Refined and Updated Ecosystem Mapping for the South Okanagan and lower Similkameen Valley

January 2010; updated **April 2012**

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Compendium of projects/refinements prepared for:
Regional District of the Okanagan – Similkameen,
District of Summerland,
South Okanagan – Similkameen Conservation Program,
Parks Canada,
Canadian Wildlife Service, and
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1 Introduction

There are numerous versions of ecosystem mapping for the south Okanagan and lower Similkameen Valleys. In 1991-1994 the area was mapped using a biophysical habitat mapping approach on 1:15,000 aerial photographs taken in the mid 1980's (Lea et al. 1991; Harper et al. 1996). In 2005, the mapping was updated to the current Biogeoclimatic Ecosystem Classification (BEC) site series classification, biogeoclimatic zone and subzone boundaries, ecosection boundaries, and ecosystem units, including recent burns and new developments (using 2003 orthophotos and fire boundaries). At the same time, the database was upgraded to current Terrestrial Ecosystem Mapping (TEM) standards (Resources Inventory Committee 1998). In 2006, additional areas that had been gaps between projects were mapped, and refinements were done in the Naramata area.

The 2006 TEM was used to create a Sensitive Ecosystems Inventory (SEI) by evaluating and grouping TEM units into SEI map units. The resulting SEI map had many polygons where a small proportion was sensitive and the remaining area was considered not sensitive.

To be more useful in assisting land management decisions, the Regional District of the Okanagan – Similkameen (RDOS) desired that the mapping be refined in three main respects: divide sensitive from non-sensitive areas where possible; delineate wetland and riparian areas as separate polygons (where possible) and to map continuous riparian corridors; and delineate areas of new development as new polygons. To further enhance the SEI as a planning tool, ecosystems were to be given a Conservation Ranking based on their at-risk status, ecological sensitivity and wildlife habitat values.

Since the 2009 version, refinements have been carried out opportunistically, including a habitat analysis for Canadian Wildlife Service, and mapping element occurrences of rare ecological communities for BC Conservation Data Centre.

This report documents the methods and results from the upgrades and updates to the mapping for the 2009 version, including Conservation Rankings, as well as updates for the 2012 version.

2 Methods

2.1 *Mapping Revisions*

2.1.1 Refinement of SEI Mapping

For the 2009 update, the RDOS wanted the mapping refined to reduce the number of polygons where only a small portion of the polygon (30% or less) was sensitive, in order to use the SEI Mapping to create Development Permit (DP) areas. They produced maps identifying ecosystem polygons with only 10-30% Sensitive Ecosystems, and these polygons were targeted for refinement.

Using the aerial photographs from the original biophysical mapping (dating from the mid-1980's), polygons were divided to separate sensitive from non-sensitive areas where possible. The original polygons appear as black lines on the photos and new lines are drawn in red. The attributes for all resulting polygons were updated or recorded in the TEM database. Some areas were too intermixed to be divided and some polygons were too small to divide.

Additionally, all aerial photographs were examined for wetland and riparian areas that could be delineated as separate polygons, rather than having them as components of larger polygons.

Ecosystem attributes were updated for all new or modified polygons. The attributes for all resulting polygons were updated or recorded in the TEM database.

Between 2010-2012, the natural part of Okanagan River (McIntyre dam to McAlpine Bridge) was updated for changes to the river and adjacent riparian vegetation. Refinement of additional polygons containing riparian ecosystems in the Okanagan valley-bottom was done in 2011. Changes to the Similkameen River floodplain were captured in early 2012, as part of mapping element occurrences.

2.1.2 Development Updating

In 2009, areas of recent development were digitized by overlaying existing polygons onto recent orthophotos. 2008 orthophotos were supplied by RDOS for much of the valley bottom, particularly municipalities. Most of the remainder of the study area had 2007 orthophotos available, supplied by the Ministry of Environment, except for mapsheets 082E053 and 082E062, which had only 2004 orthophotos available. However, most of mapsheet 082E062 had 2005 high resolution orthophotos provided by the District of Summerland, and late 2008 orthophotos and project plans for the Bentley Rd. to Okanagan Lake Park Highway 97 expansion, supplied by the highways contractor. Subdivided polygons of new development were assigned new map labels based on aerial photograph interpretation (percentiles were reassessed for both portions). Where polygons were completely overtaken by development they were assigned new map labels in the database. Polygons that have new development within them are flagged in the database. Original polygon labels from 2006 were also retained so that ecosystem losses can be calculated. Conversions from orchards to vineyards were not updated.

Some areas had patchy or larger lot developments where polygons could not be divided to separate developed from natural areas. For these polygons, the components and their deciles were re-evaluated and updated in the database.

Some large polygons that were only partly burned in recent (2003) fires were divided to separate burned from unburned areas. Some larger cut-blocks also resulted in divided polygons to separate harvested from unharvested areas.

Since 2009, some additional opportunistic updates have been included in the 2012 version, based on the 2008 orthophotos and 2010 Google Earth imagery.

2.1.3 Incorporation of Detailed Ecosystem Mapping

The areas shown in Figure 1 below had existing detailed ecosystem mapping that was incorporated into the mapping for the 2009 update. Polygons for all areas except Summerland are smaller and have fewer complexes. The polygon boundaries for these components of the mapping (except Summerland) register accurately with TRIM at a scale of 1:10,000 and smaller/broader. All polygon labels were reviewed and updated as necessary. Mapping for the District of Summerland followed methods outlined earlier in this report; the only difference is that much of this work was completed prior to this project. Polygon boundaries in Summerland were partially fixed such that wetlands are accurately located and polygon boundaries adjacent to rural, urban and agricultural developments are also accurate.

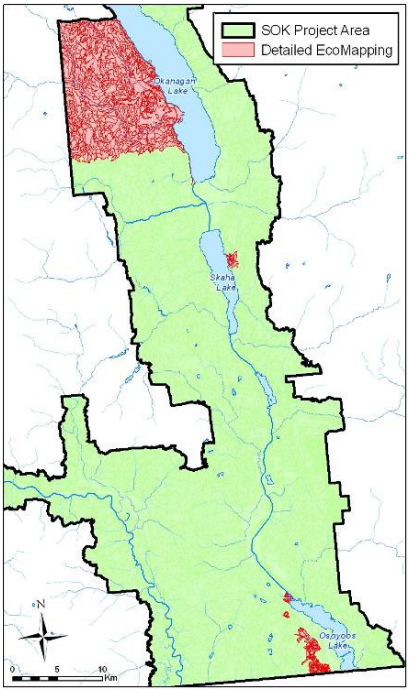

Figure 1: Areas of existing detailed mapping that were incorporated into the 2009 SOK mapping.

2.1.4 *Incorporation of mapping upgrades for a portion of the proposed National Park Reserve*

As part of their feasibility study for a proposed National Park Reserve, Parks Canada wanted more information on the condition and seral stage of grassland ecosystems. Iverson and Haney (2009) document this Parks Canada project. A brief synopsis is provided below to indicate changes relevant to the overall South Okanagan – Similkameen SEI.

Within the area outlined in red below in Figure 2, all polygons with grassland ecosystems were reviewed in stereo on 2007 aerial photographs. Additionally, the project's original aerial photographs with polygons delineated on them were visually compared to the digitized polygons overlaid on recent orthophotos. Polygons where the boundaries were misaligned with underlying features were identified. Polygon boundaries were moved so that they aligned with the landscape and vegetation features used to delineate the original polygons on aerial photographs. Boundaries of over 415 polygons were revised (Figure 2).

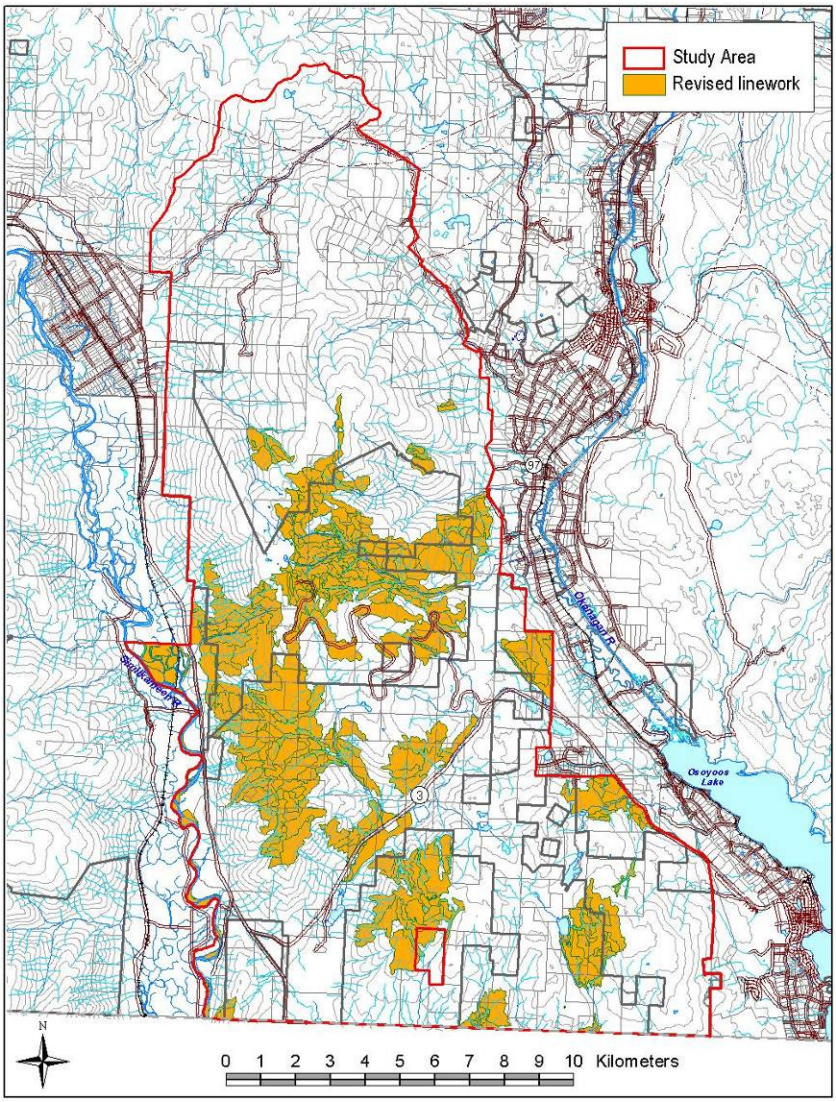

Figure 2: Proposed National Park Reserve study area where polygon boundaries were moved to correctly align, ecosystem mapping was updated, and grassland ecosystems were field verified and seral stage and condition were added to the database.

