Sensitive Ecosystems Inventory: Vernon Commonage, 2005

Volume 2: Terrestrial Ecosystem Mapping, Terrain Mapping, and Expanded Legend

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Helen Davis reviewed the draft version of this report.

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[1] The mission of the Real Estate Foundation is to support sustainable real estate and land use practices for the benefit of British Columbians.

[2] The Habitat Stewardship Program for Species at Risk is a partnership-based, conservation initiative sponsored by the Government of Canada. The Program is managed cooperatively by Environment Canada, the Department of Fisheries and Oceans and Parks Canada, and is administered by Environment Canada.

[3] Iverson & MacKenzie Biological Consulting Ltd.

[4] Polar Geoscience

[5] Ophiuchus Consulting

[6] Baseline Geomatics Inc.

Introduction

This report presents detailed information on ecosystems in the Vernon Commonage of the North Okanagan. 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 ecosystem mapping 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. It is recommended for use by people interested in developing other interpretive map themes from the ecosystem or terrain mapping.

Volume 1[7] is intended for people and organizations that need information to help conserve and protect remaining sensitive and important ecosystems in the Vernon Commonage 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[8] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following ten species: Great Basin Spadefoot (*Spea intermontana*), Painted Turtle (*Chrysemys picta*), Western Rattlesnake (*Crotalus oreganus*), Gopher Snake (*Pituophis catenifer* ssp. *deserticola*), Western Screech-owl (*Otus kennicottii* ssp. *macfarlanei*), Long-billed Curlew (*Numenius americanus*), Yellow-breasted Chat (*Icteria virens*), Grasshopper Sparrow (*Ammodramus savannarum*), Swainson's Hawk (*Buteo swainsonii*), Spotted Bat (*Euderma maculatum*) and Badger (*Taxidea taxus jeffersonii*). 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 and are listed in each ecosystem chapter of Volume 1.

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.

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[7] Iverson 2005

[8] Haney and Sarell 2005

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1 Study Area

The study area (Figure 1) lies within the north Okanagan Valley of south-central British Columbia. It is bounded by the urban extent of the City of Vernon in the north, Okanagan Lake in the west, Kalamalka Lake in the east, and the District of Lake Country in the south. The area covers 6,728 ha and includes private land, provincial parks, Department of National Defence (DND) land, and small areas of provincial crown land.

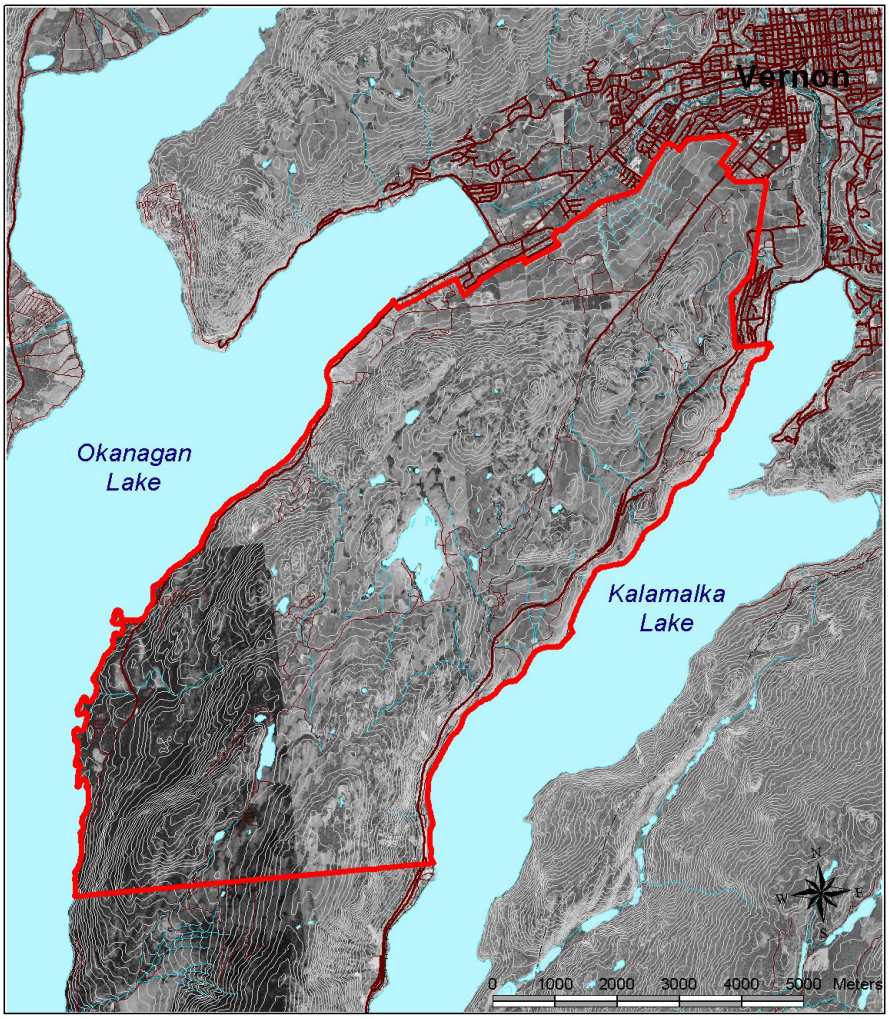

Figure 1. Study area.

1.1 Landscape Setting

The study area is located on the ridge between Okanagan Lake and Kalamalka Lake, north of the District of Lake Country and south of the City of Vernon. This area lies within the Thompson Plateau, a subdivision of the Interior Plateau Physiographic Region[9]. The Thompson Plateau is characterized by gentle, undulating upland surface, separated by large valleys.

Bedrock Geology

Bedrock mapping covering the study area[10] indicates that it is generally underlain by the following geological assemblages (in order from south to north and youngest to oldest): Coryell Syenite (locally referred to as Oyama shale), the Okanagan Plutonic Suite, and the Harper Ranch Group[11] (Table 1). There are two small inclusions of Eocene-aged volcanic rock (andesite) located along the northwestern edge of the study area.

Table 1. Bedrock groups within the study area.

Age	Bedrock Group or Suite	General Bedrock Type	Specific Rock Types	Location
Eocene	Andesitic Volcanic facies	Volcanic	Andesite	Two inclusions along NE edge of the study area
Paleocene	Coryell syenite	Intrusive	Syenite	Southern portion of the study area
	Coryell volcanic	Volcanic	Rhyolite porphyry and tuff	
Jurassic	Okanagan Plutonic Suite	Intrusive	Monzonite, quartz monzonite, diorite, quartz diorite, granodiortie and granite	Central portion of the study area
Permian	Harper Ranch Group (sedimentary and volcanic rocks)	Sedimentary and volcanic rocks partially metamorphosed	Siltstone, sandstone, argillite, conglomerate, breccia, phyllite, quartzite, limestone, tuff, andesite, minor marble, hornfels, skarn	Northern portion of the study area
	Harper Ranch Group (limestone)	Sedimentary	Limestone	

Characteristics of bedrock such as mineral composition and structure, determine the shape and texture of its weathered material. These characteristics influence the shape and size of clasts and

[9] Holland 1976
[10] Glombick et al. 2004
[11] Glombick et al. 2004

the matrix texture of colluvium and till. Intrusive bedrock (Coryell Syenite and Okanagan Plutonic Suite) commonly has a coarse crystalline texture and tends to break down into sand and coarse silt. Till and colluvium derived from these types of bedrock typically have a silty sand matrix. Well-jointed intrusive bedrock breaks into large blocks and boulders. Finer metasediments, such as phyllite and argillite (Harper Ranch Group), weather to create a silty soil matrix. This bedrock typically fractures along foliation planes and jointing to create pebble-sized rubble and slabs. Non-siliceous volcanic bedrock typically breaks down into rubble and blocks, which weather into silt and clay.

Silt and clay that weathers from volcanic bedrock and the finer sedimentary and metamorphic rock types create more erodible soil and are more susceptible to cut-slope slumping than rock types that weather to sand.

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.

Both the upland surface and the steep-sided valleys were completely buried by ice during the Pleistocene glaciation; however, glaciers affected only relatively minor modifications to the older topography. Most of the surficial materials that are of significance with regards to land management date from the last glaciation.

At the beginning of the last major glacial episode (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[12]. The rounded ridge tops suggest that the entire area was completely overridden by ice at this time, depositing till at the base of the ice sheet.

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[13]. Stagnant ice in the valley bottoms impounded temporary glacial lakes in the Okanagan Valley (Glacial Lake Penticton). 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 and fluvial sediments. Some streams and rivers that have graded to the present day lake level have downcut into glacial deposits creating terraces, benches, and steep-sided scarps. Eolian (windblown) sediments have been transported and deposited on the gentler slopes on the eastern edge (lee side of the ridge) of the study area. Fine-grained sediments have accumulated in depressions due to slope wash.

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[12] Fulton 1965; Fulton 1975

[13] Fulton 1969

Soils

In the 10,000 years since glaciation, the upper veneer of surficial deposits has been modified by natural processes, including weathering, to create soils. Soils in the study area are predominantly brunisolic soils. We also observed gleysols in wetter areas, chernozems underlying grasslands, and regosols where the soil is shallow or less developed.

Climate

The study area is located within the northern portion of a dry climatic system resulting in warm, dry conditions[14]. The Coast and Cascade Mountains create a rain shadow effect in the interior of British Columbia, reducing summer and winter precipitation. In summers, hot dry air moves in from the Great Basin to the south.

Within British Columbia, the climate of this region has resulted in semi-arid steppe vegetation with unique geological and landscape features; this has resulted in a diverse and unique assemblage of species in the Okanagan Valley.

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[15]. Situated within the southernmost region of the Interior Plateau of British Columbia, the region lies west of the Columbia Mountains and east of the Coast and Cascade Mountains within the North Okanagan Basin Ecosection (NOB), a wide trench formed by parallel fault lines and further carved out by multiple glaciations.

The Ministry of Forests biogeoclimatic ecosystem classification is a system of classifying vegetation based on climatic and topographic patterns[16]. The Okanagan Very Dry Hot Interior Douglas-fir Variant (IDFxh1) is the only biogeoclimatic variant in the study area.

The IDFxh1 is the driest variant of the Interior Douglas-fir zone; it has a long growing season with warm, dry summers, and summer drought. Winters are cool with low to moderate snowfall. Most portions of the IDFxh1 are dominated by mixed open forests of Douglas-fir and ponderosa pine; the study area also has extensive areas of grasslands.

1.2 Ecology and Disturbance Processes

Historically, frequent low-intensity surface fires maintained grasslands and open Douglas-fir and ponderosa pine forests. 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[17]. Most native grassland plants are well adapted to

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[14] Demarchi 1996

[15] 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.

[16] 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.

[17] Turner 1994; Pokotylo and Froese 1983; Daubenmire 1968

fire through perennating buds or seeds just at or below the ground surface where fire temperatures are cooler[18].

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[19]. Historically, forests were mostly very open with grassy, shrubby 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.

Moisture is very limiting in these dry forest ecosystems and available moisture is critical for the survival of ponderosa pine seedlings. Ponderosa pine seedlings, with a deeper taproot, are better able to survive moisture depletion than Douglas-fir seedlings.

Historically, the principal grazing animals were likely deer and elk[20]. Domestic cattle grazing began in the late 1800's and many of the grasslands in the study area have reduced cover of the more grazing-sensitive species such as bluebunch wheatgrass, Idaho fescue, and rough fescue and have more grazing resistant native grasses such as Columbian needlegrass, junegrass and Sandberg's bluegrass[21]. Some grasslands have been overtaken by knapweed, sulphur cinquefoil and introduced annual brome grasses such as cheatgrass. Some of the grasslands along the eastern portion of the study area are in late seral condition with abundant bunchgrasses and diverse mixes of native forbs.

1.3 Human History

The semi-arid climate of the central Okanagan, with its hot summers and mild winters, has long attracted human habitation. Archaeological evidence indicates that humans have been present in the Okanagan valley for at least 6000 years. The valley provided water, wildlife for hunting, fish, roots, berries, herbs, and other foods and medicines for First Nations peoples[22].

Following the discovery of gold in British Columbia, ranchers from western Oregon came and settled in the dry interior valleys of B.C. Cattle were turned loose on the unfenced range and by the late 1870's most grasslands had deteriorated due to overgrazing[23].

