TEM/SEI Natural Areas Project- Phase 3 Final Report

Prepared for:

CITY OF
PRINCE GEORGE

Attention: Dan Adamson
Community Forest Manager
City of Prince George

Prepared by:

Ecora
Resource Group Ltd.

May 31, 2012

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Dan Adamson
Community Forest Manager
City of Prince George
1100 Patricia Blvd.
Prince George BC, V2L 3W9

Dear Dan:

Subject: TEM/SEI Natural Areas Project Phase 3

Please find enclosed the report for the above-mentioned project. Please do not hesitate to call if you have any questions or comments.

Yours Truly,

Dan Bernier, RPBio
Vice-President, Senior Biologist

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1 INTRODUCTION

Prince George is a city dominated by natural areas within the city limits. These natural areas contribute to recreational opportunities and the overall health and aesthetics of the community and have been identified in the Official Community Plan (OCP) as a key contributor to the quality of life enjoyed by the residents of Prince George. The OCP identifies a number of initiatives aimed at maintaining and enhancing natural areas within the City.

One of these initiatives includes understanding the impacts of climate change on natural area ecosystems within the City of Prince George (CPG) and developing strategies to address changes and risks associated with climate change. Through this initiative, the City developed a comprehensive terrestrial ecosystem map (TEM) and sensitive ecosystem inventory (SEI) map for all the undeveloped (non-urban, natural forest areas) lands within the City boundaries as Phase 1 (Bio-Geo Dynamics, 2011). Using the TEM / SEI as a base, Ecora Resource Group was contracted to project the potential impacts of climate change on natural areas into the future as Phase 2 of this series of projects (Ecora and Griesbauer, 2012). These climate change projections estimate the impacts and assess risks to natural areas brought about through climate change.

The third and final phase of this project seeks to translate the valuable information developed through Phase I and Phase II into user-friendly and easy-to-understand products with clear management objectives that can be delivered to a wide range of user groups with differing backgrounds and experiences. Specifically, the objectives of this Third Phase are to:

1. Translate important ecosystem information and predicted climate change impacts into plain language and simplify the information so that it is accessible to a broad range of users that do not necessarily have a biological background;

2. Develop an associated management and monitoring framework for the predicted climate change impact to the city's natural areas that will support regular City business and decision-making around land use and management, land development and long term growth strategies; and

3. Prepare a Case Study Report and presentation to assist with translation of information to action. The case study and presentation are delivered separately from this report.

2 METHODOLOGY

In Ecora's proposal to complete this project, the methodology was organized into the following steps to be consistent with the RFP:

1. Simplifying TEM/SEI Products;
2. Development of a Management Strategy and Monitoring Framework; and
3. Case Study Report and Presentation Preparation.

Upon completion of the QA on the original TEM and SEI products (during phase 2), we recommended that some additional tasks be completed to enhance the TEM and SEI products to make them more complete and to improve precision and accuracy. These tasks were approved by CPG and are also described below.

2.1 Simplifying TEM/SEI Products

In the first phase of this project, existing TEM and SEI information was enhanced with additional sensitive ecosystem information and then simplified into a more user-friendly and easily understandable format suitable for use by a wide range of users.

2.2 TEM/SEI Mapping Enhancements

While completing Phase 2 of the Prince George Climate Change / Natural Areas Project, Ecora identified several areas where the existing Sensitive Ecosystem Inventory (SEI) could be improved to more effectively model climate change effects on sensitive ecosystems. After review of the various issues identified in the TEM/SEI QA report, we identified two key ecosystems that should be more precisely and accurately captured in the mapping. These areas are dry to very dry ecosystems, and riparian corridors. It should be noted that this enhancement only addresses the two most important issues that affect the phase 2 and 3 climate change projects and do not fix the other issues identified in the TEM/SEI QA report.

In phase 2 of this climate change project, Ecora's modeling results identified that the driest ecosystems in Prince George are the most susceptible to mortality from changing climates (Ecora and Griesbauer, 2012). As identified in the QA report, these ecosystems are not precisely or accurately captured in the current SEI. Applying climate change models and developing management strategies for these ecosystems requires well defined and relatively homogenous ecological polygons.

The riparian area polygons in the SEI are also incomplete, as identified in the QA report. In order to develop effective management and monitoring strategies for sensitive ecosystems, this layer needs to be updated to include the entire mapping area, including the SBSmh and in the numerous (10,000+ ha) old growth polygons where riparian areas were not captured in the original SEI.

2.2.1 Riparian Area Update

A more complete riparian area layer was obtained by producing a stand-alone riparian data layer using GIS buffering techniques on existing inventory data. The following data layers were used to identify all riparian areas and wetlands in the CPG area:

- LIDAR;
- CPG Hydline;
- CPG Hydpoly; and
- TRIM.

A 30 metre buffer was generated on the sides of each stream, creek, wetland and other riparian feature identified in previous inventories. Thirty metres was selected as an appropriate buffer to be consistent with Riparian Areas Regulations in BC and to assist with best management practices developed later in the project. A sample of the results of this buffering exercise is demonstrated in Figure 2.1 below. The complete riparian area layer was also delivered as part of the geodatabase (.gdb) deliverables.

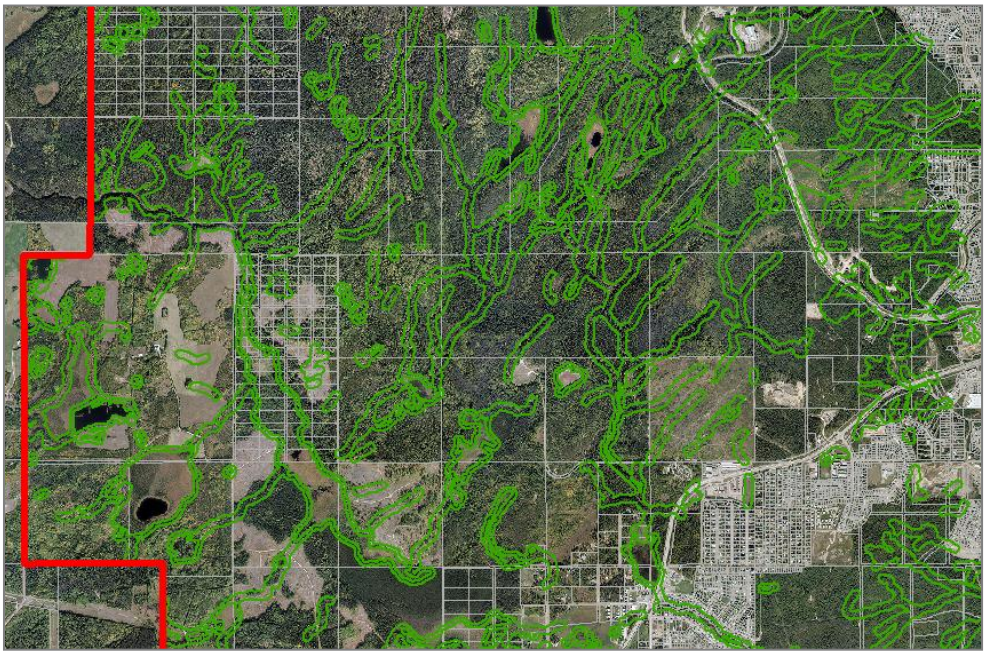


Figure 2.1: Sample of Riparian Areas Buffering and Enhancement Exercise

2.2.2 Dry Ecosystem Update

To accurately and precisely map the vulnerable dry ecosystems, we re-delineated and classified dry ecosystem polygons in the project area. Our ecologists used high resolution images, 1m contours, TEM and SEI data and steep slope polygons (from CPG) to guide new delineation within an ARC 10 platform. This is the system that is used for other ecosystem mapping projects in the province and is an accurate and precise means for delineating sensitive ecosystems.

