Mnium* or *Plagiomnium* spp.	**	*	**	**	**	leafy mosses
	Brachythecium sp.	**	*	*	**	**	ragged mosses
PLOTS				no data			

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RI	River	ICHmw2	N/A
A watercourse formed when water flows between continuous, definable banks. Includes the Shuswap River and its major tributaries.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RO	Rock Outcrop	ICHmw2	N/A
These are areas of exposed bedrock with less than 10% vegetation cover. On sites with fractured bedrock, some plants may be growing out of rock cracks.			
List of mapped units:			
ROk	cool aspect (slope >25%)	ROw	warm aspect (slope >25%)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RW	**Rural**	**ICHmw2**	**N/A**
Rural areas of human settlement with scattered houses intermingled with native vegetation or cultivated areas.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RZ	**Road Surface**	**ICHmw2**	**N/A**
A gravel or paved road used for vehicular travel.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
TA	**Talus**	**ICHmw2**	**N/A**
Steep colluvial deposits of angular rock fragments that result from rockfall. These sites have less than 10% vegetation cover.			
List of mapped units:			
TAw	warm aspect, slope 60-70%		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
UR	**Urban/Suburban**	**ICHmw2**	**N/A**
Used for the dam at Sugar Lake.			