Early forest harvesting was localised but became industrial and more widespread by the mid-1900's[24]. We observed that all accessible areas of the study area had been selectively harvested, leaving very few large, old trees.

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[18] Daubenmire 1968
[19] Agee 1993
[20] Tisdale 1947
[21] Dormaar et al.1989; McLean and Wikeen 1985; Daubenmire 1940
[22] Cannings and Durance 1998; Thomson 2000
[23] Mather 1996
[24] Cannings and Durance 1998

2 Methods and Limitations

This project has used the provincially recognised Terrestrial Ecosystem Mapping standard[25] 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 three was completed according to the methods in *Standard for Terrestrial Ecosystem Mapping in British Columbia*[26].

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),
- combined rating of quality and condition of the ecosystem (QUALCOND).

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 mechanism that continue to shape the landscape) within the natural landscape[27].

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 therefore physical properties such as texture and consolidation.

Terrain maps are the basis for many kinds of land use planning, including slope 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[28], mapping methods[29], and bioterrain mapping methodology[30].

The delineation of the terrain polygons for this project was based on the following criteria:

- terrain type;
- material depths;

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[25] Resources Inventory Committee 1998
[26] Resources Inventory Committee 1998
[27] Ministry of Forests 1999
[28] Howes and Kenk 1997
[29] Ryder 1994
[30] Resources Inventory Committee 1998

- drainage;
- slope breaks;
- slope position;
- aspect: cool from 315-90°, moderate: 270-315° and 90-135°, and warm from135-270°;
- geomorphological processes;
- surface expression and slope morphology (e.g., concave or convex);
- slope stability class;
- erosion potential class;
- vegetation changes;
- riparian zones and corridors; and
- any other ecologically significant areas such as cliffs, talus slopes, and ponds.

Preliminary terrain mapping was completed by Polly Uunila, P.Geo. on 1994 colour aerial photographs at a scale of approximately 1: 15 000 (Table 2). Appendix C provides a terrain legend and describing all materials and geological processes mapped. Figure 2 shows an example of a terrain map label.

Table 2. Mapsheet and aerial photograph list.

TRIM Mapsheets	82L.013 82L.014 82L.023 82L.024
Flight Line and Air Photo Numbers	30BCC 94044: No. 29 - 31 30BCC 94049: No. 52 - 58 30BCC 94052: No. 121 - 126 30BCC 94054: No. 55 - 61 30BCC 94089: No. 96 - 101

During preliminary terrain mapping prior to field work, polygons were delineated, and given a terrain and drainage for each polygon. The southern boundary of the study area was edge-matched to a TEM project completed for the District of Lake Country. After fieldwork, the terrain mapping was updated to reflect field observations. The final terrain mapping is presented on the 1994, colour aerial photographs, and the terrain labels for each polygon has been entered into the ecosystem mapping database. Although a terrain map was not produced, an example terrain map label is shown below in Figure 2.

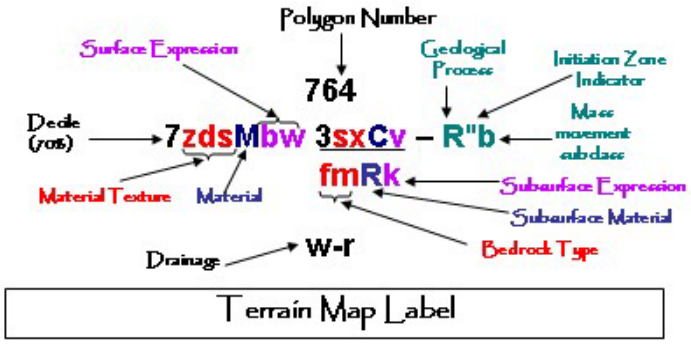

Figure 2. Sample terrain map label.

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 12% 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 2005. A team of three scientists conducted field sampling: a plant ecologist (Kristi Iverson, R.P.Bio.), a terrain and soil specialist (Polly Uunila, P.Geo.), and a wildlife habitat ecologist (Allison Haney).

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 sampling procedures for detailed ecological plots and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[31]. We followed guidelines from the *Standard for Terrestrial Ecosystem Mapping* in British Columbia[32] 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 quality and condition of all sensitive ecosystems.

The location of all detailed ecological plots, ground inspection plots, and visual inspections were either recorded by GPS or marked on project aerial photographs. Site locations were digitally captured and are shown on the terrestrial ecosystem map.

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*[33]. Non-forested units such as wetlands and rock outcrops and grassland seral associations were adopted from previous projects: the Bella Vista – Goose Lake Range SEI[34] and the Central Okanagan SEI[35]. These units

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[31] B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998
[32] Resources Inventory Committee 1998
[33] Lloyd et al. 1990
[34] Iverson 2003

were originally described based on field data and units were developed in conjunction with Dennis Lloyd, the Ministry of Forests and Range's Regional Ecologist in Kamloops.

Approximately 5% of the plots were detailed ecological plots (Table 3), 41% were ground inspections, and 54% were visual inspections. We checked a total of 13% of the polygons (TEM Survey Intensity 4, a total of 1348 polygons in 6728 ha[36]). Detailed ecological field plots were used to sample representative sensitive ecosystems, unclassified ecosystems, and representative examples of each site series. Ground inspections were used to sample sensitive ecosystems and representative examples of site series. Visuals were primarily used to verify ecosystem units, structural stages, or terrain.

Table 3. Numbers and types of plots conducted at field sites.

FS882	Ground Inspections	Visuals	TOTAL
8	69	92	169

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 and Sarell 2005).

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*[37]. 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[38]. For ecosystems not included in current site series classifications, new 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*[37].

Core polygon attributes collected for all polygons are shown below in Table 4. 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

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[35] Iverson and Cadrin 2003

[36] 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 insection was only 40 hectares (Survey intensity level 3).

[37] Resources Inventory Committee 1998

[38] Resources Inventory Committee 2000a

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. Structural stage modifiers were used to subdivide shrub and herb structural stages. Stand composition modifiers indicate the dominant stand composition and were mapped for all forested ecosystems. Seral associations were mapped for grassland ecosystems.

Definitions and descriptions for all site modifiers, structural stage, structural stage modifier, and stand composition modifiers can be found in the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[39].

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 3).

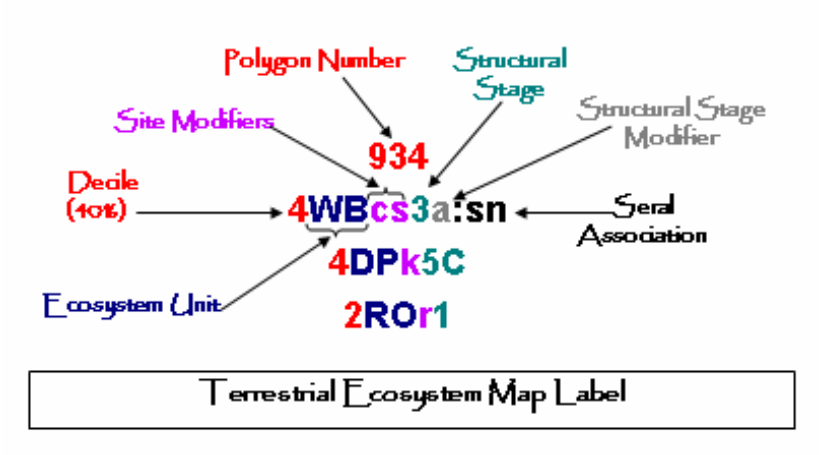

Figure 3. Example of a terrestrial ecosystem map label.

[39] Resources Inventory Committee 1998

Table 4. 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
Ecosection unit
Biogeoclimatic unit (zone and subzone; variant and phase required if present)
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 (optional but should be done where possible; record up to three for each component)
• Surficial material (record one for each component; could include a surficial subtype)
• Qualifiers (when present, record one for each component)
• Surface expression (record 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). 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 D).

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*[40] (Table 4). Table 5 lists the optional attributes we also applied in this project. We also applied two "user-defined" polygon attributes for all occurrences of sensitive ecosystems: Quality/condition and viability. We ran quality assurance error checking routines to ensure the attribute databases were free of errors.

Table 5. List of Optional Attributes

Attribute
Structural stage modifiers
Stand Appearance
Seral Stage
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[41]. The Terrain Resource Information Management (TRIM) was used as the mapping base. The 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.

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 on which the sites are delineated. Orthophotos from 2003 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 aerial photographs or field work. Wherever possible, polygons were updated to reflect changes noted at the time of field work.

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[40] Resources Inventory Committee 2000b

[41] Resources Inventory Committee 2000b

One of the primary limitations of aerial photograph interpretations is the limited ability to see disturbances such as grazing and invasion of noxious weeds. The mapper applies 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 be incorrectly assigned to either 'grasslands' or 'disturbed grasslands'.

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 SEI polygons.

Terrain Mapping Limitations

The accuracy of the terrain mapping and the reliability of the air photo interpretations are dependant on a number of factors. These factors include;

- skill and experience of the mapper;
- scale and quality of the air photos;
- terrain survey intensity level;
- detail and quality of field work;
- type and complexity of terrain and surficial materials;
- type and density of vegetation;
- accuracy of the base maps;
- transfer of linework and terrain symbols into digital format; and
- quality control.

The terrain mapping was completed by an experienced, local terrain mapper who has completed many projects throughout the Okanagan and the rest of B.C. The mapping was checked by Kristi Iverson. The air photos used were of good quality, however, steep west-facing slopes are shadowed and the air photos were taken 11 years ago at the time this project was completed.

In general, the vast areas of grasslands and open forest allowed the mapper a good view of landform features while mapping.

A majority of the study area is private land, and access to some properties was denied. Overall, the project team was able to check a representation of most ecosystems throughout the study area. The project team also worked on a TEM project on the central part of the current study area the previous year.

3 Results

3.1 Terrestrial Ecosystem Mapping

Table 6 lists the ecosystems mapped in the study area, the area they covered and the percentage of the study area landbase. Appendix C provides a list of all plant species encountered during field sampling. Appendix D (Expanded Legend) provides a complete description of each ecosystem.

Table 6. Ecosystem Units mapped, their area, and their percent of the study area.

Code/ Number	Ecosystem Unit Name	Area (hectares)	% of study area
AS /98	At – Snowberry – Kentucky bluegrass	222	3.3
BM /00	Bulrush Marsh	8	0.1
BN /96	Kentucky bluegrass – Stiff needlegrass	39	0.6
BR /00	Baltic Rush Marsh-Meadow	16	0.2
CB/00	Cutbank	11	0.2
CD /00	ActFd –Common Snowberry – Red-osier Dogwood Riparian	7	0.1
CF /00	Cultivated Field	1160	17.2
CL /00	Cliff	8	0.1
CS /00	Common Spikerush Marsh	0.4	0.01
CT /00	Cattail Marsh	1	0.01
CW /00	Choke cherry – Bluebunch wheatgrass rocky bluff	35	0.5
DP /01	FdPy – Pinegrass	371	5.5
DS /07	FdPy – Snowberry – Spirea	431	6.4
DW /03	FdPy – Bluebunch wheatgrass – Pinegrass	406	6.0
ES /00	Exposed Soil	47	0.7
FO/00	FdPy –Saskatoon – Mock orange	31	0.5
FW /91	Idaho fescue – Bluebunch wheatgrass	1289	19.2
GC/00	Golf Course	64	1.0
GP/00	Gravel Pit	8	0.1
OW /00	Shallow Open Water	36	0.5
PB /02	FdPy – Bluebunch wheatgrass – Balsamroot	521	7.7
PD /00	Pond	24	0.4
RE/00	Reservoir	63	0.9
RF /97	Prairie Rose – Idaho fescue	70	1.0
RO /00	Rock Outcrop	1	0.02
RW /00	Rural	224	3.3
RZ /00	Road Surface	128	1.9
SA/00	Antelope brush – Selaginella[42]	85	1.3
SB /00	Selaginella – Bluebunch wheatgrass rock outcrop	219	3.3
SD /08	SxwFd – Douglas maple – Dogwood	124	1.8
SO /00	Saskatoon – Mock orange Talus	33	0.5
SP /04	FdPy – Snowbrush – Pinegrass	455	6.8
UR /00	Urban/Suburban	26	0.4
WB /93	Bluebunch wheatgrass – Balsamroot	564	8.4
TOTAL		**6728**	**100**

[42] Although the plant association name includes antelope brush, antelope brush does not occur in the study area.