Detailed dry ecosystem polygons were classified using the simplified ecosystem categories described in the following section. Figure 2.2 below shows a sample of the detailed dry ecosystem mapping completed. The complete dry ecosystem layer was also delivered in .gdb format.

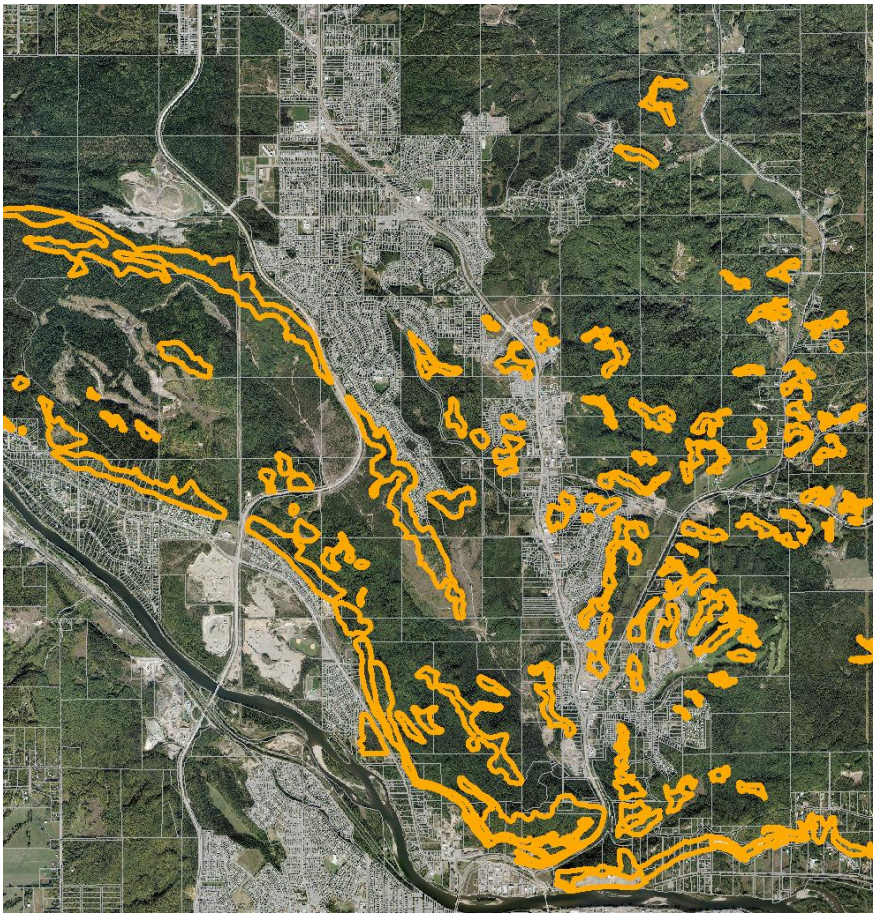


Figure 2.2: Sample of Dry Ecosystem Mapping

2.3 Simplified Ecosystem Mapping

To allow multiple users to access and use the TEM/SEI information (including uploading coverages to PGMap), the technical ecological data needed to be simplified, but without losing any of the technical details in the database. We took the following steps to create a new database with all original data as well as the new riparian and dry ecosystem enhancements:

1. Add Project Boundary;
2. Add BGC Linework;
3. Add rare dry forests (RDF) from dry ecosystem layer (either Site_S1 or Site_S2;
4. Add TEM polygons with other provincially sensitive ecosystems in Site_S1, Site_S2 or Site_S3;
5. Add Remainder of dry ecosystem polygons;

6. Add all double-sided water features;
7. Add new riparian polygons;
8. Add remainder of TEM polygons; and
9. Eliminate slivers less than 0.04ha.

After the new database was generated, we assigned each polygon in the CPG area one of 14 'simplified ecosystems' and gave them generic ecosystem names. The original TEM mapping had 107 different vegetated ecosystems identified and 9 non-vegetated ecosystems for a total of 116 ecosystems simplified to 14 types. The simplification process ensured that ecosystems were combined based on their similarities in function on the landbase, their sensitivity to climate change, as well as their unique management requirements.

For the first level of classification, all ecosystems were placed in one of three categories based on their provincial and local sensitivity. The three general categories were:

1. Provincially Sensitive Ecosystems – these include all ecosystems identified as at-risk (red or blue-listed) in BC (CDC, 2012);
2. Locally Sensitive Ecosystems – these include all ecosystems with significant local value for their wildlife habitat, sensitivity to climate change, contribution to hydrological function, or other local significance; and
3. Non-Sensitive Ecosystems – these include all other ecosystems that do not have provincial or local significance.

The next level of classification was to split each of the three categories above into discreet ecosystem types that we called 'simplified ecosystems'. Every polygon in the TEM database was assigned one of the following labels:

- Provincially Sensitive Ecosystems
  1. Rare Dry Forests
  2. Rare Mature Forests
  3. Rare Riparian Areas and Wetlands
  4. Rare Grasslands

- Locally Sensitive Ecosystems
  5. Sensitive Dry Forests
  6. Sensitive Dry Non-Forested Areas
  7. Sensitive Riparian Areas and Wetlands
  8. Sensitive Old Growth Forests

- Non-Sensitive Ecosystems
  9. Common Douglas-fir Forests
  10. Common Coniferous Forests
  11. Common Mixed Forests
  12. Common Deciduous Forests
  13. Common Non-forested Areas
  14. Urban / Developed Areas

Table 2.1 below identified how each polygon was ultimately assigned one of the 14 simplified ecosystem types.

Table 2.1: Assignment of Simplified Ecosystems from Original TEM Database

General Sensitivity Classification	Simplified Ecosystem Name	Data Layer	SBSdw3	SBSmh	SBSmk1
Provincially Sensitive Ecosystem	Rare Dry Forests	Dry Ecosystems	RDF	RDF	RDF
	Rare Mature Forests	TEM	05, 06	01, 05, 06	00/SS
	Rare Riparian Areas and Wetlands	TEM	00/OF, Ws03	07, 08, Fl03, Fl05	Fl05, Ws03
	Rare Grasslands	TEM	00/BW	00/BW	00/BW
Locally Sensitive Ecosystem	Sensitive Dry Forests	Dry Ecosystems	SDF	SDF	SDF
	Sensitive Dry Non-Forested Ecosystems	Dry Ecosystems; TEM	SDN	SDN	SDN
	Sensitive Riparian Areas and Wetlands	New Riparian Areas	all	all	all
	Sensitive Old Forests	TEM	Structural Stage 7	Structural Stage 7	Structural Stage 7
Common Ecosystem	Common Douglas-fir Forests	TEM/VRI	>50% Fd	>50% Fd	>50% Fd
	Common Coniferous Forests	TEM/VRI	>=80% coniferous species	>=80% coniferous species	>=80% coniferous species
	Common Mixed Forests	TEM/VRI	>20 and <80 coniferous and deciduous	>20 and <80 coniferous and deciduous	>20 and <80 coniferous and deciduous
	Common Deciduous Forests	TEM/VRI	>=80% deciduous species	>=80% deciduous species	>=80% deciduous species
	Common Non-forested Areas	TEM	Remainder, not UR	Remainder, not UR	Remainder, not UR
	Urban / Developed Areas	TEM	UR	UR	UR

The simplified ecosystem maps and database were delivered along as a new .gdb file as requested by CPG. Figure 2.3 below shows the entire CPG area classified into the simplified ecosystems. Figure 2.4 is a close-up sample of the map. Table 2.2 below is an area summary of the different simplified ecosystems.