Ecosystem mapping was reviewed and revised as necessary. A proportion of the polygons were field-verified in August 2009. Field work indicated that some subzone boundaries required adjustment and the boundaries of the IDFdk1, MSxk, and ESSFxc were generally lowered. "Condition"[3] and "seral stage"[4] were evaluated and added into the database for each component of a polygon with a grassland ecosystem.

2.1.5 Update of CFx (Cultivated Field, dry) Polygons

During the 2009 updating of this mapping, we realized that many polygons mapped as CFx (Cultifvated Field, dry; formerly called Dry Pastures in the biophysical mapping) were mislabelled. These polygons arose from the conversion of areas mapped as "Dry Pasture" in the biophysical habitat mapping. However, most of these areas have never been cultivated and are often grasslands in poor condition. We checked and revised the ecosystem label as necessary for polygons with 30% or greater CFx if the polygon did not also have cultivated field, rural, or urban components associated with it.

2.1.6 Polygon Numbers

New polygons arising from the division of existing polygons are numbered 13000 and higher. Original polygon numbers were typically retained for the larger or undeveloped portion of the original polygon. Polygons that resulted from delineating new development or updates/refinements to riparian ecosystems generally contain the original polygon number, preceded by a 2 (and higher numbers if multiple polygons were split off the original, e.g., 6250, 26250, 36250, etc.).

2.2 *Digital Data Capture*

2.2.1 Digital Capture of Biophysical Polygon Boundaries

In the 1990s, the original polygon boundaries for the South Okanagan Biophysical Mapping were captured using a zoom transfer scope. No controls were used to correct for distortion inherent in the aerial photographs. Later, when TRIM first became available, the mapping was "rubber-sheeted". The mapping was digitally stretched to match TRIM features such as larger water bodies, streams and roads. This resulted in areas where the mapping matches the underlying TRIM data well and in other areas, the polygon boundaries may be shifted up to about 200m, especially where there are few features to tie the mapping to.

2.2.2 Digital Capture of SEI Refinement Polygons

Current TEM digital standards require that polygon lines be captured using monorestitution. Smaller scale aerial photographs and TRIM are used as controls to correct for distortion in the aerial photographs. The original biophysical project did not use current standards, and linework was instead captured using zoom transfer scope.

For the 2009 project, new polygon boundaries were marked in red on the original SOK biophysical mapping aerial photographs. However, the new lines marked on the original aerial photographs could not be captured using monorestitution because the photos had not been controlled. They also could not be captured using TRIM features as controls because the new polygons would be drifting in space

[3] The attribute fields in the TEM user-defined database (TEM_9922_uda.csv) and the SEI database (SEI_9922_ecp.csv): cond_1; cond_2; cond_3.

[4] The attribute fields in the TEM user-defined database (TEM_9922_uda.csv): seralst_1; seralst_2; seralst_3. Seral stage is defined as the percent similarity to the potential natural community, where climax is 75-100% similar, late seral is 50-75% similar, mid seral is 25-50% similar and early seral is 0-25% similar.

relative to the original polygon lines they should tie into. Thus, the new lines were digitally captured using the existing lines as controls.

In a few areas in the south-west portion of the mapping, original lines were re-captured using TRIM features as controls. However, it rapidly became apparent that re-capturing all polygon lines was beyond the scope of the project. Thus, these new polygon boundaries were not as accurately captured as in standard TEM projects.

Subsequent refinements to valley-bottom riparian habitats in the Okanagan were digitized in ArcGIS using 2007 and high-resolution 2008 orthophoto base. Updates and refinements to the Similkameen River floodplain were done in Google Earth using 2010 imagery.

2.2.3 Digital Capture of Development Polygons

New polygons arising from new development were captured using ArcGIS and an orthophoto base. In some cases the surrounding original linework was adjusted in this process, to better match recent orthophotos, but the time involved to fix all of the original linework was beyond the scope and budget of the project. Areas of previously-existing development that comprised only a portion of the polygon were also delineated where they could be separated from a non-altered portion of the polygon.

Boundaries of new development polygons register accurately with TRIM at a scale of 1:10,000 and broader.

2.2.4 Data Verification

All coding was reviewed to ensure it is correct in the database. This was done using the DC Tools application which verifies the data is to current TEM standards (Resources Inventory Committee 2000b).

2.3 *Sensitive Ecosystems Inventory*

The SEI ratings table used to convert the Terrestrial Ecosystem Map into an SEI map was updated as necessary to account for new ecosystem units. The SEI ratings table was used to create an SEI database for the mapping. Table 1 below shows the SEI units mapped.

Table 1. SEI units, codes and descriptions.

SEI Class Code[5]	SEI Class Name	SEI Class Description	SEI Class and Subclass Code[6]	SEI Subclass Name
AS	Antelope-brush Steppe	Shrub-steppe ecosystems dominated by antelope-brush.	AS:as	Antelope-brush Steppe
			AS:ds	Disturbed Antelope-brush Steppe
BW	Broadleaf Woodlands	Ecosystems dominated by trembling aspen occurring in depressions and moist areas in grasslands; old Broadleaf Woodlands are part of the Old Forest category.	BW:ac	Aspen copse
FS	Seasonally Flooded Fields	Agricultural areas that are often flooded during spring run-off.	FS	Seasonally Flooded Fields

[5] The related attribute field headings from the SEI database (SEI_9922_ecp.csv): SEcl_1; SEcl_2; SEcl_3. The numbers indicate the decile (i.e. SECl_1 is the SEI Class for the 1st decile).

[6] A combination of SE Class and SE Subclass attributes from the SEI database (SEI_9922_ecp.csv): SEcl_1;SEsubcl_1; SEcl_2:SEsubcl_2; SEcl_3:SEsubcl_3.

SEI Class Code[5]	SEI Class Name	SEI Class Description	SEI Class and Subclass Code[6]	SEI Subclass Name
GR	Grasslands	Ecosystems dominated by bunchgrasses.	GR:gr	Grasslands
			GR:st	Steep Grasslands
			GR:ss	Steep, Shallow-soiled Grasslands
			GR:ds	Disturbed Grasslands
			GR:sh	Shrub Grasslands (moist)
MF	Mature Forest	Forests dominated by mature coniferous trees; excludes mature coniferous and broadleaf woodlands	MF:co	Mature Forest
NS	Not Sensitive		NS	Not Sensitive
OF	Old Forest	Forest ecosystems dominated by large, old trees; includes old Coniferous Woodlands and Broadleaf Woodlands.	OF:co	Old Forest
RI	Riparian	Treed or shrubby ecosystems associated with pond and lake shorelines (fringe), swamps, floodplains, or gullies with intermittent or permanent creeks.	RI:ff	Fluvial Fringe
			RI:sh	Shrub
			RI:fp	Floodplain
			RI:gu	Gully
			RI:ri	River
SS	Sagebrush Steppe	Shrub-steppe ecosystems dominated by big sagebrush.	SS:ss	Sagebrush Steppe
			SS:st	Steep Sagebrush Steppe
			SS:sh	Steep, Shallow-soiled Sagebrush Steppe
			SS:ds	Disturbed Sagebrush Steppe
SV	Sparsely Vegetated	Ecosystems with little vegetation occurring on bedrock or colluvial features.	SV:cl	Cliff
			SV:ro	Rock Outcrop
			SV:sh	Shrubby Rock Outcrop
			SV:ta	Talus Slope
WD	Coniferous Woodlands	Open stands of Douglas-fir or ponderosa pine, often on shallow soils, with typically grassy understories; old Coniferous Woodlands are part of the Old Forest category.	WD:co	Coniferous Woodlands
WN	Wetlands	Ecosystems where the water table is at or near the surface.	WN:ms	Marsh
			WN:sp	Swamp
			WN:sw	Shallow Open Water
			WN:wm	Wet Meadow

2.4 *Reconciled Conservation Rankings*

As part of the Biodiversity Conservation Strategy for the South Okanagan – Similkameen, all units mapped in the TEM were linked to the appropriate ecosystem in the provincial Conservation Framework[7]. These linkages were often made using biogeoclimatic site series or ecosystem name; when this was not possible, then linkages were made by cross-walking the ecosystem concept provided in the expanded legend. Several mapped units did not have equivalent ecosystems in the Conservation Framework, such units included non-vegetated units (i.e. talus or cliffs), or very rare ecosystems that are not included in the provincial ecosystem assessments completed by the Conservation Data Centre (CDC).

Once the initial link was made between the mapped TEM units and the CF ecosystems, the Conservation Framework data was filtered to ensure the greatest applicability to this project. Focus was given to the 'highest priority' in Goals 2 and 3 of the Conservation Framework, and the decision not to use Goal 1 was made, as Goal 1 in the ecosystems component of the Conservation Framework is currently being revised and is subject to change. This put emphasis on ecosystems that are provincially at-risk, as well as those that are showing significant downward trends.