3.2 Terrain Results

The study area consists of a northeast, southwest ridge located between Okanagan and Kalamalka Lakes. In general, the ridge top (upland surface) is hummocky, bedrock-controlled terrain with many short, moderately steep to steep sided slopes. The northern portion of the study area is an east-west trending ridge flanked by a gently sloping bench to the north. The southern portion of the study area consists of gentler, bedrock-controlled, undulating terrain containing many roche moutonnées (bedrock-controlled ridges carved by glacial ice) and drumlins oriented in a north-south direction. The valley sides, reaching from the edge of the upland surface to the shores of both lakes, contain moderately steep and steep terrain separated by areas of gentler terrain.

The rolling uplands generally consisted of thinner soils (till and weathered bedrock) overlying bedrock with thicker materials in the depressions (till and some glaciofluvial sediments). The steep valley sides consisted of thin material (till and colluvium) and bedrock outcrops flanked by talus slopes. The lower, gentle slopes along Okanagan and Kalamalka Lakes were covered by glaciolacustrine sediments and till. Scattered throughout the study area, glaciofluvial sediments occurred in some meltwater channels and at the mouths of meltwater channels. There was a large kettled kame (glaciofluvial sediments) terrace located upslope from Ellison Provincial Park. For glaciofluvial sediments, this deposit contains a high percentage of silt (approximately 10 – 20%). Various thicknesses of eolian sediments were mapped on the gentler slopes along the eastern side (lee side) of the study area. Slope wash, derived largely from eolian sediments, was found in many depressions throughout the study area.

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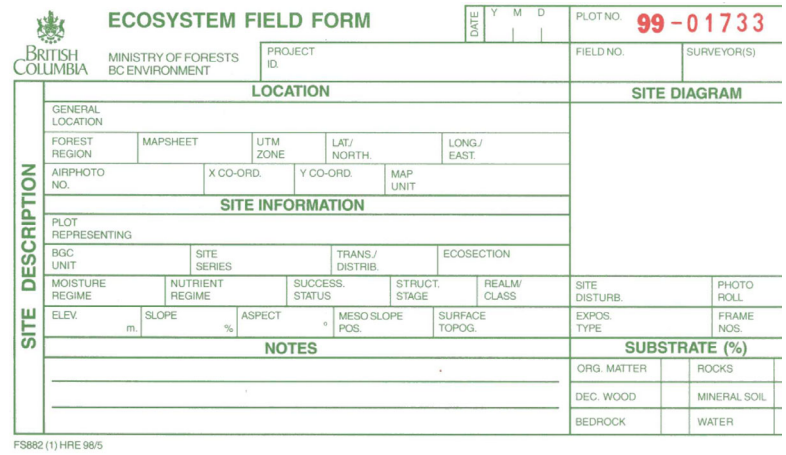
Appendix A: Plot forms



ECOSYSTEM FIELD FORM

BRITISH COLUMBIA — MINISTRY OF FORESTS, BC ENVIRONMENT

DATE (Y M D) | PLOT NO. 99-01733 | PROJECT ID. | FIELD NO. | SURVEYOR(S)

SITE DESCRIPTION

LOCATION | SITE DIAGRAM

GENERAL LOCATION

FOREST REGION | MAPSHEET | UTM ZONE | LAT./ NORTH. | LONG./ EAST.

AIRPHOTO NO. | X CO-ORD. | Y CO-ORD. | MAP UNIT

SITE INFORMATION

PLOT REPRESENTING

BGC UNIT | SITE SERIES | TRANS./ DISTRIB. | ECOSECTION

MOISTURE REGIME | NUTRIENT REGIME | SUCCESS. STATUS | STRUCT. STAGE | REALM/ CLASS | SITE DISTURB. | PHOTO ROLL

ELEV. m. | SLOPE % | ASPECT ° | MESO SLOPE POS. | SURFACE TOPOG. | EXPOS. TYPE | FRAME NOS.

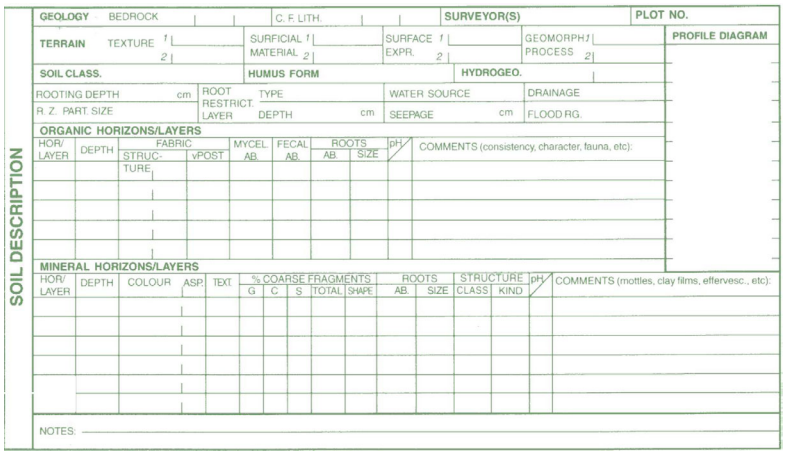
NOTES | SUBSTRATE (%)

ORG. MATTER | ROCKS

DEC. WOOD | MINERAL SOIL

BEDROCK | WATER

FS882 (1) HRE 98/5



SOIL DESCRIPTION

GEOLOGY BEDROCK | C. F. LITH. | SURVEYOR(S) | PLOT NO.

TERRAIN TEXTURE 1 2 | SURFICIAL 1 MATERIAL 2 | SURFACE 1 EXPR. 2 | GEOMORPH 1 PROCESS 2 | PROFILE DIAGRAM

SOIL CLASS. | HUMUS FORM | HYDROGEO.

ROOTING DEPTH cm | ROOT RESTRICT. LAYER | TYPE | WATER SOURCE | DRAINAGE

R. Z. PART. SIZE | DEPTH cm | SEEPAGE cm | FLOOD RG.

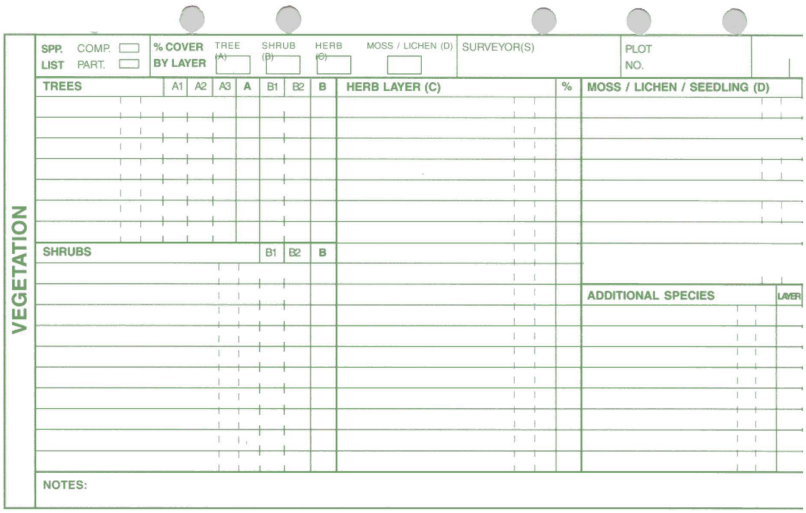
ORGANIC HORIZONS/LAYERS

HOR/ LAYER	DEPTH	FABRIC STRUC-TURE	FABRIC vPOST	MYCEL AB.	FECAL AB.	ROOTS AB.	ROOTS SIZE	pH	COMMENTS (consistency, character, fauna, etc):

MINERAL HORIZONS/LAYERS

HOR/ LAYER	DEPTH	COLOUR	ASP.	TEXT	% COARSE FRAGMENTS G	C	S	TOTAL	SHAPE	ROOTS AB.	SIZE	STRUCTURE CLASS	KIND	pH	COMMENTS (mottles, clay films, effervesc., etc):

NOTES:



VEGETATION

SPP. LIST COMP. PART. | % COVER BY LAYER TREE (A) SHRUB (B) HERB (C) MOSS / LICHEN (D) | SURVEYOR(S) | PLOT NO.

TREES	A1	A2	A3	A	B1	B2	B	HERB LAYER (C)	%	MOSS / LICHEN / SEEDLING (D)

SHRUBS	B1	B2	B

ADDITIONAL SPECIES	LAYER

NOTES:

GROUND INSPECTION FORM

BRITISH COLUMBIA

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 POSTION	☐ 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	☐ Aquic	☐ Perhumid	
	☐ Peraquic	☐ Subaquic	☐ Humid	
MINERAL SOIL TEXTURE	☐ Sandy (LS,S)	☐ Silty (SiL,Si)		
	☐ Loamy (SL,L,SCL,FSL)	☐ 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				
	%	SS	SM	ST
EC1				
EC2				
EC3				

TERRAIN POLYGON SUMMARY		
	%	Classification
TC1		
TC2		
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 & VISUAL INSPECTION FORM

PROJ. ID.	**SURV.**

POLY	**AIR PHOTO #**	**DATE**

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

PLOT #	**GR. PHOTO #.**	MAPSHEET
UTM ZONE	LAT./NORTH	LONG./EAST
ASPECT °	ELEVATION m	SLOPE %
MESO SLOPE	SOIL DRAINAGE	SOIL TEXTURE

ECOSYSTEM COMPONENT 1:	
TERRAIN COMPONENT 1	

DOMINANT / INDICATOR VEGETATION SPECIES

TOTAL	**A:**	**B:**	**C:**	**D:**

SPECIES	L	%	SPECIES	L	%	SPECIES	L	%

COMPLETE ❒ PARTIAL ❒

% Fragmentation (Plant Association)				
❑ UNFRAGMENTED (< 5% of polygon) ❑ PARTLY FRAGMENTED (5 - 25 % of polygon) ❑ HIGHLY FRAGMENTED (> 25% of polygon)				
SITE DISTURBANCE (e.g., L.c/F.l.b.b)				
ADJACENT LAND USE:				
KNOWN THREATS:				
OTHER FACTORS:				
EVALUATION SUMMARY:				
QUALITY	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
CONDITION	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
VIABILITY	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
DEFENSIBILITY	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
NOTES (site diagram, exposure, gleying, etc.)				

Appendix B: Vegetation Species List

Note: This is not a complete list of all plant species in the study area. It is a list of species that were encountered during field sampling and includes all species mentioned in this report.

*denotes introduced species; ~denotes rare plants. Please check the BC Conservation Data Centre web site for current provincial status of plant species (http://srmwww.gov.bc.ca/cdc/), and the COSEWIC web site (http://www.cosewic.gc.ca/) for national status of plant species. The sampling methodology did not include searches for rare plants and it is probable that many other rare plants occur in the study area. Known rare plants from previous inventories in the study area include *Arabis lignifera* (woody-branched rockcress; blue-listed).

Common Name	Scientific Name
Alaska brome	*Bromus sitchensis*
alfalfa*	*Medicago sativa*
American bulrush	*Schoenoplectus pungens*
American vetch	*Vicia americana*
annual agoseris	*Agoseris heterophylla*
annual hawksbeard	*Crepis tectorum*
apple pelt	*Peltigera malacea*
arrowleaf balsamroot	*Balsamorhiza sagittata*
awned haircap moss	*Polytrichum piliferum*
Baltic rush	*Juncus balticus*
Bebb's willow	*Salix bebbiana*
big sagebrush	*Artemisia tridentata*
birch-leaved spirea	*Spiraea betulifolia*
black gooseberry	*Ribes lacustre*
black hawthorn	*Crataegus douglasii*
black medic*	*Medicago lupulina*
black sanicle	*Sanicula marilandica*
blue forget-me-not	*Myosotis stricta*
blue wildrye	*Elymus glaucus*
bluebunch wheatgrass	*Pseudoroegneria spicata*
bluegrass	*Poa* sp.
blunt-leaved sandwort	*Moehringia lateriflora*
boreal pixie-cup	*Cladonia borealis*
brittle prickly-pear cactus	*Opuntia fragilis*
brown-eyed Susan	*Gaillardia aristata*
bulbous bluegrass*	*Poa bulbosa*
bull thistle*	*Cirsium vulgare*
Canada thistle*	*Cirsium arvense*
catnip*	*Nepeta cataria*
celery-leaved buttercup	*Ranunculus sceleratus*
cheatgrass*	*Bromus tectorum*
chocolate lily	*Fritillaria affinis*
choke cherry	*Prunus virginiana*
clad lichens	*Cladonia* spp.