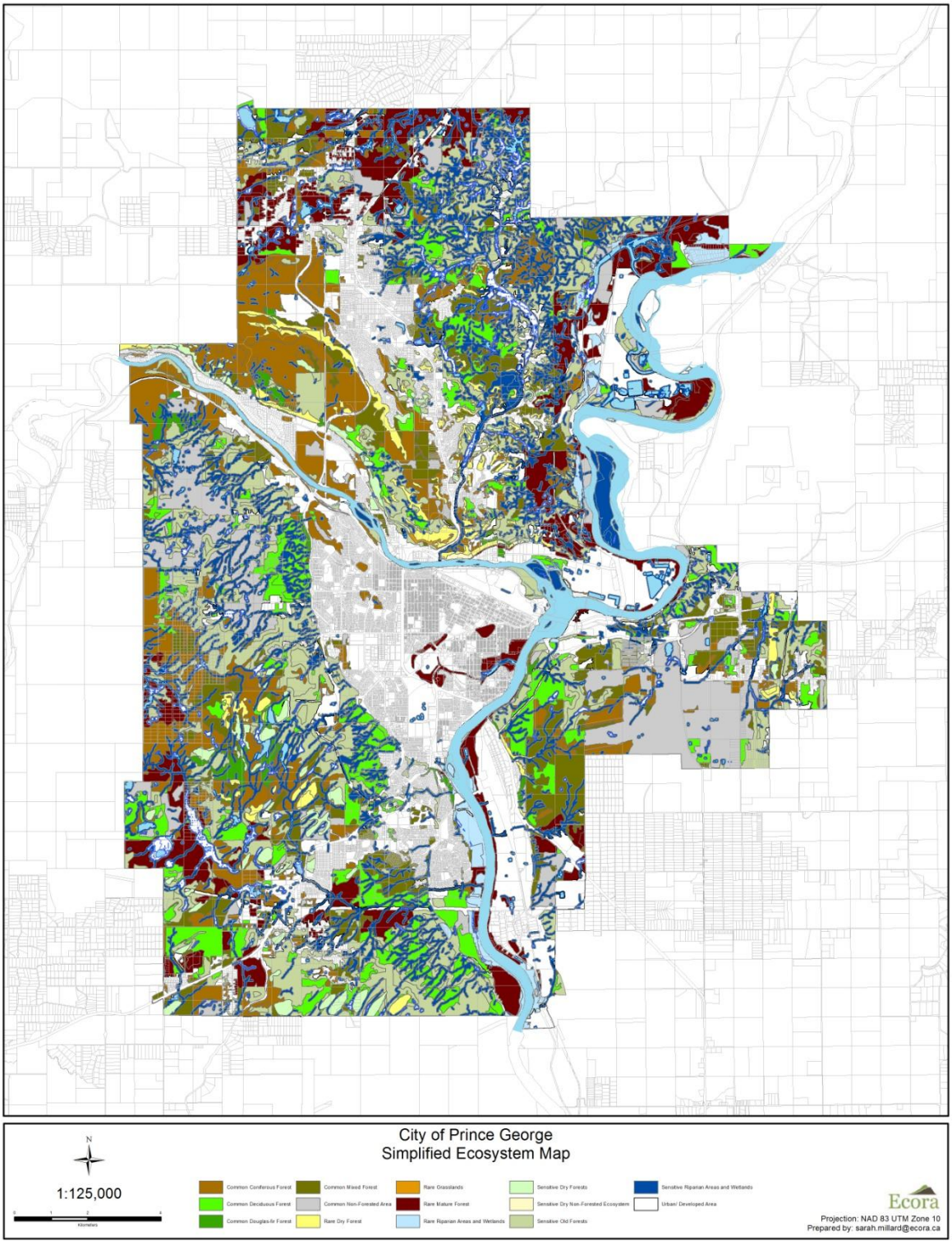


Figure 2.3: CPG Simplified Ecosystem Map

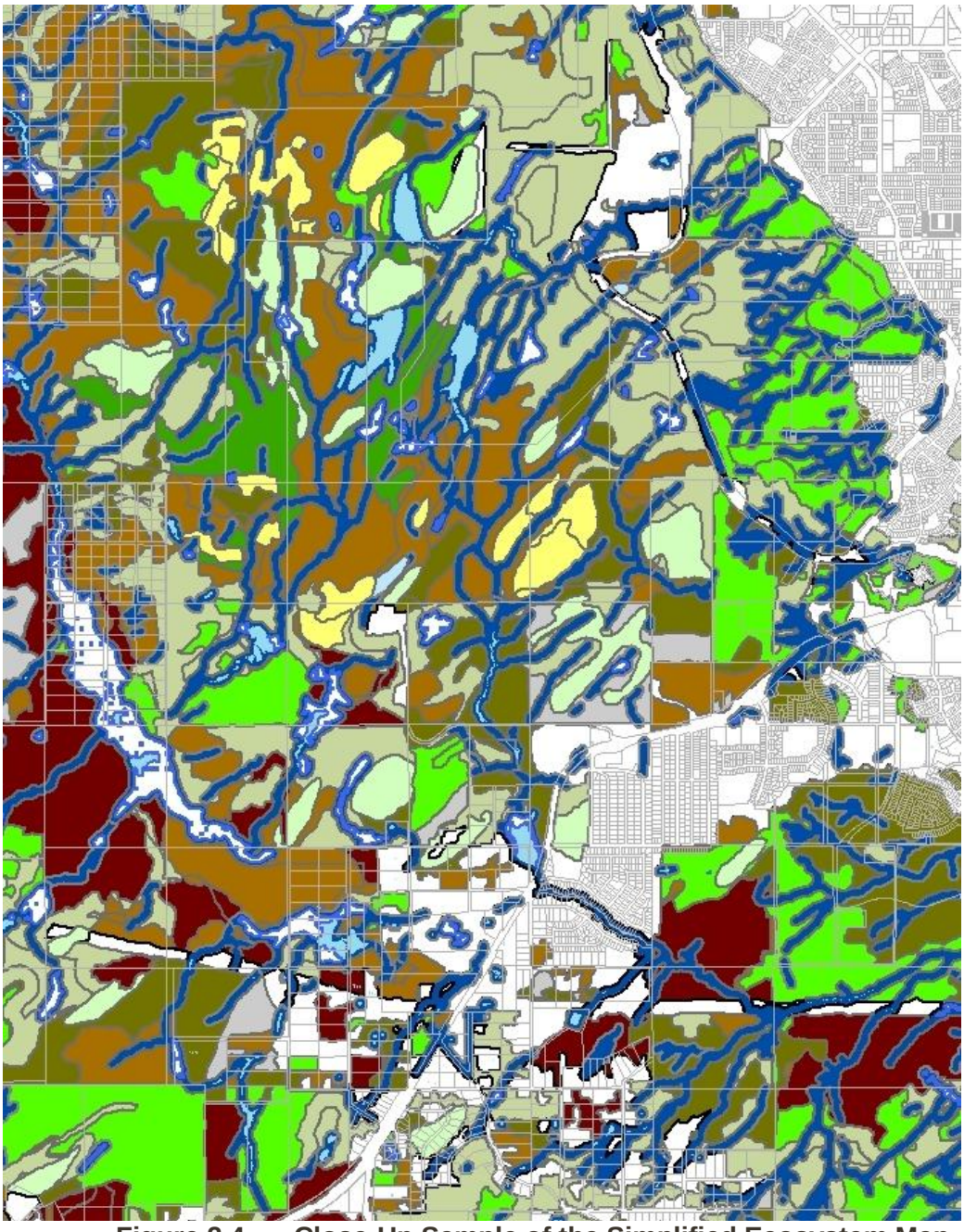


Figure 2.4: Close-Up Sample of the Simplified Ecosystem Map

Table 2.2: Area Summary of Simplified Ecosystems in CPG

Ecosystem #	Simplified Ecosystem Classification	Total Area (ha)
1	Rare Dry Forests	585.71
2	Rare Mature Forests	2,235.06
3	Rare Riparian Areas and Wetlands	434.84
4	Rare Grasslands	11.09
5	Sensitive Dry Forests	421.84
6	Sensitive Dry Non-Forested Areas	14.54
7	Sensitive Riparian Areas and Wetlands	7,360.54
8	Sensitive Old Forests	4,286.17
9	Common Douglas-fir Forests	233.93
10	Common Coniferous Forests	3,128.23
11	Common Mixed Forests	2,096.53
12	Common Deciduous Forests	1,958.27
13	Common Non-Forested Areas	2,142.91
14	Urban / Developed Areas	8,030.99
	Total	**32,940.65**

3 MANAGEMENT AND MONITORING OF NATURAL AREAS

Given the considerable uncertainty and complexity of forest responses to climate change and resultant future conditions (Millar *et al.* 2007), it is now widely recognized that ecosystem and forest management paradigms need to change to maintain or increase resiliency to future changes (Ran and Swift in press, Spittlehouse 2005, Puettman *et al.* 2008). Approaches that increase diversity across multiple spatial, structural, and biological scales will help mimic natural forest processes and increase forest resiliency to climate-related disturbances (Ran and Swift in press, Puettman *et al.* 2008). More deterministic approaches such as facilitated migration may help match tree species and genotypes to anticipated future climates and reduce maladaptation (Ukrainetz *et al.* 2011). For example, long-term climatic shifts in the SBS BGC zone (and Prince George) could result in Douglas-fir gaining suitable habitat in the area, although hybrid spruce and subalpine fir will continue to be important species on the landscape (Ran *et al.* in press). Western red cedar and western larch are currently absent from Prince George forests at a landscape scale, but may be productive under projected climates (Rehfeldt and Jaquish 2010, Ran *et al.* in press), and are thus suggested as potential candidates for facilitated migration (Ran *et al.* in press). Measures such as facilitated migration have inherent risk and require careful consideration of many site- and landscape-level factors; decisions should be made by experienced ecologists with strong local knowledge (Puettman *et al.* 2008, Ran and Swift in press, Ran *et al.* in press).

Maintaining large contiguous undisturbed (e.g., no roads, trails) forest areas will be key for maintaining sensitive wildlife species and habitat structures (e.g. large trees and snags), carbon storage, and protecting rare ecosystems and plant species. These high conservation value areas will require important management consideration. Specific management strategies will vary according to the management context (e.g., park, ALR, wildfire interface). What follows are descriptions of the various ecological units, their values, risks and consequent management recommendations by management context.

The steps taken to develop a management and monitoring plan included:

1. Determine scope of plan;
2. Map high conservation value areas;
3. Identify management zones;
4. Recommend best management practices for ecosystems by management zones; and
5. Recommend monitoring plan.

3.1 Management and Monitoring Plan Scope