All Conservation Framework (CF) priorities were reviewed by a group of ecology and wildlife experts and the ranking converted to a three-point scale to correlate with the Sensitive Ecosystem Ranks[8] (SER) that had been done in the area. These rankings are referred to as the "reconciled conservation ranking". When the SER and the CF priorities differed, a group of experts agreed upon a reconciled rank. These reconciliations were done consistently across the project area and the rationale behind these decisions can be found in the file "conservation framework TEM cross walk.xls". Local conservation priorities, threats, and wildlife values were incorporated into this process with priorities being adjusted slightly up or down depending on the significance of these values provided by the ecosystem. For some forested ecosystems, different structural stages were assigned different priorities (i.e. mature and old forests may be rarer or more threatened than younger structural stage).

When the ecosystem did not occur in the CF, the SER was assigned; this was most often the case for non-vegetated units that provide high valued wildlife habitat (i.e. cliffs, talus).

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[7] The **Conservation Framework** is British Columbia's new approach for maintaining the rich biodiversity of the province. Developed by the Ministry of Environment in collaboration with other scientists, conservation organizations, industry and government, the Framework provides a set of science-based tools and actions for conserving species and ecosystems in B.C. The Framework ensures that British Columbia is a spectacular place with healthy, natural and diverse ecosystems that sustain and enrich the lives of all.

The Three Goals of the CF are:

1. Contribute to global efforts for species and ecosystem conservation
2. Prevent species and ecosystems from becoming at risk
3. Maintain the diversity of native species and ecosystems

Now being implemented, the Framework will determine the conservation actions needed for species and ecosystems of conservation concern in British Columbia for management action using the *Prioritization Tool* and the *Action Sorting Tool.*

[8] Sensitive Ecosystem Ranks represented relative conservation priorities for SEI units in the South Okanagan (SEI units were ranked from 1 to 3). Most TEM units were grouped in to SEI units and thus threats and rarity of the broad SEI unit were only considered, not the specific rarity of a particular site series or TEM unit. In a few cases, SEI units were ranked differently for different biogeoclimatic subzones or variants.

Reconciled conservation rankings were applied to the database using the Sensitive Ecosystems ratings table. The following four conservation ranking categories were applied to the dataset:

- 1 = High
- 2 = Moderate
- 3 = Low
- 4 = Not Sensitive

The ratings table was used to generate conservation ranks for each component of the polygon (consrank_1, consrank_2, consrank_3), the highest conservation rank for each polygon (consrnk_hv), and the weighted average of the conservation ranks in each polygon (consrnk_avg).

3 Results

Appendix I has a map legend with the current classification, biophysical classification and a brief description of each TEM map unit.

3.1 *Revisions*

At least 4035 polygons were modified or created as part of the 2009 update (Figure 3). Over 580 additional polygons modifications were done since then for the 2012 version. Numerous additional polygons had small revisions done that were not kept track of, including adjusting polygon boundaries to better match pre-existing conditions, or areas of expanded development that were too small to warrant a new polygon, so were merged with an adjacent polygon of the same type.

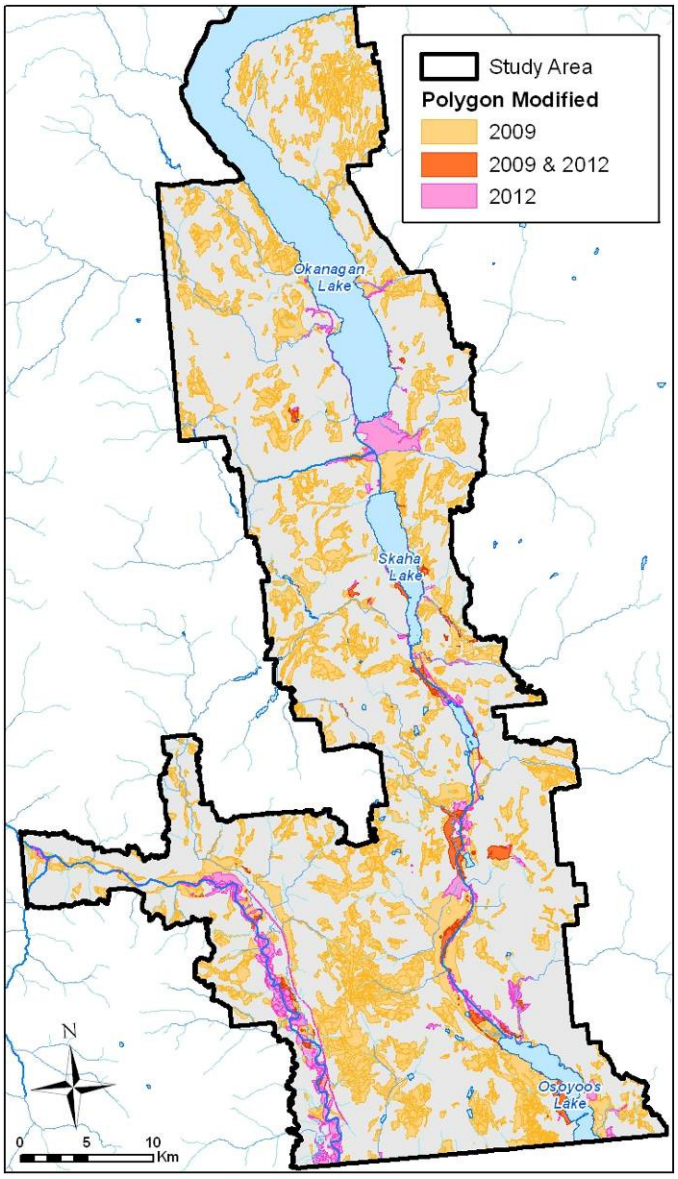

Figure 3: Polygon modifications made for the 2009 and/or 2012 update.

3.2 *User-defined Data*

In addition to the standard TEM and SEI attributes, the following attributes are recorded in the user-defined database (TEM_9922_uda.csv):

- **PolyMod_Yr** – indicates the year that a polygon that was divided or the linework modified, or the polygon label was reviewed and (sometimes) the database record modified
- **EcoLoss_Yr** – any polygon where all or part of it has been lost to development since the 2006 update
- **CONSRANK_1** – reconciled conservation rank for the first component of the polygon
- **CONSRANK _2** – reconciled conservation rank for the second component of the polygon
- **CONSRANK _3** – reconciled conservation rank for the third component of the polygon
- **CONSRNK_HV** – highest reconciled conservation ranking for the polygon
- **CONSRNK_AVG** – weighted average (by decile) of reconciled conservation ranks for each polygon
- **TEM_2009** – TEM polygon label from 2009
- **TEM_06** – TEM polygon label from 2006
- **ECP_TAG06** – the original ECP_TAG from 2006, which indicates what polygon new polygons were formerly part of
- **ABCOV_1** – antelope-brush cover of the first component of the polygon, only recorded in polygons where antelope-brush is likely to occur
- **ABCOV_2** – antelope-brush cover of the 2nd component of the polygon
- **ABCOV_3** – antelope-brush cover of the 3rd component of the polygon
- **RNG1** – range condition of 1st component as recorded in the Biophysical Habitat Mapping, retained in this field only where condition has not been mapped
- **RNG2** – range condition of 2nd component as recorded in the Biophysical Habitat Mapping, retained in this field only where condition has not been mapped
- **RNG3** – range condition of 3rd component as recorded in the Biophysical Habitat Mapping, retained in this field only where condition has not been mapped
- **COND_1** – ecological condition of the first component of the polygon; only recorded for antelope-brush polygons and grassland polygons in the proposed National Park interest area
- **COND_2** – ecological condition of the 2nd component of the polygon
- **COND_3** – ecological condition of the 3rd component of the polygon
- **SERALST_1** – grassland seral stage of the 1st component of the polygon, only mapped for grassland ecosystems in the proposed National Park interest area
- **SERALST_2** – grassland seral stage of the 2nd component of the polygon
- **SERALST_3** – grassland seral stage of the 3rd component of the polygon
- **BPH_ECOS** – Ecosection as mapped in the Biophysical Habitat Mapping
- **BPH _BIO** – Biogeclimatic Subzone or Variant as mapped in the Biophysical Habitat Mapping
- **BPH _LABEL** – original ecosystem label from the Biophysical Habitat Mapping
- **BPH _RNG1** – range condition of 1st component as recorded in the Biophysical Habitat Mapping
- **BPH _RNG2** – range condition of 2nd component as recorded in the Biophysical Habitat Mapping
- **BPH _RNG3** – range condition of 3rd component as recorded in the Biophysical Habitat Mapping

3.3 *Sensitive Ecosystems Inventory*

Figure 4 shows the sensitive ecosystem class for the largest area of each polygon.