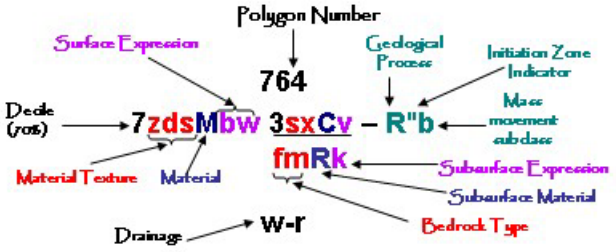
cleavers	*Galium aparine*
Columbia needlegrass	*Achnatherum nelsonii*
common barberry*	*Berberis vulgaris*
common burdock*	*Arctium minus*
common dandelion*	*Taraxacum officinale*
common horsetail	*Equisetum arvense*
common hound's-tongue*	*Cynoglossum officinale*
common juniper	*Juniperus communis*
common rabbit-brush	*Ericameria nauseosus*
common silverweed	*Potentilla anserina*
common snowberry	*Symphoricarpos albus*
common spike-rush	*Eleocharis palustris*
common stork's-bill*	*Erodium cicutarium*
common timothy*	*Phleum pratense*
compact selaginella	*Selaginella densa*
corn gromwell*	*Lithospermum arvense*
crested wheatgrass*	*Agropyron cristatum*
cut-leaved daisy	*Erigeron compositus*
Dalmatian toadflax*	*Linaria genistifolia*
Davidson's penstemon	*Penstemon davidsonii*
diffuse fleabane	*Erigeron divergens*
diffuse knapweed*D95	*Centaurea diffusa*
dog pelt	*Peltigera canina*
Douglas maple	*Acer glabrum*
Douglas-fir	*Pseudotsuga menziesii*
early blue violet	*Viola adunca*
electrified cat's-tail moss	*Rhytidiadelphus triquetrus*
European bittersweet	*Solanum dulcamara*
false Solomon's-seal	*Maianthemum racemosum*
falsebox	*Paxistima myrsinites*
felt pelt	*Peltigera ponojensis*
felt pelt	*Peltigera rufescens*
fern-leaved desert-parsley	*Lomatium dissectum*
field filago*	*Filago arvensis*
field mint	*Mentha arvensis*
field pussytoes	*Antennaria neglecta*
fire-moss	*Ceratodon purpureus*
fireweed	*Epilobium angustifolium*
flixweed*	*Descurainia sophia*
foxtail barley	*Hordeum jubatum*
fragile fern	*Cystopteris fragilis*
freckle pelt	*Peltigera aphthosa*
fringed brome	*Bromus ciliatus*
golden curl-moss	*Homalothecium aeneum*
golden-aster	*Heterotheca villosa*
graceful cinquefoil	*Potentilla gracilis*
great mullein*	*Verbascum thapsus*
grey reindeer	*Cladina rangiferina*
hairy vetch*	*Vicia villosa*

hard-stemmed bulrush	*Schoenoplectus acutus*
heart-leaved arnica	*Arnica cordifolia*
heron's-bill moss	*Dicranum* sp.
Holboell's rockcress	*Arabis holboellii*
Idaho fescue	*Festuca idahoensis*
interrupted apera*	*Apera interrupta*
Japanese brome*	*Bromus japonicus*
junegrass	*Koeleria macrantha*
juniper haircap moss	*Polytrichum juniperinum*
Kentucky bluegrass*	*Poa pratensis*
lamb's-quarters*	*Chenopodium album*
large-fruited desert-parsley	*Lomatium macrocarpum*
lawn moss	*Brachythecium albicans*
leafy moss	*Plagiomnium* sp.
lemonweed	*Lithospermum ruderale*
lesser green reindeer	*Cladina mitis*
Lindley's aster	*Aster ciliolatus*
littlepod flax*	*Camelina microcarpa*
Loesel's tumble-mustard*	*Sisymbrium loeselii*
long-leaved fleabane	*Erigeron corymbosus*
low pussytoes	*Antennaria dimorpha*
meadow death-camas	*Zigadenus venenosus*
meadow saxifrage	*Saxifraga nidifica*
Michaux's mugwort	*Artemisia michauxiana*
miner's funnel	*Cladonia cenotea*
miner's-lettuce	*Claytonia perfoliata*
mock-orange	*Philadelphus lewisii*
mountain cliff fern	*Woodsia scopulina*
mountain sweet-cicely	*Osmorhiza berteroi*
mutton grass	*Poa fendleriana*
n/a lichen	*Cladonia gracilis*
n/a lichen	*Fulgensia bracteata*
n/a lichen	*Ochrolechia upsaliensis*
n/a vascular plant	*Comandra umbellata*
needle-and-thread grass	*Hesperostipa comata*
night-flowering catchfly*	*Silene noctiflora*
Nootka rose	*Rosa nutkana*
northern bedstraw	*Galium boreale*
northern gentian	*Gentianella amarella*
northwestern sedge	*Carex concinnoides*
Nuttall's pussytoes	*Antennaria parvifolia*
oceanspray	*Holodiscus discolor*
old man's whiskers	*Geum triflorum*
orange arnica	*Arnica fulgens*
orchard-grass*	*Dactylis glomerata*
pale alyssum*	*Alyssum alyssoides*
paper birch	*Betula papyrifera*
parsnip-flowered buckwheat	*Eriogonum heracleoides*
pasture sedge	*Carex petasata*

pebbled pixie-cup	*Cladonia pyxidata*
peg-leg soldiers	*Cladonia cariosa*
perennial sow-thistle*	*Sonchus arvensis*
Philadelphia fleabane	*Erigeron philadelphicus*
pinegrass	*Calamagrostis rubescens*
pink twink	*Phlox gracilis*
poison ivy	*Toxicodendron rydbergii*
ponderosa pine	*Pinus ponderosa*
powdered trumpet	*Cladonia fimbriata*
prairie rose	*Rosa woodsii*
prairie sagewort	*Artemisia frigida*
prickly rose	*Rosa acicularis*
purple sweet-cicely	*Osmorhiza purpurea*
quackgrass*	*Elymus repens*
ragged-moss	*Brachythecium* sp.
red-osier dogwood	*Cornus stolonifera*
redstem ceanothus	*Ceanothus sanguineus*
red-stemmed feathermoss	*Pleurozium schreberi*
Rocky Mountain juniper	*Juniperus scopulorum*
Ross' sedge	*Carex rossii*
rough fescue	*Festuca campestris*
rough-fruited fairybells	*Prosartes trachycarpa*
round-leaved alumroot	*Heuchera cylindrica*
sagebrush mariposa lily	*Calochortus macrocarpus*
Sandberg's bluegrass	*Poa secunda*
saskatoon	*Amelanchier alnifolia*
Scouler's hawkweed	*Hieracium scouleri*
sedge	*Carex* sp.
shaggy fleabane	*Erigeron pumilus*
shepherd's purse	*Capsella bursa-pastoris*
shining starwort	*Stellaria nitens*
showy aster	*Aster conspicuus*
showy daisy	*Erigeron speciosus*
showy pussytoes	*Antennaria pulcherrima*
shrubby penstemon	*Penstemon fruticosus*
sidewalk moss	*Tortula ruralis*
silky lupine	*Lupinus sericeus*
silverleaf phacelia	*Phacelia hastata*
six-weeks grass	*Vulpia octoflora*
slender hawksbeard	*Crepis atribarba*
small-flowered blue-eyed Mary	*Collinsia parviflora*
smooth brome*	*Bromus inermis*
snow buckwheat	*Eriogonum niveum*
soft brome*	*Bromus hordeaceus*
soopolallie	*Shepherdia canadensis*
spear-leaved fleabane	*Trimorpha lonchophylla*
spreading dogbane	*Apocynum androsaemifolium*
spring speedwell*	*Veronica verna*
star-flowered false Solomon's-seal	*Maianthemum stellatum*

stepladdered pixie-cup	*Cladonia macrophyllodes*
sticky cinquefoil	*Potentilla glandulosa*
sulphur cinquefoil*	*Potentilla recta*
swale desert-parsley	*Lomatium ambiguum*
sweet-scented bedstraw	*Galium triflorum*
tall annual willowherb	*Epilobium brachycarpum*
tall Oregon-grape	*Mahonia aquifolium*
tall tumble-mustard*	*Sisymbrium altissimum*
tarpaper lichens	*Collema* spp.
tarragon	*Artemisia dracunculus*
thimbleberry	*Rubus parviflorus*
Thompson's paintbrush	*Castilleja thompsonii*
thread-leaved fleabane	*Erigeron filifolius*
thread-leaved phacelia	*Phacelia linearis*
thyme-leaved sandwort	*Arenaria serpyllifolia*
timber milk-vetch	*Astragalus miser*
trembling aspen	*Populus tremuloides*
triple-nerved fleabane	*Erigeron subtrinervis*
tufted thread-moss	*Bryum caespiticium*
twinflower	*Linnaea borealis*
umber pussytoes	*Antennaria umbrinella*
violet	*Viola* sp.
wall lettuce*	*Lactuca muralis*
water birch	*Betula occidentalis*
western dock	*Rumex aquaticus*
western fescue	*Festuca occidentalis*
western meadowrue	*Thalictrum occidentale*
western snowberry	*Symphoricarpos occidentalis*
western tansy mustard*	*Descurainia pinnata*
Wheeler's bluegrass	*Poa wheeleri*
white clover*	*Trifolium repens*
white hawkweed	*Hieracium albiflorum*
white pussytoes	*Antennaria microphylla*
wild sarsaparilla	*Aralia nudicaulis*
wild strawberry	*Fragaria virginiana*
wood strawberry	*Fragaria vesca*
woody-branched rockcress~	*Arabis lignifera*
woolly plantain	*Plantago patagonica*
worm-leaved stonecrop	*Sedum stenopetalum*
yarrow	*Achillea millefolium*
yellow gromwell	*Lithospermum incisum*
yellow salsify*	*Tragopogon dubius*

Appendix C:



Terrain Polygon Sym	Terrain Map Label	

Note: Two or three 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

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 Materials

Anthropogenic Material (A)

Anthropogenic materials are deposits that were 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 has accumulated during post-glacial times as a result of gravity-induced slope movement, for example, rock fall and soil creep. Thin colluvium was draped over some of the steeper slopes, and talus slopes flank a few bedrock cliffs. Texture was closely related to the bedrock from which it has weathered (see Bedrock Geology section). In the study area, the matrix was dominantly sandy with some silt. Colluvial slopes were generally rapidly drained.

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 texure was silty sand or sandy silt with generally less than 5 % coarse fragments. It commonly included some imperfect drainage as it accumulated in receiving sites.

Weathered Bedrock (D)

Weathered bedrock has been modified *in situ* by mechanical and chemical weathering. In the study area, weathered bedrock was found as a discontinuous very thin veneer (Dx) overlying gently sloping or undulating bedrock outcrops. It typically contained a high proportion of angular coarse fragments with varying amounts of interstitial silty sand. It was non-cohesive and rapidly to very rapidly drained.

Eolian Sediments (E)

Eolian sediments were transported and deposited by wind. They typically occurred as a thin cap (Ev) over other materials, but may have been locally thickened into a blanket or dunes. Eolian veneers were found on the gentler slopes on the eastern side (lee side) of the study area. These deposits typically consisted of silt and fine sand.

Fluvial Materials (F, F^A)

Fluvial materials have been deposited in post-glacial time by streams. Fluvial materials consist of loosely packed, non-cohesive sands and silt with some gravel. In the study area, fluvial materials were present mainly as small portions of a polygon that included a stream. Fluvial materials were generally mapped as floodplains (Fp, F^Ap) or gentle fluvial areas (Fj) with imperfect to poor drainage. There were no large areas of fluvial material mapped in 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 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. The large kettled kame terrace located upslope to the east of Ellison Provincial Park contained higher percentage of silt (10 – 20%) than was typical for these sediments. In general, glaciofluvial materials create well-drained and relatively dry sites due to the highly porous and permeable sands and gravels. The material is non-cohesive and therefore erodible, and will tend to ravel when exposed on steep slopes and road cuts. Glaciofluvial sands and gravels are potential sources of aggregate.