The City of Prince George has numerous plans and policies related to the management of the environment and natural areas. The OCP, the myPG Integrated Community Sustainability Plan, the Parks and Open Space Master Plan, the Community Forest Management Plan and other CPG plans all need to be considered when making decisions on the management of natural areas.

The management of natural areas and sensitive ecosystems in the face of climate change is the focus of the management and monitoring plans described below. At the request of CPG, numerous additional BMP's are suggested for natural areas in the CPG area depending on the zonation where those ecosystems are found.

Prior to making development-limiting management decisions, the presence and operational boundaries of sensitive ecosystems should be confirmed by a qualified professional. Available ecosystem maps are expected to have landscape level accuracy but are less accurate at the stand and operational level.

3.2 High Conservation Value Mapping

Not all ecosystems have the same value from a conservation and management perspective. For example, a wetland on the edge of a major highway has less wildlife and hydrological value than a wetland in the middle of an undisturbed tract of land. It is therefore important to classify the conservation value of each ecosystem to allow for different management practices to be used for high value versus standard value areas.

Attributes used in this process to assign conservation value included:

- Intactness of forest;
- Ecosystem size;
- Ecosystem age since last disturbance;
- Leading tree species; and
- Existing OCP zone.

3.2.1 Intact Forest

An intact forest is an area that is free from the effects of anthropogenic disturbance. Intact forests, also known as forests with interior forest conditions, are important for numerous flora and fauna that require relatively pristine areas for their survival. The conservation value of a stand is dramatically reduced in areas with moderate to high disturbance levels.

The distance from an edge where the disturbance no longer affects the condition of the forest ranges depending on the type of ecosystem, slope gradients, aspects, heights of trees, etc. For the purposes of determining intact forest in the Prince George area, we used 100m from the nearest disturbance, and the technical details of how GIS was used to determine intact forest is described below.

GIS analysts took the following steps to identify intact forests in the CPG area:

- Used existing data as well as the Simplified Ecosystems layer to select out areas of disturbance. Areas of disturbance were defined as roads, urban areas, major rivers, the Otway trail system, forest cover under 50 years old, as well as blocks from the TEM layer where leading site series is labeled CU, ES or GP;
- Used 2010 ORTHO photos to identify and digitize additional disturbances not selected by these queries;
- Created a 100m buffer on all disturbances, with the exception of the river polygon;

- Merged all buffer polygons together with the river polygon;
- Overlaid the merged buffered disturbance layer with the forested layer to identify and erase all disturbed areas leaving behind polygons representing intact forests. The resulting layer contained many small (<1ha) "island" polygons that were eliminated from the intact forest layer; and
- QA of the intact forest layer included a review of the polygons draped over an ORTHO photo backdrop to visually identify areas of intact forest that had unmapped roads, farms, harvesting, and remove them from the intact forest.