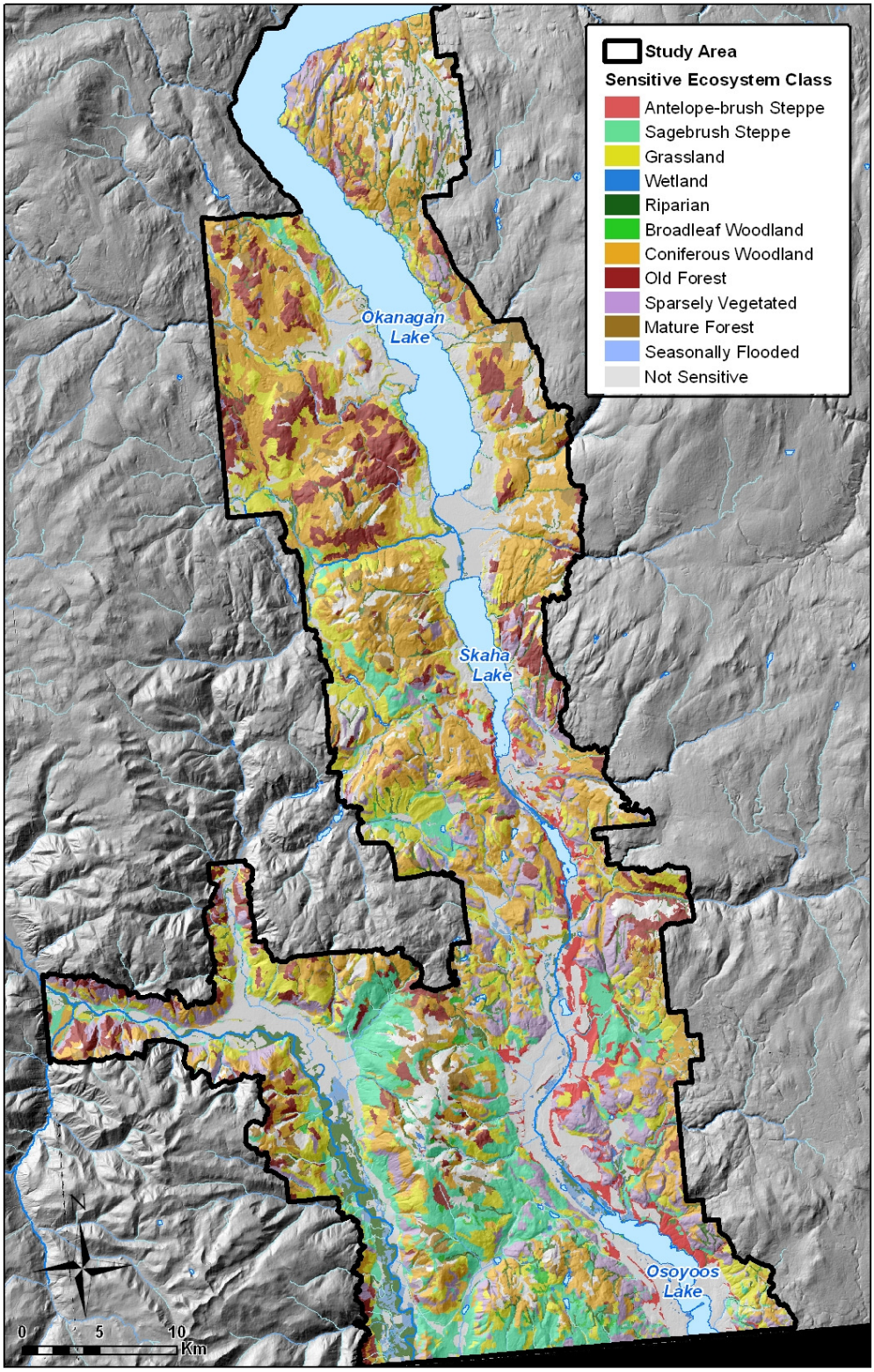

Figure 4: Sensitive Ecosystem class, shown by largest area.

3.4 *Conservation Rankings*

Figure 5 shows the weighted average of conservation rankings for each polygon in the study area.

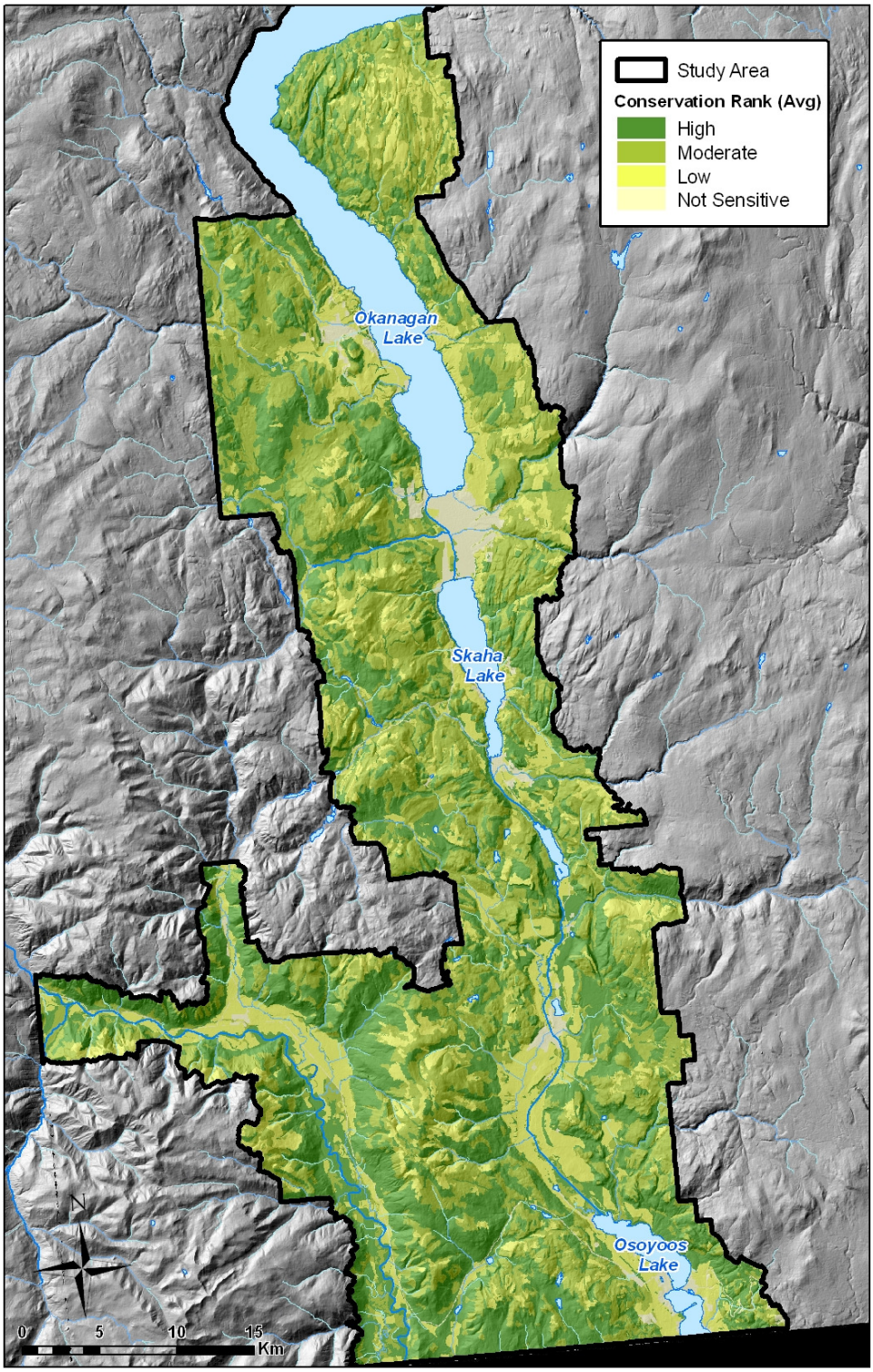

Figure 5: Reconciled Conservation Rankings, shown by weighted average.

3.5 *Data Access*

Databases are structured according to TEM and At-risk Ecosystem Mapping standards. All databases can be linked to the spatial data by the ECP tag.

Spatial and nonspatial data are available for download on EcoCat (http://a100.gov.bc.ca/pub/acat/public/welcome.do), with the following file name formats:

- **SOK9922_all-info_shp.zip** contains the spatial data and all TEM and SEI non-spatial attributes in shapefile format (non-standard)
- **TEM_9922_ecp.e00** contains the spatial data for the polygon coverage in Arc export format
- **TEM_9922_eci.e00** contains the spatial data for the proposed National Park field plots in Arc export format
- **TEM_9922_project.csv** contains the TEM project meta-data
- **TEM_9922_ecp.csv** contains the TEM ecosystem attributes for each polygon
- **TEM_9922_usr.csv** contains the definitions of user-defined attributes
- **TEM_9922_uda.csv** contains the user-defined attributes for each polygon
- **TEM_9922_eci.mdb** contains the VENUS data for the proposed National Park field plots
- **SEI_9922_project.csv** contains the SEI project meta-data
- **SEI_9922_rt.csv** contains the SEI ratings table to apply SEI attributes based on the TEM data
- **SEI_9922_ecp.csv** contains the SEI polygon ecosystem attributes for each polygon
- **SEI_9922_usr.csv** contains the definitions of non-standard ecosystem units and seral stages used in the SEI database
- **SEI-ConsRank_9922_rt.csv** contains the ratings table to apply SEI attributes and Conservation Rankings based on the TEM data (non-standard)

4 Limitations

1. Polygon boundaries vary in their accuracy and may be out by up to 200m relative to their original placement on the project aerial photographs.
2. The attributes of polygons follow the boundaries delineated on the aerial photographs, thus they may not accurately register with other information layers such as TRIM at scales of 1:20,000. New development polygons from the 2009 update, and all subsequent revisions for the 2012 update, do accurately register with TRIM and 1:10,000 or broader scale orthophotos.
3. Most polygons that are >30% sensitive did not have the polygon label verified or modified.
4. The ecological attributes of all modified polygons were examined in stereo on the original aerial photographs (2009 update only) and either Google Earth or the most recent orthophotos available to assign ecological attributes (TEM map label) to the polygons. In many cases, there were changes in proportions or in the ecosystem units assigned that reflect a change to a smaller polygon size, a different interpretation from the original ecosystem mapper, or a different interpretation from the algorithm used to convert the biophysical habitat mapping to TEM coding.

5 Recommendations

The existing mapping is highly variable in the accuracy of the digital capture of polygon boundaries. Boundaries vary from accurately registering with TRIM and orthophotos, to "drifting" by up to about 200m. Additionally, some polygon boundaries appear on the original aerial photographs that were never digitally captured.

We recommend one of the following two approaches to improve the accuracy of the mapping where it is not correctly aligned (Option 3 is presented but is not considered practical):

Option 1. Acquire a set of digital aerial photographs of a scale of 1:20,000 or larger. Using a DiAP viewer and softcopy or similar technology, digitally move the polygon boundaries to follow those on the aerial photographs, and, where appropriate, capture new polygon boundaries to refine the mapping.

Option 2. Using the most recent available orthophotos and appropriate software, move polygon boundaries to better follow boundaries delineated on aerial photographs. The person moving the boundaries would refer to features on the original aerial photographs to determine which polygon boundaries need moving, and where to move them to. This method was used in the proposed National Park interest area and it took approximately seven days to fix the polygon boundaries in that area.