Lacustrine (L)

Lacustrine materials have been deposited from standing bodies of water. Fine sand, silt, or clay that have been suspended in the water settle to the lake bed creating sediments that are commonly stratified and fine textured. These sediments may be exposed when the lake is drained. In the study area, lacustrine materials occurred in shallow ponds that are periodically inundated (szLp and szLv). Sediments can also be deposited at the margins of the lake by wave action, such as, on the beaches of Okanagan and Kalamalka Lakes. These materials generally consist of sand and gravel.

Glaciolacustrine (L^G)

Glaciolacustrine materials have been 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 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, glaciolacustrine materials resulting from glacial Lake Penticton were found on the gentler slopes adjacent to Okanagan and Kalamalka Lakes.

Till (M)

Till was deposited directly by glacial ice and is the most common surficial material within the study area. A discontinuous mantle of till filled in the depressions and gentler slopes. Variable thicknesses of till covered the minor valley bottoms. The deposits typically consisted of poorly sorted silt, sand and gravels. In general, till on slopes was well drained and moderately-well drained. In some depressions it was imperfectly drained.

Organics (O)

Organic materials form where decaying plant material accumulates in poorly or very poorly drained areas. In the study area, organic materials were uncommon, but occurred as veneers (Ov) or very thin veneers (Ox) in some of the wetlands.

Bedrock (R)

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

Geological Processes

Geological Processes	
Code	**Name**
-E	Glacial meltwater channels
-H	Kettled
-L	Surface seepage
-R	Rapid mass movement (slides and falls)
-R"	Rapid mass movement initiation zone
-Rb	Rockfall
-Rs	Debris slide
-V	Gullying

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.

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. Meltwater channels were found occasionally in the study area, sometimes in association with gullies that formed from meltwater (-EV).

Kettled (-H)

Kettled topography consists of hummocky undulating terrain, which developed when blocks of glacial ice buried by or surrounded by glaciofluvial gravels and ablation till melted. A kettled kame terrace was located east of Ellison Provincial Park.

Surface Seepage (-L)

Seepage was mapped where relatively wet soils were widespread in a polygon. This commonly occurred where soils were on slowly permeable materials such as till, where thin surficial materials overlied bedrock, and on lower slopes where shallow subsurface water was 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. In the study area, areas of abundant surface seepage were rare and were mapped in two polygons.

Rapid Mass Movement (-R, -R”s, -Rs, -R”b, -Rb)

Rapid mass movement refers to downslope movement by falling, rolling or sliding of debris derived from surficial material and/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.

Debris slides (-R”s, -Rs) are a type of landslide. 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 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 slides can be triggered from excessive moisture as a result of weather or as a result of redirected drainage (e.g., poorly placed culverts). During wet conditions, they can also be triggered by tree throw, rock fall, or vibrations due to earthquakes or human activity. In the study area, debris slides were relatively rare and are mapped in only a few polygons.

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 or cliffs.

Gully Erosion (-V)

Gullies are small ravines with a V-shaped cross section formed in surficial material or bedrock. The symbol was applied to terrain polygons where more than one gully is present, or to gullies large enough to delineate as a polygon. Gullies are formed by the erosive effects of debris slides, meltwater channels, small streams and rockfall. Their presence is an indicator of former or present-day erosion, and the symbol ‘-V’ identifies potentially erodible and presently eroding materials. In the study area, gully erosion was mapped in polygons scattered throughout the study area.

Appendix D: Expanded Legend

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AS	**At – Snowberry – Kentucky bluegrass**	**IDFxh1**	**98**

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

This forest ecosystem commonly occurs in large, broad depressions in grassland areas. These sites collect moisture from surrounding grassland areas. They have an overstory of trembling aspen and a shrubby understory dominated by snowberry and roses.

List of mapped units:

ASg	gully	ASgk	gully, cool aspect; slope >25%
ASgw	gully; warm aspect; slope >25%	ASk	cool aspect; slope >25%
ASn	fan	ASw	warm aspect; slope >25%
ASwx	warm aspect; slope >25%; drier than typical	ASx	drier than typical
ASy	moister than typical		

SITE INFORMATION

Common Terrain Types:

- morainal blankets, colluvial slopewash and sometimes glaciofluvial blankets

Slope position:	lower, toe, depression, mid
Slope (%):	0 – 10 (40)
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AS	At – Snowberry – Kentucky bluegrass	IDFxh1	98

	Structural Stage	3	4	5	6	7	
Trees	*Populus tremuloides*	*	***	***	***	***	trembling aspen
Shrubs	*Amelanchier alnifolia*	***	*	*	*	*	saskatoon
	Acer glabrum	**					Douglas maple
	Mahonia aquifolium	*	*				tall Oregon-grape
	Prunus virginiana	*	*				choke cherry
	Symphoricarpos albus	*****	****	*****	*****	*****	common snowberry
	Rosa spp.		**	**	**	**	roses
Grasses	*Poa pratensis*	**	*	**	**	**	Kentucky bluegrass
Herbs	*Osmorhiza berteroi*	*	*	*	**	**	mountain sweet-cicely
	Thalictrum occidentalis	**	*	*	*	*	western meadowrue
Mosses	*Brachythecium* sp.		*	*	*	*	ragged moss
PLOTS		COMG034 COMG042 COMG049 COMV042	COMG024 COMG035 COMV037	COMG017 COMG022	COMG050		

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
BM	**Bulrush Marsh**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).

This unit is equivalent to the *Great bulrush marsh* association in the provincial classification (MacKenzie and Shaw 2000).

This marsh wetland ecosystem commonly occurs on small ponds adjacent to shallow open water as a fringe along the shoreline. This unit is uncommon in the study area. It typcially occurs as a complex with shallow open water (OW). Water depths are up to 1.5 m but water levels draw down significantly in the summer. These sites are most commonly dominated by hard-stemmed bulrush, with some floating aquatic plants (duckweed, bladderwort and water smartweed). Vegetation species diversity is typically low on these sites. Soils are typically mineral, sometimes with a thin organic veneer.

SITE INFORMATION	
Common Terrain Types: • lacustrine veneer over morainal blanket	
Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric - hydric
Soil Nutrient Regime:	rich

	Structural Stage	2b	
Rushes	*Schoenoplectus acutus*	***	hard-stemmed bulrush
Herbs	*Lemna minor*	**	common duckweed
	Utricularia macrorhiza	*	greater bladderwort
PLOTS	COMG021		

* 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
BN	**Kentucky bluegrass – Stiff needlegrass**	**IDFxh1**	**96**

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

This ecosystem commonly occurs in moisture-collecting swales and depressions in grasslands and grassland openings. These sites are generally quite small and are dominated by grasses with scattered forbs. All sites observed were disturbed and dominated by Kentucky bluegrass. This ecosystem is likely dominated by needlegrasses at climax but the presence of Kentucky bluegrass may prevent these ecosystems from returning to a climax state.

List of mapped units:

BNw warm-aspect; slope >25%

SITE INFORMATION

Common Terrain Types:

- thick morainal blankets

Slope position:	toe, depression
Slope (%):	0 – 15
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	medium – rich

	Stuctural Stage	**2b**	
Grasses	*Poa pratensis*	****	Kentucky bluegrass
	Elymus repens	**	quackgrass
Herbs	*Taraxacum officinale*	**	dandelion
Plots		COMV007	

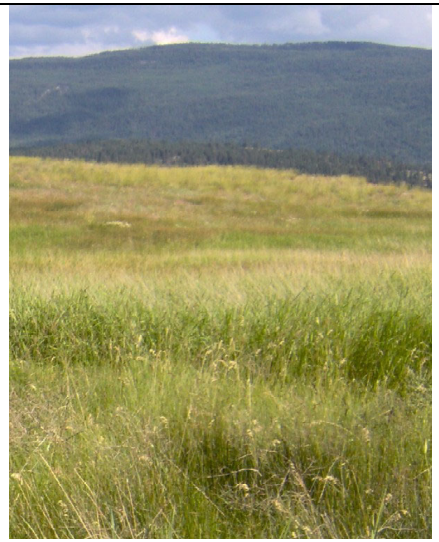
Species – non-native species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Comments: no late seral or climax sites were observed so it is not known what climax vegetation is but may be dominated by Columbia needlegrass and forbs.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BR	**Baltic Rush Marsh-Meadow**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).
This unit is equivalent to the *Baltic rush – Field sedge marsh* association in the provincial classification (MacKenzie and Shaw 2000).
This marsh-meadow wetland ecosystem occurs in areas where water draws down below the soil surface most summers (seasonal flooding). This unit is rare in the study area. These sites are dominated by baltic rush. Field sedge may also occur in slightly drier situations. Soils are typically mineral.

SITE INFORMATION	
Common Terrain Types: • lacustrine veneer over thick morainal or glaciofluvial materials	
Slope position:	toe, depression, (lower)
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich



	Structural Stage	2b	
Rushes	*Juncus balticus*	***	baltic rush
Grasses	*Poa pratensis*	**	Kentucky bluegrass
	Elymus repens	**	quackgrass
PLOTS	COMV039		

* 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

Comments: We only observed disturbed sites.
It is unknown if these sites will recover climax vegetation (baltic rush, common silverweed, and field sedge).

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.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	**ActFd –Common Snowberry – Red-osier Dogwood Riparian**	**IDFxh1**	**00**

Typic unit occurs on level or very gently sloping sites with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is rare but was found along the edge of Okanagan Lake and Kalamalka Lake. Forests are often mixed black cottonwood with Douglas-fir, and paper birch. The understory is typically rich and shrubby, often dominated by Nootka rose, mock orange, snowberry and red-osier dogwood. Forbs are uncommon and scattered.

List of mapped units:

CDn fan

SITE INFORMATION

Common Terrain Types:

- glaciofluvial and colluvial slopewash

Slope position:	lower and toe
Slope (%):	0-15
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	ActFd –Common Snowberry – Red-osier Dogwood Riparian	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Populus balsamifera* ssp. *trichocarpa*	**	***	***	***	***	black cottonwood
	Betula papyrifera		**	**	**	**	paper birch
	Pseudotsuga menziesii var. *glauca*			*	**	**	Douglas-fir
Shrubs	*Symphoricarpos albus*	*****	****	****	****	****	common snowberry
	Philadelphus lewisii	***	**	***	***	***	mock orange
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Mahonia aquifolium	**	*	**	**	**	tall oregon-grape
	Rosa nutkana	***	*	**	**	***	Nootka rose
	Cornus stolonifera	***	**	**	**	**	red-osier dogwood
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
	Poa pratensis	**	*	*	*	*	Kentucky bluegrass
Herbs	*Equisetum arvense*	**	*	*	*	**	common horsetail
Mosses	*Brachythecium* sp.				*	*	ragged moss

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
CF	**Cultivated Field**	**IDFxh1**	**N/A**
These are agricultural fields with tilled soils and planted crops or ground cover. Mapped units: CFcn – coarse-textured soils, fan; CFk – cool aspect, slope >25%			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CL	**Cliff**	**IDFxh1**	**N/A**
These are steep, vertical or overhanging rock faces. Typically there are scattered plants such as saskatoon and cliff ferns occurring in rock fractures or soil pockets. The non-standard modifier 'b' was used to indicate big cliffs large enough to support populations of spotted bats.			
List of mapped units:			
CLbz	big cliff, very steep warm aspect	CLq	very steep cool aspect
CLz	very steep warm aspect		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CS	**Common Spikerush Marsh**	**IDFxh1**	**00**

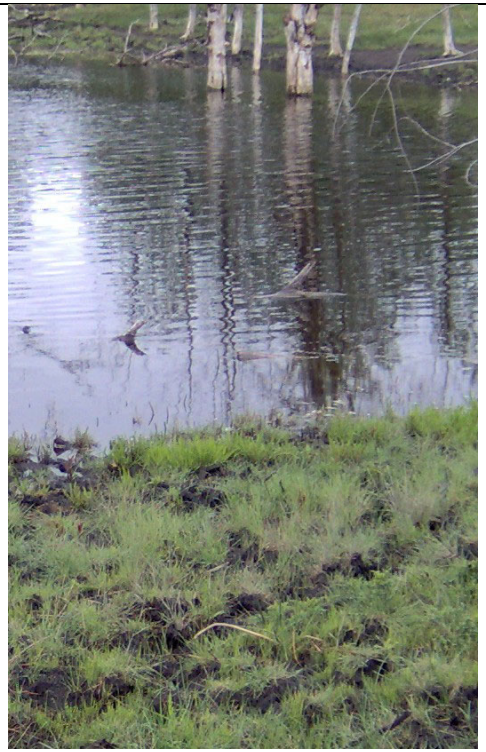
Typic unit occurs on level sites with deep, fine textured soils (assumed modifiers are d, f, and j).