Figure 3.1 below identifies the areas within the city limits that still have relatively intact ecosystems. 5,035ha or 15% of the area are still considered intact. Table 3.1 provides a breakdown of intact forest.

Table 3.1: Area Summaries of Intact Forest in CPG

Intact Forest		
Simplified Ecosystem	**Conservation Value**	**Area (ha)**
Common Coniferous Forests	High	560
Common Coniferous Forests	Standard	359
Common Deciduous Forests	High	69
Common Deciduous Forests	Standard	174
Common Douglas-fir Forests	High	71
Common Douglas-fir Forests	Standard	25
Common Mixed Forests	High	150
Common Mixed Forests	Standard	194
Common Non-Forested Areas	Standard	28
Rare Dry Forests	High	86
Rare Dry Forests	Standard	98
Rare Grasslands	High	4
Rare Mature Forests	High	115
Rare Mature Forests	Standard	142
Rare Riparian Areas and Wetlands	High	51
Rare Riparian Areas and Wetlands	Standard	1
Sensitive Dry Forests	High	6
Sensitive Dry Forests	Standard	80
Sensitive Dry Non-Forested Ecosystem	High	1
Sensitive Old Forests	High	1,204
Sensitive Old Forests	Standard	1
Sensitive Riparian Areas and Wetlands	High	1,515
Sensitive Riparian Areas and Wetlands	Standard	102
	Total Area	5,035

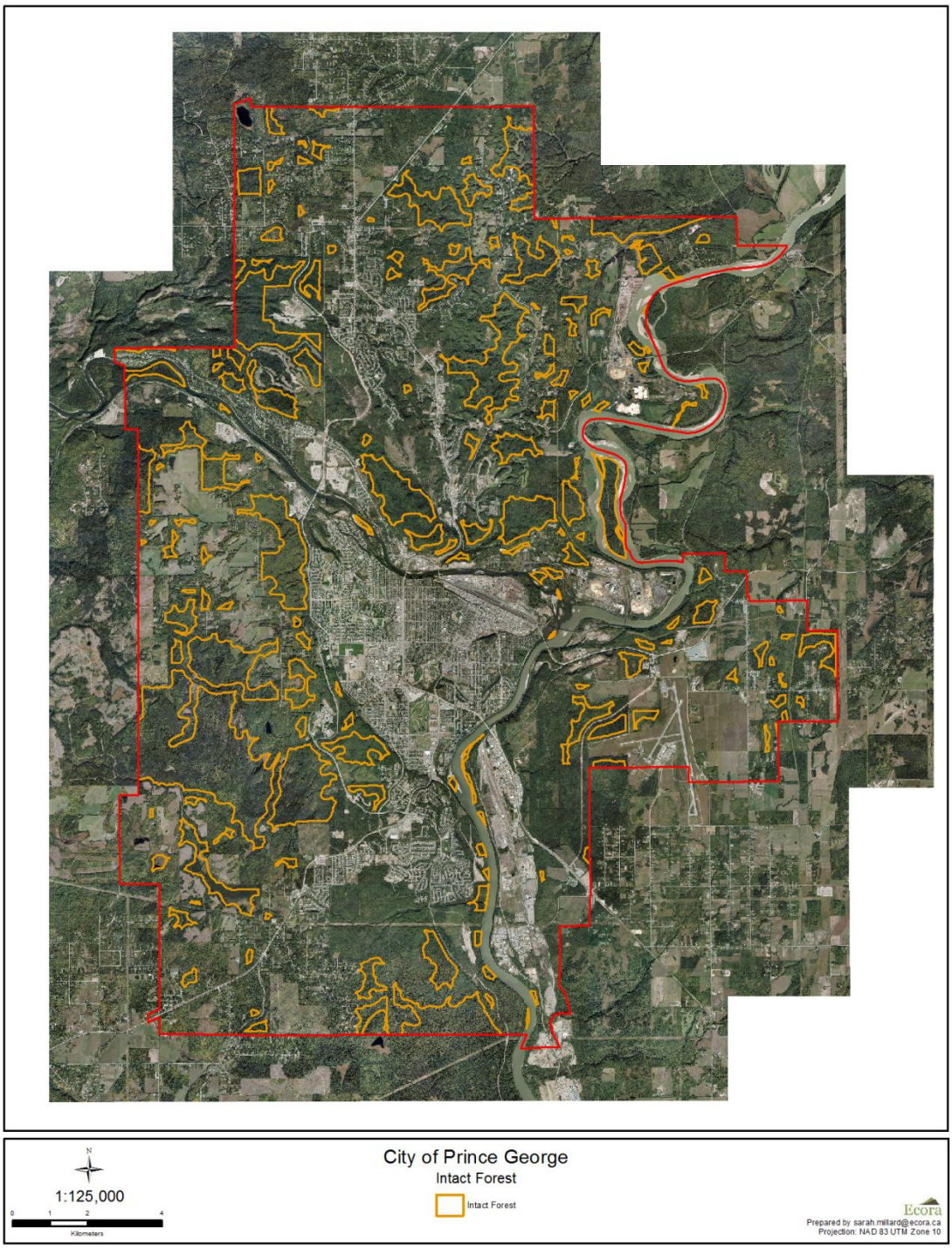


Figure 3.1: Intact Forest Mapping of CPG

Two of the largest areas of intact forest are on Cranbrook Hill. Cranbrook Hill East is just south of the University of Northern British Columbia (UNBC) campus and west of Tyner

Boulevard. Cranbrook Hill West is just west of Kueng Road and south of the UNBC campus. Much of the area is found within the Prince George Community Forest. Maintaining these areas unharvested should be an important consideration for the community forest plan.

The other large area is located north of Noranda Road East and west of the old Summit Lake Road at the north end of Prince George. This is an important area since it is further away from urban areas that surround the Cranbrook Hill areas. It is connected to the forests north of Prince George and thus should play an important role for maintaining organisms that require intact mature forest, especially as the pressure to harvest the adjacent forests impacted by MPB.

3.2.2 High Conservation Values

Each simplified ecosystem polygon was assigned either a high conservation value or a standard conservation value. The specific attributes used to assign the conservation value was based on the following:

1. Rare Dry Forests:
   - Older than 80yrs;
   - Larger than 2ha; and
   - Containing intact forest.

2. Rare Mature Forests:
   - Older than 80yrs;
   - Larger than 5ha; and
   - Containing intact forest.

3. Rare Riparian Areas and Wetlands:
   - In the RPDP or GPDP zones; OR
   - Larger than 1ha; and
   - Containing intact forest.

4. Rare Grasslands:
   - All.

5. Sensitive Dry Forests:
   - Older than 80yrs;
   - Larger than 2ha;
   - Containing intact forest; and
   - Fd leading.

6. Sensitive Dry Non-Forested Ecosystems:
   - All.

7. Sensitive Riparian Areas and Wetlands:
   - In the RPDP or GPDP zones; OR

- Larger than 1ha; and
- Containing intact forest.