Option 3. Control original aerial photographs and use monorestitution to capture polygon boundaries to TEM standards. This option is not considered viable because of the difficulty involved in re-numbering polygons to match up to the database and to capture the numerous changes to the mapping that have occurred since the date of the original aerial photographs.

Option 1 provides more accurate capture of polygon boundaries, but is more expensive. The accuracy is improved because a 3-D view allows the person mapping to view the land features used as criteria for delineating polygons. The Regional District may want to acquire a work station with the digital aerial photographs for all or part of the Regional District as this would allow staff members to view development proposals in 3-D and this set-up would be used to move polygon boundaries for this option.

Option 2 would be less expensive but may be challenging in some areas where extensive new development or burns have occurred. Difficulties would arise in these areas because it would be harder to reference vegetation features from the original photographs to determine the appropriate placement of the polygon boundaries on the orthophotos.

Any upgrades to the digital capture of polygon boundaries should be done by a qualified ecologist able to update ecological attributes in polygons as will be necessary as part of the upgrade.

6 Future Upgrades

When any future upgrades are completed for this project, the following changes are recommended:

1. Review any polygons mapped as canals. Where "canal" has been used for channelized portions of creeks and rivers, the TEM code should be changed to use cn (canal) as a seral stage and the SEI code should be changed to RI:ch (riparian, channelized). Other canals should become an 'other important ecosystem' (canal, CN) in the SEI database.
2. Reservoirs (code RE in TEM database) should be added as an 'other important ecosystem' (code RE in SEI database).
3. Review the following red-or blue-listed TEM units for possible addition to the SEI as new classes or subclasses (and possible changes to the Mature Forests for these units):
    a. BGxh1, PPxh1 and IDFxh1 – DS, structural stages 3 -5;
    b. IDFdm1, IDFdk1, MSdm1 – DP, structural stages 3-5;
    c. PPxh1, IDFxh1, and IDFdm1 – SP, structural stages 3-5;
    d. IDFdm1 – DT and DW, structural stages 3-5; and
    e. ESSFxc – FG, structural stages 3-5.
4. Review PPxh1 polygons with WBc and WBcn for possible change to SN unit.
5. Review all wetland polygons for changes to the plant community. Also, map more current provincial wetland ecosystem units rather than more generalized units retained from the biophysical mapping.
6. Add lakes as a "Freshwater:lake" (FW:la) sensitive ecosystem and move ponds to the "Freshwater:pond" (FW:pd) SEI category. Note: not completed for 2012 update in order to stay consistent with other Okanagan mapping projects.

7 References

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8 Appendix I: Map Legend

Table 2. Terrestrial Ecosystem Mapping (TEM) units mapped in the study area.

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
Non-vegetated, Sparsely Vegetated, and Anthropogenic Units common to all subzones			
AK	OWa	Alkaline pond	A body of fresh water with a pH greater than 7 and less than 2m deep. Usually indicated by a white colour in the draw-down zone. The modifier "x" is used to indicate areas with seasonal water only.
BE	BE	Beach	Beaches on large lakeshores.
CB	BA (in part)	Cutbank	Cutbanks of large roads or other sites.
CF	CF PD PM	Cultivated field	Cultivated areas or irrigated fields. The modifier 'x' is used to distinguish sites formerly mapped as dry pastures (PD); the modifier 'y' is used to distinguish sites formerly mapped as moist pastures (PM).
CL	CLc and CLw, CMc and CMw	Cliff	Large steep, vertical or overhanging rock faces. The modifier 'b' is a non-standard modifier added to differentiate large cliffs (formerly mapped as CL) from moderate cliffs (formerly mapped as CM).
CN	CA	Canal	An artificial watercourse including canals and channelized rivers.
CO	CO	Cultivated Orchard	An agricultural area with fruit trees.
CV	CV	Cultivated vineyard	An agricultural area with grape vines.
ES	BA	Exposed soil	Areas of exposed soil with no vegetation. May be caused by natural erosion or human causes. Can occur on cool (ESk) or warm (ESw) aspects.
GB	GB	Gravel bar	Gravel bars along rivers.

[9] Related attribute field headings from the TEM database (TEM_9922_ecp.csv): SiteMC_S1 / Site_S1; SiteMC_S2 / Site_S2; SiteMC_S3 / Site_S3. The numbers indicate the decile (i.e. SiteMC_S1 is the ecosystem code for the 1st decile).

[10] Related attribute field headings from the TEM user-defined database (TEM_9922_uda.csv): included in BPH_label.

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
GC	GC	Golf Course	Golf courses
GP	GP	Gravel pit	Gravel pit – areas exposed through the removal of sand and gravel.
LA	LA	Lake	Lakes – water bodies greater than 5ha in size and greater than 2m deep.
MI	MI	Mine	An area of exposed rock where minerals or other materials are extracted.
OW	OW	Shallow open water	Permanent shallow open water less than 2m deep with less than 10% cover of emergent plants. The modifier "x" is used to indicate areas with seasonal water only.
PD	PD	Pond	Small body of water less than 5ha in size and more than 2m deep.
RE	SL	Reservoir	Man-made water bodies, including sewage lagoons.
RI	ST	River	An intermittent or permanent water-course formed when water flows between two continuous, definable banks.
RN	n/a	Railway	Railway lines.
RO	RO & ROc & ROw (in part)	Rock outcrop	A bedrock escarpment or outcropping with little soil development and sparse vegetation cover. Many sites originally mapped as RO are now mapped as SA. Very short steep rock outcrops are mapped as ROq (cool aspect) and ROz (warm aspect) rather than cliffs.
RW	UR (in part)	Rural	An area where residences are scattered and intermingled with native vegetation or agricultural areas. Most areas mapped as rural were only mapped based on the remaining native vegetation in the biophysical mapping.
RZ	TC	Road surface	An area cleared and compacted for the purposes of vehicular travel. Secondary roads are now included as a component of the polygon where they cover more than 10% and there are not already three ecosystem components in the polygon.
TA	TA	Talus	Accumulated angular rock fragments at the base of rock outcrops or cliffs.
UR	UR	Urban	Areas where residences or other human developments cover nearly all of the landscape.

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
BGxh1			
AB	n/a	Nuttall's alkaligrass – Foxtail barley graminoid meadow	An alkaline wet meadow ecosystem that occurs at the fringes of alkaline lakes and ponds with rich, deep, fine-textured soils. Presently only mapped in the proposed National Park interest area but may occur elsewhere. Assumed modifiers: d, f, j
AN /02	AN, ANc, ANf, ANw, AE	Antelope-brush – Needle and thread grass	Occurs on level and gently undulating coarse-textured (sandy, and sandy gravely) glaciofluvial sites. This unit was not mapped on morainal or colluvial materials. Some areas with glaciofluvial materials have medium textured soils (sandy loam) or an aeolian cap (sandy loam); the soils on these sites allows for different vegetation development (mapped as SW). Can occur on cool aspects (ANk), fans (ANn, ANnw), warm aspects (ANnw, ANsw, ANw) and occasionally on shallow soils (ANsw). Assumed modifiers: c, d, j
AS	ASg, ASp	At – common snowberry	Moist gullies (ASg) and floodplains (ASa) with trembling aspen and a shrubby understory. Occurs on morainal materials. Non-standard unit retained from biophysical mapping. Similar to AS unit described for IDFxh1. Assumed modifiers: d, j, m
BD	BD	Water birch – red-osier dogwood swamp	Swamps adjacent to streams or other wetlands. Non-standard unit retained from biophysical mapping. Assumed modifiers: d, j, m
BM	SB in part	Bulrush marsh	Bulrush marsh. Used only in polygons reviewed in stereo and appear to be dominated by bulrushes. Assumed modifiers: d, f, j
BR	SB in part	Silverweed – Bulrush marsh	Marshes and wet meadows on lacustrine sites. Non-standard unit retained from biophysical mapping; code changed from SB to BR to avoid conflicts. BR is retained for Baltic rush marsh – meadows where appropriate for polygons reviewed on aerial photographs. Assumed modifiers: d, j, m
CD /07	CD	Cottonwood – Water birch	Active floodplain, coarse-textured fluvial soils. Cottonwood overstory with a shrubby understory. Assumed modifiers: a, c, d, j

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
CM	CB	Summer-cypress – bentgrass meadow	Pond edges with high water tables for much of the year; lacustrine soils. Non-standard unit retained from biophysical mapping; code changed from CB to CM to avoid conflicts. Variable vegetation sometimes dominated by non-native species. Assumed modifiers: d, j, m
CT	CT	Cattail Marsh	Marshes on lacustrine soils, typically dominated by cattails and bulrushes. Non-standard unit retained from biophysical habitat mapping. Assumed modifiers: d, j, m
DS	SP	Douglas-fir / Ponderosa pine – Snowberry – Spirea	Moisture receiving sites with Douglas-fir overstories and mixed snowberry and birch-leaved spirea understories. Terrain is generally morainal. Unit from the PPxh1. Assumed modifiers: d, j, m
HA	HA	Black Hawthorn Copse	Moist copses dominated by black hawthorn with other shrubs. Non-standard unit retained from biophysical habitat mapping. Assumed modifiers: d, j, m
OS	OS	Oregon grape – Saskatoon Gully	Moist shrubby gullies. Non-standard unit retained from biophysical habitat mapping. Assumed modifiers: d, j, m
PA /04	PA, PAf	Py – Antelope-brush – Red three-awn	Forested level and gently sloping sites with coarse glaciofluvial soils (sandy or sandy gravely). Open ponderosa pine overstories with mixed bunchgrass and antelope-brush understory. Most sites were historically AN with occasional trees; these sites are now dominated by encroached trees. Can occur on cool aspects (PAk, PAkn, PAks); they are particularly susceptible to encroachment. Can also occur on fans (PAkn, PAn), shallow soils (PAks, PAs), and warm aspects (PAw). Shallow soil sites likely always had trees historically. (Sometimes AN, PW, and YS biophysical map units were re-interpreted as PA in the photo interpretation for antelope-brush mapping.) Assumed modifiers: c, d, j