This unit is equivalent to the *Common spike-rush marsh* association in the provincial classification (MacKenzie and Shaw 2000).

These marsh wetland ecosystems occur in standing water as a fringe around ponds, shallow open water and other marshes. This unit is rare in the study area. The water table often drops to the soil surface in late summer. These sites usually have shallower water than Bulrush marshes or Cattail marshes. Soils are typically mineral, but may have a thin organic veneer on top.

CSx – drier than typical – occurs where there have been drier conditions for several years.

SITE INFORMATION	
Common Terrain Types: • lacustrine	
Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric
Soil Nutrient Regime:	rich – very rich



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CS	Common Spikerush Marsh	IDFxh1	00

	Structural Stage	2b	
Rushes	*Eleocharis palustris*	***	common spike-rush
	Schoenoplectus pungens	**	American bulrush
Grasses	*Hordeum jubatum*	**	foxtail barley
Herbs	*Potentilla anserina*	*	common silverweed
PLOTS		COMG014 COMV008	

Highlighted species – indicate important forage plants for ungulates
* 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
Comments: Vegetation may have more foxtail barley, oak-leaved goosefoot, and golden dock in drier years.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CT	**Cattail Marsh**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, medium-textured soils (assumed modifiers are d, j, m).

This unit is equivalent to the *Cattail marsh* association in the provincial classification (MacKenzie and Shaw 2000).

This marsh wetland ecosystem occurs as a fringe on pond edges or in depressions, often adjacent to shallow open water (OW). This unit is rare in the study area. Water depths are typically up to 1 m in spring but draw down to the soil surface by late summer; soils remain saturated for most of the season. Some wetlands convert to cattail marshes when they are subject to nutrient loading. These sites are dominated by cattails with few other species. Soils are typically mineral, but may have a thin organic veneer on top.

List of mapped units:

CTp peaty materials, 40+cm of organic material overlaying mineral deposits

SITE INFORMATION

Common Terrain Types:

- thin organic veneer over lacustrine materials

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

	Structural Stage	2a	
Herbs	*Typha latifolia*	****	common cattail
	Lemna minor	**	common duckweed
Mosses	*Drepanocladus aduncus*	***	common hook-moss

* 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
CW	**Choke cherry – Bluebunch wheatgrass rocky bluff**	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with very shallow soils (assumed modifiers are j and v)

This ecosystem commonly occurs on bedrock bluffs where the bedrock is quite fractured. This unit is uncommon in the study area. Exposed bedrock usually occupies 30-50% of the area. Shrubs are common, typically occurring in cracks in the rocks. Grasses, forbs, lichens and mosses occur in small soil pockets scattered in amongst the bedrock.

List of mapped units:			
CWk	cool aspect; slope >25%	CWr	occurs on a ridge
CWw	warm aspect; slope >25%	CWz	warm aspect; slope very steep (>100%)

SITE INFORMATION	
Common Terrain Types: • rock and very thin colluvial and morainal veneers	
Slope position:	crest, upper
Slope (%):	0 – 130
Aspect:	all
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CW	Choke cherry – Bluebunch wheatgrass rocky bluff	IDFxh1	00

	Structural Stage	3	
Shrubs	*Amelanchier alnifolia*	**	saskatoon
	Symphoricarpos albus	**	common snowberry
	Philadelphus lewisii	*	mock-orange
	Prunus virginiana	**	choke cherry
Grasses	*Pseudoroegneria spicata*	**	bluebunch wheatgrass
Herbs	*Woodsia scopulina*	*	mountain cliff fern
	Selaginella densa	*	compact selaginella
	Balsamorhiza sagittata	*	arrowleaf balsamroot
Mosses	*Tortula ruralis*	*	sidewalk moss
PLOTS		COMG023 COMV091 COMV092	

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
DP	FdPy – Pinegrass	IDFxh1	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. This is the most common forest unit in the study area. Forests are moderately closed with mixed Douglas-fir and ponderosa pine overstories, although historically they would have been quite open. The understory has abundant pinegrass with scattered snowberry, birch-leaved spirea, tall Oregon-grape, grasses, herbs and mosses. This unit is also common on cool aspects (DPk) where there is usually more of a moss layer. Mature (structural stage 6) and old (structural stage 7) forests are uncommon because most of the large trees historically present on these sites have been logged. Because of fire exclusion, most sites have become ingrown with higher densities of smaller stems. Grazing and ingrowth have together reduced the presence of bunchgrasses which were likely historically common.

List of mapped units:

DPf	fine-textured soils	DPk	cool aspect (usually NW to E)
DPks	cool aspect (usually NW to E), shallow soils (generally 50-100cm)	DPs	shallow soils (generally 50-100cm)
DPw	warm aspect (usually SE or NW)		

SITE INFORMATION

Common Terrain Types:

- deep morainal materials on gentle slopes
- moderate to steep cool aspect morainal and colluvial slopes (deep or variable thickness)

Slope position:	lower to upper
Slope (%):	0-30; up to 70% on cool aspects
Aspect:	all
Soil Moisture Regime:	mesic – submesic
Soil Nutrient Regime:	medium (poor)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	FdPy – Pinegrass	IDFxh1	01

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	****	***	***	Douglas-fir
	Pinus ponderosa	**	***	***	**	**	ponderosa pine
Shrubs	*Symphoricarpos albus*	****	*	**	**	**	common snowberry
	Spirea betulifolia	**	*	**	**	**	birch-leaved spirea
	Mahonia aquifolium	**	*	*	*	*	tall oregon-grape
Grasses	*Calamagrostis rubescens*	***		**	**	**	pinegrass
	Festuca idahoensis	**		*	*	**	Idaho fescue
	Festuca campestris			*	*	**	rough fescue
	Elymus glaucus	*		*	*	*	blue wildrye
Herbs	*Amica cordifolia*	**	*	*	*	**	heart-leaved arnica
	Achillea millefolium	**	*	*	*	*	yarrow
	Fragaria virginiana	***		*	*	*	wild strawberry
Mosses and Lichens	*Rhytidiadelphus triquetrus*			*	**	**	electrified cat's tail moss
	Brachythecium albicans.	*	*	*	**	**	lawn moss
	Peltigera canina	*		*	*	**	dog pelt
	Dicranum sp.	*	*	*	*	*	heron's bill moss
				COMG006			
				COMV002			
				COMV083			

Highlighted species – indicate important forage plants for ungulates
* 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	**FdPy – Snowberry – Spirea**	**IDFxh1**	**07**

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 gently sloping sites that are receiving some moisture. This is an uncommon forested ecosystem in the study area. These forests typically have moderately closed Douglas-fir overstories with very shrubby understories dominated by snowberry with some Oregon-grape, Douglas maple, and saskatoon. Often there is scattered Kentucky bluegrass with some heart-leaved arnica and other scattered forbs. There is a minimal moss layer with scattered patches of ragged mosses. Because these sites are moist, they may have had a longer fire-return interval than adjacent mesic and drier forests. These sites also tend to recover more quickly after disturbance (such as logging) because they are moister and more productive.

Although these sites are productive and vegetation recovers relatively quickly following disturbances such as logging, the moist soils on these sites are sensitive to disturbance and are difficult to find places for septic fields. Alterations in subsurface water flow present considerable risks to soil stability.

List of mapped units:

DSf	fine-textured soils	DSfw	fine-textured soils; warm aspect, slope >25%
DSg	gully	DSgw	gully, warm aspect, slope >25%
DSk	cool aspect	DSks	cool aspect, shallow soil (50-100cm), slope >25%
DSw	warm aspect (usually SE or NW, sites with some compensating moisture)		

SITE INFORMATION

Common Terrain Types:

- gentle morainal slopes

Slope position:	lower and middle
Slope (%):	0-15% (up to 50% on cool aspects)
Aspect:	none, cool
Soil Moisture Regime:	mesic – subhygric
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	FdPy – Snowberry – Spirea	IDFxh1	07

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	*****	****	****	***	Douglas-fir
	Populus tremuloides	**	*	**	*		trembling aspen
Shrubs	*Symphoricarpos albus*	*****	***	****	****	****	common snowberry
	Mahonia aquifolium	**		*	**	**	tall oregon-grape
	Paxistima myrsinites	**	**	**	**	**	falsebox
	Acer glabrum	***	**	**	**	***	Douglas maple
	Spirea betulifolia	***	*	**	**	**	birch-leaved spirea
	Ceanothus sanguineus	****					redstem ceanothus
Grasses	*Calamagrostis rubescens*	**		*	*	**	pinegrass
	Elymus glaucus	**		*	*	**	blue wildrye
	Poa pratensis	**	*	*	*	*	Kentucky bluegrass
Herbs	*Osmorhiza berteroi*	***	*	**	**	**	mountain sweet-cicely
Mosses	*Brachythecium* sp.			*	**	**	ragged moss
	Rhytidiadelphus triquetrus						electrified cat's-tail moss
PLOTS		COMG052		COMG012	COMG043		

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
NOTES: Amount of trembling aspen varies from none to a significant part of the overstory (mixed)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DW	**FdPy – Bluebunch wheatgrass - Pinegrass**	**IDFxh1**	**03**

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

This forest ecosystem is common on moderate to steep warm aspects (excluding southeast and west aspects which are usually /04 sites). This is an uncommon unit in the study area. It sometimes occurs on cooler aspects were soils are shallower and on ridges and crests where soils are not shallow enough to be the IDFxh1 /02 (PB). Mixed ponderosa pine – Douglas-fir forests are open and dominated by bunchgrasses, particularly bluebunch wheatgrass with scattered forbs (mostly balsamroot). Idaho fescue and sometimes rough fescue occur on sites that have not been heavily grazed. Mosses and lichens are scattered and uncommon. Ingrowth is commonly present, but drier conditions have helped keep most stands somewhat open.

List of mapped units:

DWc	coarse-textured soils (usually glaciofluvial)	DWcs	coarse-textured shallow soils
DWf	fine-textured soils (usually glaciolacustrine)	DWjs	gentle slope, shallow soils
DWks	cool aspect (generally NW or ESE), shallow soils (<20cm)	DWkv	cool aspect (generally NW or ESE), very shallow soils (<20cm); exposed bedrock (typically 10-20% cover) is present
DWrs	ridge, shallow soils (20-100cm)	DWs	shallow soils (20-100cm)
DWv	very shallow soils (<20cm)		

SITE INFORMATION

Common Terrain Types:

- steep warm aspect thin to thick colluvial and morainal slopes
- occasionally on glaciofluvial and glaciolacustrine slopes

Slope position:	middle and upper
Slope (%):	(30) 35 – 60%
Aspect:	south, southwest, west (also southeast on shallow soils)
Soil Moisture Regime:	subxeric (submesic)
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DW	FdPy – Bluebunch wheatgrass - Pinegrass	IDFxh1	03

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	***	***	***	***	Douglas-fir
	Pinus ponderosa	**	****	***	**	**	ponderosa pine
Shrubs	*Amelanchier alnifolia*	**	*	**	**	**	saskatoon
Grasses	*Pseudoroegneria spicata*	****	**	***	***	****	bluebunch wheatgrass
	Festuca campestris	***	*	**	**	***	rough fescue
	Koeleria macrantha	**	*	**	**	**	junegrass
	Poa fendleriana	***	*	**	**	**	Fendler's bluegrass
	Bromus tectorum	*	*	*	*	*	cheatgrass
Herbs	*Balsamorhiza sagittata*	***	*	**	***	***	arrowleaf balsamroot
	Achillea millefolium	*		*	*	*	yarrow
	Antennaria microphylla or *Antennaria parviflora* or *Antennaria umbrinella*	**	*	*	*	*	white pussytoes Nuttall's pussytoes umber pussytoes
	Stellaria nitens	**		*	*	*	shining starwort
Mosses and Lichens	*Cladonia* spp.	**	*	**	**	**	clad lichens
	Tortula ruralis	**	*	**	**	**	sidewalk moss
	Polytrichum piliferum	*		*	*	*	lawn moss
	Peltigera spp.	*		*	*	*	pelt lichens
PLOTS		COMG011 COMG031	COMG054	COMG004 COMG063	020668 020673 COMG025 COMG057 COMG061 COMG069 COMV084		

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
ES	**Exposed Soil**	**IDFxh1**	**N/A**
These are areas of exposed soils and typically include recent disturbances such as soil erosion.			
List of mapped units:			
ESk	cool aspect	ESq	very steep cool aspect
ESw	warm aspect	ESz	very steep warm aspect

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FO	**Douglas-fir / Ponderosa pine –Saskatoon – Mock orange**	**IDFxh1**	**00**

Typic unit occurs on steep slopes with deep, coarse-textured (rocky) soils (c, and d are assumed modifiers).