8. Sensitive Old Forests:
   - Containing intact forest.

9. Common Douglas-fir Forests:
   - Larger than 10ha; and
   - Containing intact forest.

10. Common Coniferous Forests:
    - Larger than 10ha; and
    - Containing intact forest.

11. Common Mixed Forests:
    - Larger than 10ha; and
    - Containing intact forest

12. Common Deciduous Forests:
    - Larger than 10ha; and
    - Containing intact forest.

13. Common Non-Forested Areas:
    - No high value.

14. Urban / Developed Areas:
    - No high value.

A total of 6,222ha of land in the CPG area have been classified as having a high conservation value according to the definitions above. This accounts for about 19% of the total CPG area or 25% of the non-urban areas of the City. Table 3.2 below summarizes the amount of high and standard conservation value for each simplified ecosystem type. Figure 3.2 identifies the high conservation value areas in CPG.

Table 3.2: Area Summaries of High and Standard Conservation Areas in CPG

Simplified Ecosystem Classification	Conservation Value	Area (ha)	Total Area (ha)
Common Coniferous Forests	high	560.42	3,128.23
	standard	2,567.81	
Common Deciduous Forests	high	69.20	1,958.27
	standard	1,889.07	
Common Douglas-fir Forests	high	70.57	233.93
	standard	163.37	
Common Mixed Forests	high	149.81	2,096.53
	standard	1,946.72	
Common Non-Forested Areas	standard	2,142.91	2,142.91
Rare Dry Forests	high	86.09	585.71
	standard	499.61	
Rare Grasslands	high	11.09	11.09
Rare Mature Forests	high	115.26	2,235.06
	standard	2,119.80	
Rare Riparian Areas and Wetlands	high	198.02	434.84
	standard	236.82	
Sensitive Dry Forests	high	5.78	421.84
	standard	416.06	
Sensitive Dry Non-Forested Ecosystems	high	14.54	14.54
Sensitive Old Forests	high	1,204.31	4,286.17
	standard	3,081.86	
Sensitive Riparian Areas and Wetlands	high	3,737.30	7,360.54
	standard	3,623.24	
Urban/ Developed Areas	standard	8,030.99	8,030.99
		Total	**32,940.65**

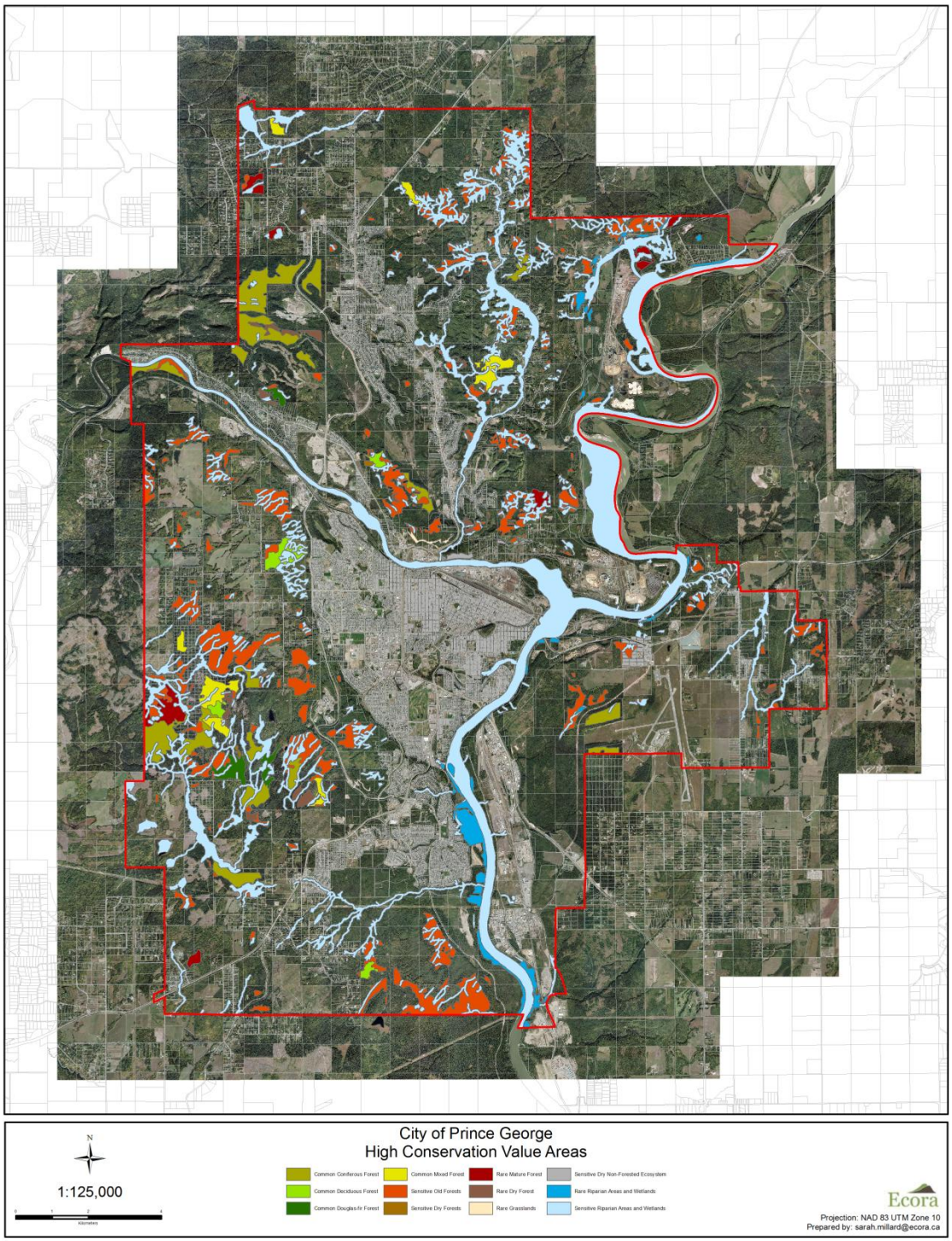


Figure 3.2: High Conservation Value Ecosystems of CPG

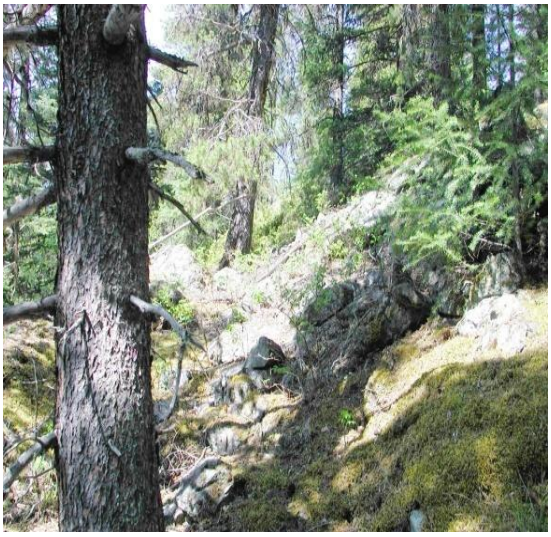
3.3 Best Management Practices

The best management practices for natural areas were written once all of the intact forest and high conservation analysis was completed. Each ecosystem has different requirements and recommendations because of their different sensitivities to climate change, their function on the landbase, etc. BMP's for individual provincially sensitive and locally sensitive ecosystems are provided in the following sections. One set of BMP's are provided for the high conservation but common (non-sensitive) areas.