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
PR /06	BS	Py – Nootka rose – Poison ivy	Moist ponderosa pine forests on morainal materials with some aspen or cottonwood and variable shrubby understories. Can occur in gullies (PRg) and on moist fans (PRn). Assumed modifiers: c, d, j
PS /05	YS	Py – Sumac	Slightly moister ponderosa pine forests on fans with sumac and scattered shrubs (PSn). Assumed modifiers: c, d, j
PT	PF, PS	Ponderosa pine – Red three-awn	Dry forests on warm slopes. Open ponderosa pine overstory with bluebunch wheatgrass and selaginella dominated understory. Unit from the PPxh1. Assumed modifiers: c, d, w
PW	PW, PWc, PWf	Py – Bluebunch wheatgrass	Forested sites on gently to moderately sloping medium-textured morainal materials. Open ponderosa pine forests with bunchgrasses and often with big sagebrush. Non-standard unit from biophysical mapping. Assumed modifiers: d, j, m
SA	RO, ROc, ROw (in part)	Antelope-brush – Selaginella	Rocky areas with scattered shrubs and bunchgrasses. Terrain is mapped as rock. Rock is generally fractured and stepped with vegetation growing in cracks and in shallow soils on ledges. Shrubs (saskatoon, mock orange, antelope-brush, choke cherry, big sagebrush) together with bunchgrasses and lichens dominate the pockets of vegetation. Non-standard unit from the IDFxh1. Antelope-brush is limited to its core range in this unit; the unit itself is widely distributed. Occurs on both aspects and on gently sloping sites. Assumed modifiers: j, m, s
SB	SS, RO, ROc, ROw (in part)	Selaginella – Bluebunch wheatgrass rock outcrop	Very shallow colluvial or weathered bedrock materials over bedrock. Bedrock is usually exposed in places but is low relief and lacking large fractures. Vegetation is dominated by selaginella with bluebunch wheatgrass and other bunchgrasses, mosses, and lichens, with scattered saskatoon. Some sites have moderate to high covers of big sagebrush or antelope-brush (structural stage 3). This is a non-standard unit from the PPxh1 and IDFxh1. (AN and WS biophysical units were sometimes reinterpreted as SB in the antelope-brush mapping.) Assumed modifiers: j, v

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
SN	SN	Big sagebrush – Needle-and-thread grass	Coarse glaciofluvial sites with sandy soils. Limited primarily to the Similkameen Valley where there is no antelope-brush. Similar site features to the AN unit. Grasses dominated by needle-and-thread grass with varying amounts of big sagebrush. Assumed modifiers: c, d, j
SO	SOc, SOw	Saskatoon – Mock orange talus	Colluvial talus slopes with more than 10% vegetation cover. Cover is usually dominated by shrubs such as mock orange, saskatoon, and choke cherry. Scattered ponderosa pine trees may occur. Some cliff ferns and bunchgrasses may occur in pockets. This is a non-standard unit from the PPxh1 and IDFxh1. Assumed modifiers: c, d
SW /01	SWl, SWm, WBc, WBw	Big sagebrush – Bluebunch wheatgrass	Zonal and near zonal sites. Materials are typically morainal or medium-textured glaciofluvial (sandy loam) and often have an aeolian cap on them. Vegetation is a mixture of bunchgrasses with forbs and with big sagebrush (structural stage 3) or without big sagebrush (structural stage 2). Sites with coarse-textured soils tend to have less overall sand content than AN sites or sands are much finer; on such sites some 'AN' biophysical map units were re-interpreted as 'SW'. Assumed modifiers: d, j, m
WS /03	WSc, WSw	Bluebunch wheatgrass – Selaginella	Submesic areas usually with shallow sandy loam soils, mixed big sagebrush and antelopebrush and bunchgrasses (dominated by bluebunch wheatgrass) with selaginella. Soils are morainal, colluvial, or glaciofluvial. Due to site history (fire or other disturbance), some sites have few or no shrubs (structural stage 2). Soils tend to be shallower than in SWs and have some selaginella, which SWs is generally lacking. Assumed modifiers: j, m, s
ESSFxc			
BS /09	SE	Bluejoint - Sedge	Sedge wetlands; usually on organic matierials. Assumed modifiers: d, j, p
FF /07	SG	Bl - Gooseberry - Foamflower	Moist receiving sites with medium-textured morainal soils. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
FG /01	FG, FGc	Bl - Grouseberry - Valerian	Mesic and near-mesic sites with medium-textured morainal soils. Assumed modifiers: d, j, m
LJ /02	n/a	Pl - Juniper - Lupine	Forested dry, warm slopes with shallow soils. Assumed modifiers: m, s, w
SP /04 $vk	VK, VKc, VKw	Big sagebrush – Pinegrass	Warm aspect grasslands dominated by the Vasey's subspecies of big sagebrush. Assumed modifiers: d, m, w
WP /03	WS	Bluebunch wheatgrass - Pasqueflower	Warm aspect grasslands on dry shallow soils Assumed modifiers: m, s, w
		IDFdk1	
AS /94	AS	At - Snowberry - Kentucky bluegrass	Moist basins with trembling aspen and a shrubby understory. Occurs on morainal materials, most often in grassland dominated areas. Assumed modifiers: d, j, m
CT	CT	Cattail marsh	Marshes on lacustrine soils, typically dominated by cattails or bulrushes. Non-standard unit retained from biophysical mapping. Assumed modifiers: d, j, m
DJ /03	IDFxh1 DW, PSc & MSxk DAs (where subzone has changed)	Fd - Juniper - Pinegrass	Dry, moderately open Douglas-fir forests with an understory dominated by pinegrass and kinnikinnick. Assumed modifiers: j, r, s
DW /02	DYs (in part)	Fd - Snowberry - Bluebunch wheatgrass	Dry, open Douglas-fir forests with an understory dominated by bluebunch wheatgrass and common snowberry at climax. Assumed modifiers: d, m, w
DY /04	DY	Fd - Pinegrass - Yarrow	Slightly drier than mesic Douglas-fir forests with a pinegrass understory. Generally occurs on morainal materials. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
FW /91	VK, VKc	Fescue - Bluebunch wheatgrass (Idaho fescue) ($vk Big sagebrush – Kentucky bluegrass seral association)	Grasslands dominated by a mixture of rough fescue and bluebunch wheatgrass at climax. Often mapped as a shrubby seral stage ($vk Big sagebrush – Kentucky bluegrass, structural stage 3) dominated by the *vaseyana* variety of big sagebrush with a seral understory dominated by Kentucky bluegrass. Assumed modifiers: d, j, m
LP /01	LP, LPc, LPs (in part), DT	FdPl - Pinegrass - Feathermoss	Mesic and near mesic forests on morainal materials. Dominated by Douglas-fir with some lodgepole pine at climax. The understory is dominated by pinegrass with feathermosses. Assumed modifiers: d, j, m
RF	n/a	Prairie Rose – Idaho Fescue	Moist shrubby areas in grasslands. Dominated by snowberry and rose. Assumed modifiers: d, j, m
SG /05	SP	SxwFd - Gooseberry - Feathermoss	Moist forests with a mixed Douglas-fir – hybrid white spruce overstory, with scattered shrubs, pinegrass and forbs in the understory. Assumed modifiers: d, j, m
SH /06	n/a	Sxw – Horsetail	Spruce forests with a permanently high water table and an understory characterized by abundant horsetail. Not mapped in the biophysical mapping but appears to occur adjacent to some organic wetlands. Assumed modifier: d, j, m
SO	SOc, SOw	Saskatoon – Mock orange talus	Colluvial talus slopes with more than 10% vegetation cover. Cover is usually dominated by shrubs such as mock orange, saskatoon, and choke cherry. Scattered Douglas-fir trees may occur. Some cliff ferns and bunchgrasses may occur in pockets. This is a non-standard unit retained from the biophysical habitat mapping. Assumed modifiers: c, d
WJ /92	WSw, WAw, VKw	Bluebunch wheatgrass – Junegrass ($vk Big sagebrush – Kentucky bluegrass seral association)	Submesic grasslands on warm aspects. Dominated by bluebunch wheatgrass at climax (structural stage 2). Some seral sites are dominated by big sagebrush and Kentucky bluegrass ($vk; structural stage 3). Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
WS /07	SE	Willow – Sedge	Sedge (structural stage 2) dominated wetlands. Usually occurs on organic materials. Assumed modifiers: d, j, m
IDFdm1			
CT	CT	Cattail marsh	Marshes on lacustrine soils, typically dominated by cattails or bulrushes. Non-standard unit retained from biophysical mapping. Assumed modifiers: d, j, m
DP /04	DTs	Fd - Pinegrass - Kinnikinnick	Dry Douglas-fir forests with a mixed pinegrass and kinnikinnick understory. Assumed modifiers: d, j, m
DT /01	DT, DTc	FdPl - Pinegrass - Twinflower	Mesic and near mesic sites. Climax forests are dominated by Douglas-fir with some lodgepole pine and have pinegrass dominated understories with kinnikinnick and twinflower. Assumed modifiers: d, j, m
DW /03	PPd, PPs	Fd/Py – Bluebunch wheatgrass - Pinegrass	Open Douglas-fir – ponderosa pine forests on moderate to steep warm aspects with deep, medium-textured colluvial or morainal soils. Understories are typically dominated by bluebunch wheatgrass at climax. Assumed modifiers: d, m, w
SD /06	SD	SxwFd - Dogwood - Gooseberry	Moist forests with a hybrid white spruce overstory, and with red-osier dogwood and scattered shrubs and forbs in the understory. Assumed modifiers: d, j, m
SE	SE	Sedge wetland	Sedge wetlands on organic materials. Assumed modifiers: d, j, p
SH /07	SD (in part)	Sxw - Horsetail	Spruce forests with a permanently high water table and an understory characterized by red-osier dogwood and abundant horsetail. Not mapped in the biophysical mapping but appears to occur adjacent to some organic wetlands. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
SO	SOc, SOw	Saskatoon – Mock orange talus	Colluvial talus slopes with more than 10% vegetation cover. Cover is usually dominated by shrubs such as mock orange, saskatoon, and choke cherry. Scattered Douglas-fir trees may occur. Some cliff ferns and bunchgrasses may occur in pockets. This is a non-standard unit retained from the biophysical habitat mapping. Assumed modifiers: c, d
SP /05	SD (in part)	FdLw - Spruce - Pinegrass	Slightly moister forests with a mixed Douglas-fir – hybrid white spruce – Western larch – lodgepole pine overstory, with scattered shrubs, abundant pinegrass, and scattered forbs in the understory. Assumed modifiers: d, j, m
WJ /02	SS, WSc, WSw	Bluebunch wheatgrass - Junegrass	Submesic grasslands on warm aspects. Dominated by bluebunch wheatgrass at climax. Some of these grasslands may be fescue dominated at climax on cool aspects and level sites – may need to be split and may be split in new classification. Assumed modifiers: d, m , w
WS	n/a	Willow – Sedge	Generalized wetland unit; structural stage 2 is dominated by sedges and structural stage 3 is dominated by willows.
IDFxh1			
AB	n/a	Nuttall's alkaligrass – Foxtail barley graminoid meadow	An alkaline wet meadow ecosystem that occurs at the fringes of alkaline lakes and ponds with rich, deep, fine-textured soils. Presently only mapped in the proposed National Park interest area but may occur elsewhere. Assumed modifiers: d, f, j
AS	AS	At – Common snowberry – Kentucky bluegrass	Moist gullies (ASg) and basins (AS) with trembling aspen and a shrubby understory. Occurs on morainal materials and is most common in grassland dominated areas. Assumed modifiers: d, j, m
BD	BD	Water birch - red-osier dogwood swamp	Shrubby swamps dominated by water birch, red-osier dogwood, mountain alder and poison ivy. Occurs on active floodplains with imperfectly to poorly drained soils. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
BM	SB (in part)	Bulrush Marsh	Bulrush dominated marshes associated with ponds and shallow open water. Old SB unit may be broader, this may actually include what is now BR and BM. Assumed modifiers: d, j, m
BN /96	n/a	Kentucky bluegrass – Stiff needlegrass	A moist grassland ecosystem found on deep, medium-textured soils, in small swales and depressions where moisture collects. Most sites are seral and are dominated by Kentucky bluegrass with a diverse mixture of forbs. Assumed modifiers: d, j, m
BR	n/a	Baltic Rush Marsh - Meadow	Marshes and wet meadows on lacustrine sites; drier than BM, usually dominated by Baltic rush. Assumed modifiers: d, f, j
CD	CD	Act – Fd – Common Snowberry – Red-osier Dogwood Riparian	Black cottonwood ecosystem commonly associated with active floodplains and fluvial terraces with subsurface water flow. It has a shrub-dominated understory. Assumed modifiers: a, d, j, m
CT	CT	Cattail Marsh	Marshes on lacustrine soils, typically dominated by cattails or bulrushes. Non-standard unit retained from biophysical mapping. Assumed modifiers: d, j, m
DP /01	DP, DPc, DPf	Fd / Py – Pinegrass	Mesic and near-mesic sites on medium-textured morainal materials. Climax forests are dominated by a mixture of Douglas-fir and ponderosa pine with a pinegrass dominated understory. Assumed modifiers: d, j, m
DS /07	SP (in part)	Fd / Py – Snowberry – Spirea	Slightly moist forests on medium-textured morainal soils. Climax forests are dominated by Douglas-fir with a shrubby understory of common snowberry and birch-leaved spirea. Assumed modifiers: d, m, j
DW /03	DW, PS, PSc, PSw (in part)	Fd / Py – Bluebunch wheatgrass - Pinegrass	Open Douglas-fir – ponderosa pine forests on moderate to steep warm aspects with deep, medium-textured colluvial or morainal soils. Understories are typically dominated by bluebunch wheatgrass with scattered forbs and shrubs at climax. Assumed modifiers: d, m, w