This forest ecosystem is commonly associated with steep colluvial sites with rocky soils. This is an uncommon unit in the study area. It occurs on both cool (FOk) and warm (FOw) aspects. The soil matrix is a mixture of both angular rocks and sandy, silty material. The overstory is generally open and dominated by Douglas-fir with scattered ponderosa pine. Understories are often quite shrubby with snowberry, saskatoon and mock orange. There is usually scattered bluebunch wheatgrass. Small rocks dominate a large portion of the soil surface.

List of mapped units:

FOk cool aspect (>25%)

FOw warm aspect (slope >25%)

SITE INFORMATION

Common Terrain Types:

- moderate and steep colluvial slopes

Slope position:	lower to upper
Slope (%):	50-75%
Aspect:	all
Soil Moisture Regime:	submesic – subxeric
Soil Nutrient Regime:	medium, poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FO	Douglas-fir / Ponderosa pine –Saskatoon – Mock orange	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	***	***	***	***	Douglas-fir
Shrubs	*Symphoricarpos albus*	*****	***	***	****	****	common snowberry
	Spirea betulifolia	***	*	*	**	**	birch-leaved spirea
	Philadelphus lewisii	**		*	**	**	mock-orange
	Prunus virginiana	***		*	**	**	choke cherry
	Amelanchier alnifolia	****	**	**	***	***	saskatoon
Grasses	*Pseudoroegneria spicata*	***	**	**	***	***	bluebunch wheatgrass
	Calamagrostis rubescens	***	**	**	***	***	pinegrass
Herbs	*Balsamorhiza sagittata*	**		*	**	**	spreading dogbane
	Lomatium dissectum	*	*	*	*	*	fern-leaved desert parsley
Mosses	*Tortula ruralis*	*		*	*	*	sidewalk moss
PLOTS		COMG039		COMG002	020671		

Highlighted species – indicate important forage plants for ungulates
* 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**	**IDFxh1**	**91**

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

This grassland ecosystem occurs on gentle warm aspects, levels sites, and cool aspects. A mixture of Idaho fescue and bluebunch wheatgrass with balsamroot and other herbs dominates late seral sites, but late seral sites are uncommon in the study area and no climax sites were observed. Soils are typically dark brown or black chernozems. Most of these sites are highly disturbed and some have a significant component of weeds. These are described below and are listed in order from late seral to early seral.

FW:cn *$Cheatgrass – Columbia needlegrass seral association*
This is an early seral association dominated by cheatgrass and other invasive annual bromes, weedy species, with scattered Columbia needlegrass and some native grassland forbs.

FW:fc *$Idaho fescue – Cheatgrass seral association*
This is a mid- to late-seral asoociation dominated by Idaho fescue with significant cover of invasive annual bromes, especially cheatgrass, and a variety of native grassland forbs.

FW:kc *$Knapweed – Cheatgrass seral association*

This is an early seral association dominated by knapweed, sulphur cinquefoil, and cheatgrass with few or no native bunchgrasses remaining on these sites.

FW:nc *$Columbia needlegrass – Cheatgrass seral association*
This is an early seral association dominated by Columbia needlegrass with significant cover of invasive annual bromes, especially cheatgrass, and a variety of native grassland forbs.

FW:sk *$Big sagebrush – Knapweed seral association*
This is an early seral association dominated by big sagebrush, knapweed and cheatgrass with few or no native bunchgrasses remaining on these sites.

FW:sw *$Big sagebrush – Bluebunch wheatgrass seral association*
This is a mid- to late-seral seral association. These sites are dominated by big sagebrush, bluebunch wheatgrass and Idaho fescue. These are similar to the $wf seral association but differ in having a significant shrub layer of big sagebrush.

FW:wf *$Bluebunch wheatgrass – Idaho fescue seral association*
This is a mid- to late-seral seral association. These sites are dominated by bluebunch wheatgrass and Idaho fescue and grassland forbs.

FW:wk *$Bluebunch wheatgrass – Knapweed seral association*
This is a mid- to late-seral seral association. On these sites there is still a reasonable component of bluebunch wheatgrass with knapweed, sulphur cinquefoil, or cheatgrass.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	Idaho fescue – Bluebunch wheatgrass	IDFxh1	91
List of mapped units:			
FWf	fine-textured soils (usually glaciolacustrine)	FWk	cool aspect (>25% slope)
FWks	cool aspect, shallow soils (20-100cm)	FWs	shallow soils (50-100cm)

SITE INFORMATION	
Common Terrain Types: • morainal blankets, often with an aeolian veneer	
Slope position:	lower to upper
Slope (%):	0-35%
Aspect:	all
Soil Moisture Regime:	mesic
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	Idaho fescue – Bluebunch wheatgrass	IDFxh1	91

	Structural Stage Seral Association	2b FW	2b FW:cn	2b FW:fc	2a FW:kc	2b FW:nc	3a FW:sk	3a FW:sw	2b FW:wf	2b FW:wk	
Shrubs	*Artemisia tridentata*						***	***			big sagebrush
Grasses	*Festuca idahoensis*	****		***				***	**		Idaho fescue
	Festuca campestris	**						*	*		rough fescue
	Pseudoroegneria spicata	***		*		*		****	****	***	bluebunch wheatgrass
	Koeleria macrantha	**		*		*		**	**		junegrass
	Achnatherum nelsonii		**	*	**	****	**		*	*	Columbian needlegrass
	Bromus tectorum or *Bromus japonicus*		****	***	****	***	****	*	*	***	cheatgrass or Japanese brome
Herbs	*Balsamorhiza sagittata*	***	*	**				***	**	**	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	*	*		*	*	*	silky lupine
	Eriogonum heracleoides	**	**	**	*	*		*	**	*	parsnip-flowered buckwheat
	Lithospermum ruderale	*	*	*	*	*		*	*	*	lemonweed
	Calochortus macrocarpus	*									sagebrush mariposa lily
	Centaurea diffusa				***	**	***		*	**	diffuse knapweed
	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		020670 020672 020674 COMG016 COMG029 COMG032 COMG040 COMV024 COMV045 COMV049 COMV055		COMV050	COMV029 COMV041 COMV051	COMV023 COMV025	COMV040		COMV022	COMV021	

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
LA	**Lake**	**IDFxh1**	**N/A**
These are areas of permanent open water that are greater than 2m deep and greater than 50ha.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
OW	**Shallow Open Water**	**IDFxh1**	**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.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PB	**FdPy – Bluebunch wheatgrass – Balsamroot**	**IDFxh1**	**02**

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

This forest ecosystem is commonly associated with shallow or very shallow soils and bedrock outcrops (PB, PBrv, PBv). This unit is rare in the study area. Forests are very open with scattered large trees, often growing in bedrock fractures. The understory is variable depending on soil depth with more vegetation occurring on deeper soil pockets. Scattered shrubs and bunchgrasses (bluebunch wheatgrass and Idaho or rough fescue) dominate the understory. A lichen and moss crust may be present on undisturbed sites.

List of mapped units:

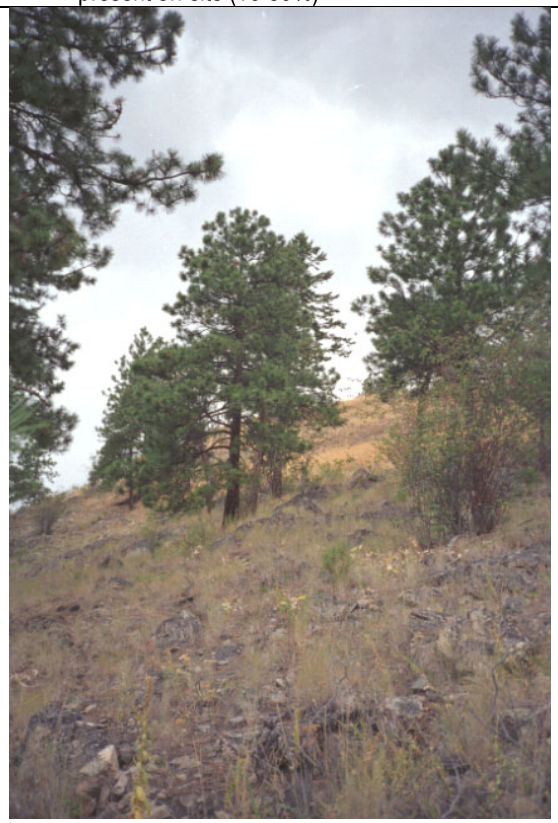
PBrv	ridge, very shallow soils, exposed pockets of bedrock are usually present on-site (10-30% cover of bedrock)	PBv	very shallow soils (<20cm), exposed pockets of bedrock are usually present on-site (10-30%)

SITE INFORMATION

Common Terrain Types:

- Thin and very thin colluvial and morainal materials over rock and patches of exposed bedrock

Slope position:	upper and crest
Slope (%):	0-70%
Aspect:	none, south, southwest
Soil Moisture Regime:	xeric
Soil Nutrient Regime:	poor (very poor, medium)



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PB	FdPy – Bluebunch wheatgrass – Balsamroot	IDFxh1	02

	Structural Stage	3	4	5	6	7	
Trees	*Pinus ponderosa*	**	****	***	***	***	ponderosa pine
	Pseudotsuga menziesii var. *glauca*	**	*	*	*	*	Douglas-fir
Shrubs	*Amelanchier alnifolia*	**	*	**	**	**	saskatoon
	Symphoricarpos albus	***	*	**	**	**	common snowberry
	Spirea betulifolia	***	*	**	**	**	birch-leaved spirea
	Mahonia aquifolium	*		*	*	*	tall oregon-grape
Grasses	*Pseudoroegneria spicata*	****	**	***	***	****	bluebunch wheatgrass
	Festuca campestris	**	*	**	**	**	rough fescue
Herbs	*Balsamorhiza sagittata*	***	*	**	**	**	arrowleaf balsamroot
	Selaginella densa	*	*	*	*	*	compact selaginella
	Woodsia scopulina	*	*	*	*	*	mountain cliff fern
	Penstemon fruiticosa	*	*	*	*	*	shrubby penstemon
Mosses and Lichens	*Cladonia* spp.	**	**	**	**	**	clad lichens
	Tortula ruralis	**	**	**	**	**	sidewalk moss
	Polytrichum piliferum	**	**	**	**	***	awned haircap moss
PLOTS				COMG066 COMV079	COMG009 COMG019 COMG059		

Highlighted species – indicate important forage plants for ungulates
* 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
PD	**Pond**	**IDFxh1**	**N/A**
These are small bodies of permanent water greater than 2m deep but less than 50ha in size. Floating aquatic vegetation is rarely present on ponds.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RE	**Reservoir**	**IDFxh1**	**N/A**
A man-made body of water created by impounding water behind a dam, berm, dyke, or wall. Older reservoirs may have marshes associated with them.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Prairie Rose – Idaho fescue**	**IDFxh1**	**97**

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.

List of mapped units:

RFk	cool 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	IDFxh1	97

	Structural stage	3a or 3b	
Shrubs	*Symphoricarpos albus*	*****	common snowberry
	Rosa woodsii	***	prairie rose
	Rosa nutkana	***	Nootka rose
Grasses	*Poa pratensis*	**	Kentucky bluegrass
	Achnatherum nelsonii	**	Columbian needlegrass
Herbs	*Erigeron speciosus*	*	showy daisy
	Galium boreale	*	northern bedstraw
PLOTS		COMG027 COMG053	

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
RN	**Railway Surface**	**IDFxh1**	**N/A**
A railway with fixed rails for single or multiple rail lines.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RW	**Rural**	**IDFxh1**	**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**	**IDFxh1**	**N/A**
A gravel or paved road used for vehicular travel.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SA	**Antelope Brush - Selaginella**[43]	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with shallow soils (assumed modifiers are j, m and s).