3.4 Provincially Sensitive Ecosystems

Provincially sensitive ecosystems are all areas identified by the BC Conservation Data Centre (CDC) as red or blue listed because they are endangered, threatened or of special concern. These ecosystems are at risk due to their rarity on the landbase, they are threatened by significant anthropogenic disturbance and/or they are endemic to BC.

3.4.1 Rare Dry Forests



Rare dry forests are quite small in size (often less than 1 hectare), have coarse soils or bedrock near the surface and are typically dominated by Douglas-fir.

3.4.1.1 Description

These forests occur where bedrock is close to the surface, on gravelly ridges left from glaciation or on steep warm slopes. Older forest canopies are generally dominated by Douglas-fir with varying amounts of lodgepole pine, white spruce and occasional subalpine fir. Younger forest canopies often contain paper birch or trembling aspen. Douglas-fir may be in the understory, especially if a light fire has burned through the stand, but it is more typical for white spruce or subalpine fir to dominate the understory tree layer. Common shrubs are soopolallie, Saskatoon, common juniper, and velvet-leaved blueberry. Common herbs are kinnikinnick, prince's pine, and twinflower. The moss layer is dominated by red-stemmed feathermoss and often various amounts of reindeer and Cladonia lichens.

The site units include:

- SBSdw3/02;
- SBSmh/02;
- SBSmh/03;
- SBSmh/04; and
- SBSmk1/04.

SBSdw3/02 and SBSmh/02 (FdPl – Cladonia): This unit occurs on warm aspects of coarse-textured eskers or on shallow soils over bedrock. The open canopy is dominated by Douglas-fir while the understory is characterized by soopolallie, birch-leaved spirea, and kinnikinnick. The forest floor is typically a mix of feathermosses and lichens.

SBSmh/03 (FdPl – Velvet-leaved blueberry – Cladonia): This unit occurs on level and gently sloping sites with coarse glaciofluvial soils, predominantly gravelly sands. The open canopy is generally a mixture of Douglas-fir and lodgepole pine. The undergrowth vegetation includes kinnikinnick, soopolallie, common juniper, and velvet-leaved blueberry. Mosses, especially red-stemmed feathermoss and wavy-leaved moss, are abundant.

SBSmh/04 (Fd – Douglas maple – Step moss) This unit occurs on mid and upper slope positions of steep south- and west-facing slopes. The canopy is dominated by Douglas-fir but occasionally includes scattered hybrid white spruce and subalpine fir. The diverse

and generally well developed understory is typified by choke cherry, American vetch, and abundant showy aster.

SBSmk1/04 (SxwFd – Knight's plume) This unit occurs in mid to crest slope positions and generally on warm aspects. The canopy is a mix of Douglas-fir, lodgepole pine and hybrid spruce. The understory often contains abundant subalpine fir and is typified by black huckleberry and prince's pine. Feathermosses form a continuous carpet on the forest floor.

3.4.1.2 Value

These forests often have high value for wildlife foraging as they are some of the first sites to lose snow and they are often open stands promoting growth of understory plants. They also often contain large Douglas-fir trees and snags which represent very high value wildlife trees.

When these sites occur along ridges they offer easy trail building as animals have already created a trail and there is little undergrowth and less logs to clear. They also offer good viewing as they tend to be above surrounding terrain. The rocky outcrops that occur in this unit are often picturesque with the combination of large Douglas-fir and rocky areas with rock garden plants such as stonecrop.

3.4.1.3 Risks

The greatest risk is land clearing for housing as these sites often represent high value view lots. Harvesting is also a threat since tree removal will significantly reduce values associated with the large trees. Heavy use trails in these ecosystems can also reduce wildlife value, especially if dogs are allowed on the trails. Climate warming will reduce moisture availability on these sites causing drought related mortality of subalpine fir, white spruce, lodgepole pine and possibly Douglas-fir. These open ecosystems are susceptible to dry, weedy invasive species in the understory.

3.4.1.4 Management of Rare Dry Forests

Management of provincially sensitive ecosystems depends on the ecological value of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value rare dry forests in CPG have been mapped as those areas:

- Older than 80yrs;
- Larger than 2ha; and
- Containing intact forest.

Area Summaries

There are 112 sites totaling about 586 ha where rare dry ecosystems are an important component of the ecological polygon. The area summaries of high and standard value rare dry ecosystems by designated areas in the OCP are provided in Table 3.3 below.

Table 3.3: Rare Dry Forests Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	11	12.66	96	98.51	107	111.17
Agricultural Land Reserve	0	0	39	27.55	39	27.55
Existing/ Proposed Parks	5	0.7	66	44.63	71	45.33
Riparian Protection	4	0.45	22	9.14	26	9.59
Groundwater Protection	0	0	0	0	0	0
Landslide Hazard	57	46.03	293	270.2	350	316.23
Flood Hazard	0	0	0	0	0	0
Other - Rural Resources	28	11.34	208	35.39	236	46.73
Other - Rural Areas	1	2.17	14	1.2	15	3.37
Other - Proposed Urban	6	12.75	26	12.92	32	25.67
Other - Urban	0	0	15	0.07	15	0.07
Total	**112**	**86.1**	**779**	**499.61**	**891**	**585.71**

Areas designated as Wildfire Interface and Landslide Hazard in the OCP have the largest areas of rare dry ecosystems, but a relatively small proportion of this is high value. There are 45 hectares in existing parks, most of which are standard value. Determining the proximity of high value sites adjacent to the existing parks would be useful to see what additions could be made to park space to improve protection of these ecosystems. Efforts to work in green space that includes the 25 hectares within proposed urban areas would be beneficial for maintaining this rare ecosystem.

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with a 100m no disturbance buffer;
2. Unless these sites occur in a wildfire interface zone, these sites should be managed to maintain the natural structure, composition and function of the vegetation community;
3. If this site is in a wildfire interface, avoid fuel management and vegetation conversion within this polygon if possible; and
4. Actively remove invasive species found within 1km of these sites.

Objective 2 – Manage standard value rare dry forests based on OCP zone designations

Best Management Practices:

1. Wildfire Interface DP areas:
   - If within 100m of existing structures: Follow guidelines in 'The Home Owners Fire Smart Manual;
   - Over 100m from existing structures, do not disturb these sites, avoid fuel management and vegetation conversion within this polygon where possible; and
   - Consider acquisition for new park.
2. ALR:
   - Rare dry forested ecosystems are very poor potential agricultural areas;
   - Inform and educate ALC and, where applicable, the landowner about the presence of rare ecosystem on property;
   - Maintain forested buffer of at least 30m between rare dry ecosystem and agricultural activities; and
   - Control spread of invasive species from agricultural areas into rare dry ecosystems.
3. Parks and Proposed Parks:
   - Use these sites to educate the public about the ecological values of rare dry ecosystems;
   - Actively remove invasive species from park area; and
   - Allow for natural successional pathways.
4. Riparian Protection:
   - Where these ecosystems are found within RPDP areas, they have increased value as they provide natural wildlife trails and habitat adjacent to riparian areas. Extend riparian setbacks to include this polygon.
5. Groundwater Protection:
   - There are no rare dry ecosystems within the Groundwater Protection area of CPG.
6. Landslide Hazard Area:
   - These areas are especially susceptible to vegetation conversion due to climate change;
   - Where forest health issues are prevalent, underplant these slopes with Douglas-fir; and
   - Stabilize slumping areas with vegetation native to these rare ecosystems such as soopolallie and common juniper.
7. Flood Hazard Area:
   - There are no rare dry ecosystems within the flood hazard area of CPG.
8. Other Areas:
   - No special management if under 1ha in size; and
   - If over 1ha, maintain buffer of at least 10m between rare dry ecosystem and development.