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
FW /91	FW, VKc, WAc, WJ	Idaho fescue – Bluebunch wheatgrass ($vk Big sagebrush – Kentucky bluegrass seral association)	Level and cool aspect grasslands usually on materials with an aeolian cap. Dominated by Idaho fescue and a diverse community of forbs at climax. Most sites are seral and may be dominated by Bluebunch wheatgrass, junegrass, Sandberg's bluegrass, cheatgrass or other seral species. May be dominated by big sagebrush and Kentucky bluegrass ($vk). Assumed modifiers: d, j, m
PB /02	PS, PSw (in part)	Fd / Py – Bluebunch wheatgrass – Balsamroot	Open Douglas-fir – ponderosa pine forests on shallow or very shallow morainal or colluvial soils on steep warm aspects. Understories have scattered shrubs such as saskatoon and mock orange with bunchgrasses, selaginella, and lichens. Assumed modifiers: m, s, w
RF /97	n/a	Prairie Rose – Idaho Fescue	Moist shrubby areas in grasslands. Dominated by snowberry and rose. Assumed modifiers: d, j, m
SA	RO, ROc, ROw (in part)	Antelope-brush – Selaginella	Rocky areas with scattered shrubs and bunchgrasses. Terrain is mapped as rock. Bedrock is generally fractured and stepped with vegetation growing in cracks and in shallow soils on ledges. Shrubs (saskatoon, mock orange, antelope-brush, choke cherry, big sagebrush) together with bunchgrasses and lichens dominate the pockets of vegetation. Antelope-brush is limited to its core range in this unit; the unit itself is widely distributed. Assumed modifiers: j, m, s
SB	SS, RO, ROc, ROw (in part)	Selaginella – Bluebunch wheatgrass rock outcrop	Very shallow colluvial or weathered bedrock materials over bedrock. Bedrock is usually exposed in places. It is low relief and lacking large fractures. Vegetation is dominated by selaginella with bluebunch wheatgrass and other bunchgrasses, mosses, and lichens with scattered saskatoon. Assumed modifiers: j, v
SD /08	BS, SP (in part)	Sxw – Fd – Douglas maple – Dogwood	Moist forests often occurring in gullies, adjacent to streams and rivers, and around ponds and lakes. Has a mixed overstory that has Douglas-fir and may have hybrid white spruce, paper birch, and sometimes black cottonwood. The understory is shrubby and has red-osier dogwood, Douglas maple, snowberry and other species. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
SM	SE	Sedge marsh	Marshes dominated by sedges such as beaked sedge and water sedge. Fluctuating water tables; generally inundated for part of the year. Assumed modifiers: d, j, m
SO	SOc, SOw	Saskatoon – Mock orange talus	Colluvial talus slopes with more than 10% vegetation cover. Cover is usually dominated by shrubs such as mock orange, saskatoon, and choke cherry. Scattered Douglas-fir or ponderosa pine trees may occur. Some cliff ferns and bunchgrasses may occur in pockets. Assumed modifiers: c, d
SP /04	PS and PSc (in part)	Douglas-fir / Ponderosa pine – Snowbrush - Pinegrass	Slightly drier than average Douglas-fir forests on slightly warm aspects or cool aspects with shallow soils. Sites usually have medium-textured morainal soils. Understories have a mixture of bunchgrasses and pinegrass. Assumed modifiers: d, j, m
WB /93	FWks, WAw, VKw, WSw	Bluebunch wheatgrass – Balsamroot	Grassland ecosystem commonly occurring on moderately steep to steep warm aspects with deep, medium-textured morainal or glaciofluvial soils with an aeolian cap. Dominated by bluebunch wheatgrass with balsamroot, other forbs, and lichens at climax. Assumed modifiers: d, m, w
WS /09	n/a	Willow – Sedge wetland	Swamp wetlands dominated by willows and sedges. Assumed modifiers: d, j, m
YS	YS	Ponderosa pine - saskatoon fan	Open ponderosa pine forest with saskatoon, bluebunch wheatgrass, compact selaginella and some sumach, squaw currant, Sandberg's bluegrass, and timber milk-vetch. Occurs on fans with dry surfaces and subsurface moisture. Assumed modifiers: c, n
MSdm1			
PG /03	PPs	Pl - Grouseberry - Cladonia	Dry forests, often on glaciofluvial soils. Lodgepole pine overstory with kinnikinnick and grouseberry and lichens in the understory. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
PP /04	DTs	Pl - Pinegrass - Kinnikinnick	Submesic sites, usually morainal. Lodgepole pine overstory with pinegrass, grouseberry, and twinflower in the understory. Assumed modifiers: d, j, m
SF /01	DT, DTc	Sxw - Falsebox - Feathermoss	Mesic and near mesic sites, usually on morainal soils. Mixed lodgepole pine, subalpine fir, and hybrid white spruce overstory at climax. Understory with falsebox, scattered other shrubs, pinegrass, grouseberry, and abundant feathermosses. Assumed modifiers: d, j, m
SG /06	SD	Sxw - Gooseberry	Subhygric sites, usually on morainal soils. Mixed lodgepole pine, subalpine fir, and hybrid white spruce overstory at climax. Understory with black gooseberry and scattered forbs. Assumed modifiers: d, j, m
SH /07	n/a	Sxw – Trapper's tea – Horsetail	Forested sites with the water table at or near the water surface. Dominated by hybrid white spruce with abundant common horsetail in the understory.
WS /09	SE	Willow - sedge	Sedge (structural stage 2) or willow (structural stage 3) dominated wetlands. Assumed modifiers: d, j, p
MSxk			
DA /05	DAd	FdPl - Pinegrass - Arnica	Douglas-fir forests on warm aspect submesic sites. At climax have a Douglas-fir canopy with pinegrass and heart-leaved arnica dominated understory. Assumed modifiers: d, m, w
DJ /02	DAs	Fd - Juniper - Grouseberry	Dry forests on warm aspects with shallow soils. Often occurs on colluvial materials. At climax, have open Douglas-fir – lodgepole pine canopy with common juniper, pinegrass, kinnikinnick, and lichens in the understory. Assumed modifiers: m, s, w
LL /01	LL, LLc, LLs	Pl - Pinegrass - Lupine	Mesic and near mesic forested sites. Dominated by lodgepole pine, pinegrass, grouseberry and feathermosses. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
SG /08	n/a	Sxw – Gooseberry – Grouseberry	Subhygric sites, usually on morainal soils. Mixed lodgepole pine, subalpine fir, and hybrid white spruce overstory at climax. Understory with black gooseberry and scattered forbs. Assumed modifiers: d, j, m
SH /09	n/a	Sxw – Horsetail – Leafy Moss	Forested sites with the water table at or near the water surface. Dominated by hybrid white spruce with abundant common horsetail in the understory. Assumed modifiers: d, j, m
VP /04	VK, VKw	Vasey's big sagebrush - Pinegrass	Submesic grasslands on warm aspects. Dominated by big sagebrush, fescues, pinegrass and forbs. Assumed modifiers: d, j, m
WJ /03	WSw	Bluebunch wheatgrass - Junegrass	Submesic grasslands on warm aspects. Dominated by bluebunch wheatgrass at climax. Assumed modifiers: d, j, m
WS	n/a	Willow - Sedge	Sedge (structural stage 2) or willow (structural stage 3) dominated wetlands. Assumed modifiers: d, j, p
PPxh1			
AB	n/a	Nuttall's alkaligrass – Foxtail barley graminoid meadow	An alkaline wet meadow ecosystem that occurs at the fringes of alkaline lakes and ponds with rich, deep, fine-textured soils. Presently only mapped in the proposed National Park interest area but may occur elsewhere. Assumed modifiers: d, f, j
AN	AN, ANc, ANw	Antelope-brush – Needle and thread grass	Occurs on level and gently undulating coarse-textured (sandy, and sandy gravely) glaciofluvial sites at lower elevations of the PPxh1. This unit was not mapped on morainal or colluvial materials. Non-standard unit from the BGxh1. Assumed modifiers: c, d, j
AS	ASg, ASp	Trembling aspen – Common snowberry – Kentucky bluegrass	Moist gullies (ASg) and basins (AS) with trembling aspen overstory and a shrubby understory. Occurs on morainal materials. Non-standard unit retained from biophysical mapping. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
BD	BD	Water birch – red-osier dogwood swamp	Swamps adjacent to streams, lake edges or other wetlands. Non-standard unit retained from biophysical mapping. Assumed modifiers: d, j, m
BM	n/a	Bulrush marsh	Bulrush marsh. Used only in polygons reviewed in stereo and appear to be dominated by bulrushes. Assumed modifiers: d, f, j
BR	SB	Silverweed – Bulrush marsh	Marshes and wet meadows on lacustrine sites. Non-standard unit retained from biophysical mapping; code changed from SB to BR to avoid conflicts. BR is retained for Baltic rush marsh – meadows where appropriate for polygons reviewed on aerial photographs. Assumed modifiers: d, j, m
CD	CD	Ponderosa pine - Black cottonwood – Snowberry riparian	Active floodplains, coarse-textured fluvial soils. Cottonwood overstory, sometimes with ponderosa pine, and with a shrubby understory. **Code originally mapped as PA during upgrade; TEM codes changed Jan. 2006 to 'CD' for this unit**.
CT	CT	Cattail Marsh	Marshes on lacustrine soils, typically dominated by cattails. Assumed modifiers: d, j, m
DM /08	BS, SP (in part)	Douglas-fir – Water birch – Douglas maple	Moist gullies (DMg) or riparian fringes (DM), often with permanent or intermittent streams, usually with mixed Douglas-fir and paper birch overstories and rich, shrubby understories. Materials are generally morainal or fluvial. Assumed modifiers: d, j, m
DS /07	SP (in part), YS	Douglas-fir / Ponderosa pine – Snowberry – Spirea	Moisture receiving sites with Douglas-fir overstories and mixed snowberry and spirea understories. Terrain is generally morainal. The old YS code is equivalent to DSn. Assumed modifiers: d, j, m
FB	WAc, WF, WJ, WSc	Fescue – Bluebunch wheatgrass	Grasslands on gentle and cool aspects with medium-textured soils (and occasionally on sandy soils). Dominated by Idaho fescue and bluebunch wheatgrass at climax. Assumed modifiers: d, j, m