However, in the study area, this unit more commonly occurs on steep slopes on rock outcrops with small ledges and pockets of soil. The bedrock is generally fractured. This is an uncommon unit in the study area. In contrast with areas in the South Okanagan, there is no antelope brush on these sites. Scattered ponderosa pine trees and saskatoon bushes occur in rock fractures. Soil pockets on ledges are dominated by bluebunch wheatgrass with balsamroot, selaginella, and a well developed microbiotic crust.

List of mapped units:

SAkv	cool aspect, very shallow soils	SAq	very steep cool aspect (>100% slope)
SAqv	very steep cool aspect (>100% slope), very shallow soils	SArv	ridge, very shallow soils
SAvw	very shallow soils, warm aspect	SAvz	very shallow soils, very steep warm aspect (>100% slope)

SITE INFORMATION

Common Terrain Types:

- rock, very thin morainal and colluvial veneers

Slope position:	crest, upper
Slope (%):	40 – 70
Aspect:	variable
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

[43] Although the plant association name includes antelope brush, antelope brush does not occur in the study area.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SA	Antelope Brush – Selaginella	IDFxh1	00

	Structural Stage	2b	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*		*	**	**	**	**	Douglas-fir
	Pinus ponderosa		*	***	***	***	***	ponderosa pine
Shrubs	*Amelanchier alnifolia*	**	**	**	**	**	**	saskatoon
	Spirea betulifolia	*	*	*	*	*	*	birch-leaved spirea
Grasses	*Pseudoroegneria spicata*	***	***	***	***	***	***	bluebunch wheatgrass
	Festuca campestris	*	*	*	*	*	*	rough fescue
Herbs	*Selaginella densa*	**	**	**	**	**	**	compact selaginella
	Penstemon fruticosa	*	*	*	*	*	*	shrubby penstemon
	Woodsia scopulina	*	*	*	*	*	*	mountain cliff fern
Mosses	*Cladonia* spp.	**	**	**	**	**	**	clad lichens
Lichens	*Polytrichum piliferum*	**	**	**	**	**	**	awned haircap moss
PLOTS		COMG005 COMV053	COMG010 COMG037 COMG048 COMG065	COMG060				

Highlighted species – indicate important forage plants for ungulates
* 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
Comments: most sites do no progress through the structural stages. Rather some sites are more suitable for tree growth than others.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	**Selaginella – Bluebunch wheatgrass rock outcrop**	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with very shallow soils (assumed modifiers are j and v)

This grassland ecosystem commonly occurs on bedrock outcrops. The bedrock is generally low relief and unfractured. This is an uncommon unit in the study area. Selaginella and rusty steppe moss with some grasses and forbs dominate these sites. This unit is commonly scattered as small sites in a grassland matrix.

SB:cg *Cheatgrass seral association*
This seral association is dominated by cheatgrass or sulphur cinquefoil with selaginella and rusty steppe moss.

List of mapped units:

SBk	cool aspect, slope >25%	SBr	ridge
SBw	warm aspect, slope >25%		

SITE INFORMATION

Common Terrain Types:

- rock, very thin morainal and colluvial veneers and weathered bedrock

Slope position:	crest, upper
Slope (%):	0 – 50
Aspect:	variable
Soil Moisture Regime:	xeric – very xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	Selaginella – Bluebunch wheatgrass rock outcrop	IDFxh1	00

	Structural Stage Seral stage	2a SB	2a SB:$cg	
Shrubs	*Amelanchier alnifolia*	*	*	saskatoon
Grasses	*Pseudoroegneria spicata*	**	*	bluebunch wheatgrass
	Poa secunda	**	**	Sandberg's bluegrass
	Bromus japonicus or tectorum	*	***	Japanese brome or cheatgrass
Herbs	*Selaginella densa*	***	***	compact selaginella
	Eriogonum heracleoides	*		parsnip-flowered buckwheat
	Potentilla recta		**	sulphur cinquefoil
	Centaurea diffusa		**	diffuse knapweed
Mosses and Lichens	*Cladonia* spp.	**	*	clad lichens
	Tortula ruralis	***	**	sidewalk moss
	Polytrichum piliferum	***	*	awned haircap moss
	Peltigera rufescens or *Peltigera ponojensis*	*		felt pelt felt pelt
PLOTS		COMG003 COMG044 COMG051 COMV033	COMG018	

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
SD	**SxwFd – Douglas maple – Dogwood**	**IDFxh1**	**08**

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 gullies with intermittent or permanent streams or subsurface water flow. This is an uncommon unit in the study area. These are diverse, rich sites with mixed coniferous (Douglas-fir) and deciduous (paper birch and aspen) overstories. The understories are dominated by diverse mixture of shrubs. Forbs and mosses are scattered and uncommon on these sites. These moist sites likely had a longer fire return interval than adjacent upland areas.

Although these sites are productive and vegetation recovers relatively quickly following disturbances such as logging, the moist soils on these sites are sensitive to disturbance and septic fields would be difficult to locate on these sites. Alterations in subsurface water flow present considerable risks to soil stability.

List of mapped units:

SDg	gullies, usually associated with permanent or intermittent creeks	SDgw	occurs in gullies on warm aspects

SITE INFORMATION

Common Terrain Types:

- gentle morainal sites

Slope position:	lower, toe
Slope (%):	0-15%
Aspect:	none
Soil Moisture Regime:	subhygric, hygric
Soil Nutrient Regime:	(medium) rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SD	SxwFd – Douglas maple – Dogwood	IDFxh1	08

	Structural Stage	3	4	5	6	7	
Trees	*Betula paperifera*	****	***	***	***	**	paper birch
	Pseudotsuga menziesii var. *glauca*	*	****	***	***	***	Douglas-fir
	Populus tremuloides	**	**	***	***	*	trembling aspen
Shrubs	*Symphoricarpos albus*	****	***	***	****	***	common snowberry
	Acer glabrum var. *douglasii*	****	**	***	***	***	Douglas maple
	Rosa nutkana	**	**	**	**	**	Nootka rose
	Cornus stolonifera	****	*	**	**	**	red-osier dogwood
	Betula occidentalis	***	*	**	**	**	water birch
	Mahonia aquifolium	**	*	**	**	**	tall Oregon-grape
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
Herbs	*Osmorhiza berteroi*	**	*	*	**	**	mountain sweet-cicely
	Maianthemum stellata	*	*	*	*	*	star-flowered false Solomon's-seal
Mosses	*Brachythecium* sp.	*	*	*	*	*	raggged-moss
PLOTS			COMG030	COMG001	COMG007	020669	

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
SO	**Saskatoon – Mock orange Talus**	**IDFxh1**	**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, ponderosa pine or aspen) and scattered shrubs (mock orange, 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. Historically, these sites would not have had enough fuel to burn.

List of mapped units:

SOk cool aspect

SOw warm aspect

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	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	**	**	**	***	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Acer glabrum* var. *douglasii*	***	**	**	***	***	Douglas maple
	Philadelphus lewisii	**	**	**	**	**	mock-orange
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Symphoricarpos albus	**	**	**	**	**	common snowberry
	Spirea betulifolia	*	*	*	*	*	birch-leaved spirea
	Prunus virginiana	*	*	*	*	*	choke cherry
Herbs	*Woodsia scopulorum*	*	*	*	*	*	cliff fern
	Lomatium spp.	*	*	*	*	*	desert-parsely
PLOTS		COMG041 COMG055		COMV066	COMG013		

Highlighted species – indicate important forage plants for ungulates
* 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
SP	**FdPy – Snowbrush – Pinegrass**	**IDFxh1**	**04**

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

This forest ecosystem is associated with moderate to steep slopes on slightly cool aspects (SPk; northwest and east-southeast). This is a very uncommon unit in the study area. It is also found on gently sloping sites with shallow soils (SPs). Occasionally it is found on warm aspects, but generally these are moderately sloping (25-35%) or on 'barely' warm aspects (west-northwest, southeast). The overstory is moderately closed, although historically frequent surface fires would have kept these stands very open and bunchgrasses such as rough fescue were more abundant. Understories are usually a mixture of bunchgrasses (bluebunch wheatgrass and rough fescue) and other grasses with scattered shrubs, forbs and mosses.

List of mapped units:

SPc	coarse-textured soils (usually glaciofluvial)	SPcn	coarse-textured soils, fan (glaciofluvial)
SPf	fine-textured soils (usually glaciolacustrine)	SPk	cool aspect (usually SE or NW)
SPks	cool aspect (usually SE or NW), shallow soils	SPs	shallow soils
SPw	warm aspect (usually SSE or WNW)		

SITE INFORMATION

Common Terrain Types:

- thin or thick colluvial and morainal slopes and ridges

Slope position:	middle and upper
Slope (%):	25 – 50%
Aspect:	east-southeast, west-northwest
Soil Moisture Regime:	submesic
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SP	FdPy – Snowbrush – Pinegrass	IDFxh1	04

	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
	Amelanchier alnifolia	***	*	**	**	**	saskatoon
Grasses	*Calamagrostis rubescens*	**	*	**	*	*	pinegrass
	Pseudoroegneria spicata	***	*	**	**	**	bluebunch wheatgrass
	Festuca campestris	***	*	***	****	****	rough fescue
	Koeleria macrantha	**	*	**	**	**	junegrass
Herbs	*Balsamorhiza sagittata*	**	*	*	**	**	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	**	**	silky lupine
Mosses	*Cladonia* spp.	**	*	*	*	*	clad lichens
Lichens	*Rhytidiadelphus triquetrus.*			*	**	**	electrified cat's-tail moss
PLOTS			COMG008	020675 COMG068	COMG062 COMG064		

Highlighted species – indicate important forage plants for ungulates
* 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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
UR	Urban/Suburban	IDFxh1	N/A
Residential areas with concentrated houses and buildings that almost continuously cover the area. Urban areas are shown in the lower portion of the photo.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	**Bluebunch wheatgrass – Balsamroot**	**IDFxh1**	**93**

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. Disturbed sites are mapped as seral associations as described below.

WB:kc *$Knapweed - Cheatgrass seral association*
These are early and very early seral sites. Although there are native forbs, there are few or no native bunchgrasses remaining on these sites. Invasive weeds including knapweed, cheatgrass and sulphur cinquefoil dominate these sites.

WB:sw *$Big sagebrush – Bluebunch wheatgrass seral association*
This is a late-seral seral association. These sites are dominated by big sagebrush and bluebunch wheatgrass.

WB:wk $***Bluebunch wheatgrass – Knapweed seral association***
This is a mid- to late-seral seral association. On these sites there is still a reasonable component of bluebunch wheatgrass with either knapweed, sulphur cinquefoil or cheatgrass.

List of mapped units:

WBf	fine-textured soils (generally glaciolucustrine)	WBkv	cool aspect, very shallow soils (<20cm, but no exposed bedrock)
WBrs	ridge, shallow soils (20-100cm)	WBs	shallow soils (20-100cm)

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	IDFxh1	93

	Structural Stage Seral Association	2b WB	2a WB:kc	2b WB:wk	3a WB:sw	
Shrubs	*Artemisia tridentata*				****	big sagebrush
Grasses	*Pseudoroegneria spicata*	***	*	**	***	bluebunch wheatgrass
	Koeleria macrantha	**		*	*	junegrass
	Achnatherum nelsonii	*		*		Columbia needlegrass
	Bromus tectorum or *Bromus japonicus*	*	***	**	**	cheatgrass or Japanese brome
Herbs	*Artemisia frigida*	*		*	*	pasture sage
	Balsamorhiza sagittata	***	**	**	***	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	**	silky lupine
	Eriogonum heracleoides	*	*	*	*	parsnip-flowered buckwheat
	Lithospermum ruderale	*	*	*	*	lemonweed
	Centaurea diffusa		****	**	**	diffuse knapweed
	Potentilla recta		***	**	**	sulphur cinquefoil
Mosses	*Cladonia* spp.	**		*	*	clad lichens
Lichens	*Tortula ruralis*	**		*	*	sidewalk moss
PLOTS		COMG026 COMG033 COMG038 COMG046 COMG047 COMG056 COMG058 COMV031 COMV035 COMV038 COMV073	COMG015 COMG045 COMV043	COMG020 COMV030		

Highlighted species – indicate important forage plants for ungulates
Species – non-native 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
Comments: Rabbitbrush is sometimes present on glaciolactustrine materials