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
PA	PA, PAf	Ponderosa pine – Antelope-brush – Red three-awn	Mapped on level and gentle with coarse glaciofluvial soils (sandy or sandy gravely) at lower elevations of the PPxh1. Open ponderosa pine overstories with mixed bunchgrass and antelope-brush understory. Most sites were historically AN with occasional trees; these sites are now dominated by encroached trees. Can occur on cool aspects (PAk); they are particularly susceptible to encroachment. Can also occur on fans (PAn), and shallow soils (PAs). Non-standard unit from BGxh1; **code originally mapped as AP during upgrade to avoid conflict; TEM codes changed Jan. 2006 to 'PA'**.
PC /04	PF, PS	Ponderosa pine – Bluebunch wheatgrass – Cheatgrass	Submesic sites, often on slightly warmer or drier sites. Sites are not as steep or shallow-soiled as PT /02. Terrain is generally morainal or colluvial. Open ponderosa pine overstory with bluebunch wheatgrass dominated understory (at climax). Assumed modifiers: d, j, m
PF /05	PSc (in part), PWc	Ponderosa pine – Bluebunch wheatgrass – Rough fescue	Cool aspect ponderosa pine forests with mixed bluebunch wheatgrass and fescue understory (at climax). Terrain is generally morainal or colluvial. Assumed modifiers: d, j, m
PT /02	PS, PSc, (in part), PSw	Ponderosa pine – Red three-awn	Dry, open ponderosa pine forests on steep warm aspects. Frequently occurs on shallow (PTks, PTs) or very shallow colluvial or morainal materials (PTjv, PTkv, PTrv, PTv). Occasionally occurs on slightly cool aspects with shallow or very shallow soils (PTks, PTkv). Assumed modifiers: c, d, w
PW /01	PW, PA (in part), PS (in part)	Ponderosa pine – Bluebunch wheatgrass – Idaho fescue	Mesic and near-mesic ponderosa pine forests on medium-textured soils and level or gently sloping sites. At climax, understories are dominated by a mixture of bluebunch wheatgrass and Idaho fescue. Terrain is generally morainal or glaciofluvial. Assumed modifiers: d, j, m
SA	RO, ROc, ROw (in part)	Antelope-brush – Selaginella	Rocky areas with scattered shrubs and bunchgrasses. Terrain is mapped as rock. Bedrock is generally fractured and stepped with vegetation growing in cracks and in shallow soils on ledges. Shrubs (saskatoon, mock orange, antelope-brush, choke cherry, big sagebrush) together with bunchgrasses and lichens dominate the pockets of vegetation. Non-standard unit from the IDFxh1. Antelope-brush is limited to its core range in this unit; the unit itself is widely distributed. Assumed modifiers: j, m, s

Code/ Site Series[9]	Biophysical Map Unit[10]	Name	Description & Mapping Notes
SB /00	SS (in part), RO, ROc, ROw (in part)	Selaginella – Bluebunch wheatgrass rock outcrop	Very shallow colluvial or weathered bedrock materials over bedrock. Bedrock is usually exposed in places. It is low relief and lacking large fractures. Vegetation is dominated by selaginella with bluebunch wheatgrass and other bunchgrasses, mosses, and lichens with scattered saskatoon. Some sites have moderate to high covers of big sagebrush or antelope-brush (structural stage 3). Assumed modifiers: j, v
SN	n/a	Big sagebrush – Needle-and-thread grass	Coarse glaciofluvial sites with sandy soils. Similar site features to the AN unit. Grasses dominated by needle-and-thread grass with varying amounts of big sagebrush. Assumed modifiers: c, d, j
SO	SOc, SOw	Saskatoon – Mock orange talus	Colluvial talus slopes with more than 10% vegetation cover. Cover is usually dominated by shrubs such as mock orange, saskatoon, and choke cherry. Scattered ponderosa pine trees may occur. Some cliff ferns and bunchgrasses may occur in pockets. Occurs on cool aspects (SOk) or warm aspects (SOw). Assumed modifiers: c, d
SP /06	SP (in part)	Douglas-fir / Ponderosa pine – Snowberry - Pinegrass	Slightly moister or sheltered sites with mixed Douglas-fir and ponderosa pine overstories and an understory with pinegrass and some shrubs including snowberry. Assumed modifiers: d, j, m
SR	n/a	Snowberry – Rose – Kentucky bluegass	Moist shrubby areas in grasslands. Dominated by snowberry and rose. Assumed modifiers: d, j, m
SW /03	SN, SNf, SS (in part), SWl, SWm	Big sagebrush – Bluebunch wheatgrass	Drier submesic to subxeric sites. Terrain is typically morainal or medium-textured glacioufluvial (sandy loam) and often has an aeolian cap. Vegetation is a mixture of bunchgrasses with forbs and big sagebrush. May occur on slightly coarse-textured soils (SWc), cool aspects (SWk, SWks), shallow soils (generally 50-100cm deep; SWks, SWs, SWsw), and warm aspects (SWsw, SWw). Assumed modifiers: d, j, m
WB	WAc, WAw, WF, WFf, WJ, WSc, WSw	Bluebunch wheatgrass – Balsamroot	Warm aspect grasslands. Generally morainal materials with aeolian caps. Climax sites dominated by bluebunch wheatgrass with balsamroot, other forbs, and various lichens. Also occurs on coarse textured soils (WBc, WBcn) which have less vegetation cover, and fewer forbs and lichens. Assumed modifiers: d, m, w