3.4.2 Rare Mature Forests

Provincially sensitive mature forests are areas that have been identified as at risk because they are threatened by significant anthropogenic disturbance and/or they are endemic to BC. They are variable in size, generally productive and occur on sites where moderate soil moisture is available throughout the growing season.

3.4.2.1 Description

There are 5 BGC site series identified by the CDC in the Prince George area that are blue-listed (vulnerable) because the mature and old growth stages of this site series have been greatly reduced on the landbase. All sites with the potential to develop these mature and old growth ecosystems, regardless of age, are identified as rare mature forest. Areas with earlier structural stages on these sites can be thought of as having the potential to develop the right 'rare mature forest' and should be managed in the same class as the older forests.

The site units include:

- SBSdw3/05;
- SBSdw3/06;
- SBSmh/01;
- SBSmh/05; and
- SBSmh/06.

SBSdw3/05 (PlSb – Feathermoss): This unit generally occurs on gentle slopes on compact morainal or old lake deposits. These low productivity forests are dominated by lodgepole pine, with a subcanopy of black spruce. Labrador tea is common in the understory.

SBSdw3/06 (Sxw – Pink spirea – Prickly Rose): This unit generally occurs in level areas or in depressions, often on terrain characterized as old lake deposits. Pink spirea dominates the shrub layer.

SBSmh/01 (SxwFd – Hazelnut): This unit occurs on gentle to moderate mid to lower slopes or level benches along the banks of the Fraser and Nechako rivers. The diverse understory generally contains beaked hazelnut, thimbleberry and prickly rose.

SBSmh/05 (SxwFd – Feathermoss): This unit occurs on gentle mid to toe slopes with gravelly loamy or sand soils along the banks of the Fraser and Nechako rivers. Douglas-fir generally dominates the canopy and understory cover is variable but mosses are always dominant.

SBSmh/06 (SxwFd – Coltsfoot): This unit occurs uncommonly on mid to toe slopes on medium or finer textured soils. The diverse moderately well developed understory often includes red osier dogwood, thimbleberry, high-bush cranberry, and soopolallie.

3.4.2.2 Value

Older forests contain large trees and snags which represent high value wildlife trees. Areas adjacent to larger rivers contain high value wildlife forage such as red osier dogwood and beaked hazelnut. Due to the lower risk from climate change impacts and the presence of large trees, these forests represent important carbon sinks.

3.4.2.3 Risks

The greatest risk is land clearing for permanent structures since the ecosystem is irreparably altered. Clearcut harvesting results in a long term loss of values, while selective tree removal is less damaging. Heavy use recreational trails reduce wildlife value especially if dogs are allowed on the trails. These forests are at moderate to low risk from climate change impacts related to drought mortality.

3.4.2.4 Management of Rare Mature Forests

Management of provincially sensitive ecosystems depends on the ecological value of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value rare mature forests in CPG have been mapped as those areas:

- Older than 80yrs;
- Larger than 5ha; and
- Containing intact forest

Area Summaries

There are 1520 sites totaling 2235 ha where rare mature forests dominate the ecological polygon. The area summaries of high and standard ecosystems by designated areas in the OCP are provided below in Table 3.4.

Table 3.4: Rare Mature Forests Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	0	0	48	47.29	48	47.29
Agricultural Land Reserve	9	64.86	198	1080.86	207	1145.72
Existing/ Proposed Parks	3	2.7	53	90.66	56	93.36
Riparian Protection	7	0.76	123	108.71	130	109.47
Groundwater Protection	0	0	5	5.05	5	5.05
Landslide Hazard	12	3.05	426	106.58	438	109.63
Flood Hazard	0	0	33	73.19	33	73.19
Other - Rural Resources	15	34.82	144	263.45	159	298.27
Other - Rural Areas	1	5.93	95	149.77	96	155.7
Other - Proposed Urban	0	0	34	63.02	34	63.02
Other - Urban	7	3.15	307	131.24	314	134.39
Total	**54**	**115.27**	**1466**	**2119.82**	**1520**	**2235.09**

Areas designated as Agricultural Land Reserve (ALR) in the OCP have by far the largest area of rare mature forests, a relatively small proportion of which is high value. There are 93 hectares in existing parks, most of which are standard value. Determining the proximity of high value sites, in particular areas currently designated as ALR and Rural Resources, adjacent to the existing parks would be useful to see what additions could be made to park space to improve protection of these ecosystems. Efforts to plan green space in areas that include the 63 hectares within proposed urban areas would be beneficial for maintaining these rare ecosystems.

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with a 100m no disturbance buffer;
2. Sites over 140yrs old should be considered for a new park or protected area; and
3. Remove invasive species found within 1km of these sites.

Objective 2 – Manage standard value rare mature forests based on OCP zone designations

Best Management Practices:

1. Wildfire Interface DP areas:
   - If within 100m of existing structures: Follow guidelines in 'The Home Owners Fire Smart Manual; and
   - Over 100m from existing structures, do not disturb sites over 140yrs old, avoid fuel management and vegetation conversion within this polygon where possible.

2. ALR:
   - Inform and educate ALC and, where applicable, the landowner about the presence of a rare ecosystem on property;
   - Avoid converting rare mature forests over 80 yrs old to agricultural land where possible;
   - Maintain forested buffer of at least 30m between rare mature forest and agricultural activities; and
   - Control spread of invasive species from agricultural areas into rare mature forest.
3. Parks and Proposed Parks:
   - Use these sites to educate the public about the ecological values of rare mature forested ecosystems;
   - Actively remove invasive species from park area; and
   - Allow for natural successional pathways.
4. Riparian Protection:
   - Where these ecosystems are found within RPDP areas, they have increased value as they provide natural wildlife trails and habitat adjacent to riparian areas. Extend riparian setbacks to include this polygon.
5. Groundwater Protection:
   - Follow guidelines for GPDP areas;
   - If new permanent structures are planned within GPDP, do not develop within 30m of rare mature forests over 80 yrs old; and
   - Consider acquisition for new park.
6. Landslide Hazard Area:
   - Where forest health issues are prevalent, underplant these slopes with Douglas-fir; and
   - Stabilize slumping areas with vegetation native to these ecosystems.
7. Flood Hazard Area:
   - There are no rare mature forests within the flood hazard area of CPG.
8. Other Areas:
   - No special management if under 10ha in size; and
   - If over 10ha, maintain buffer of at least 10m between rare mature forests and development.

3.4.3 Rare Riparian Areas and Wetlands

Provincially rare riparian forests and wetlands are either long linear ecosystems around water courses or small, very wet ecosystems occurring on poorly drained soils.

3.4.3.1 Description

These are rare ecosystems occurring along water courses (riparian areas) or in depressions with poorly drained soils (wetlands). The riparian forests occur on lower to toe slopes, older stands are usually dominated by white spruce and black cottonwood often dominates younger stands. The understory of the lower slope riparian forests is dominated by devil's club while on the toe slope and floodplain sites, ostrich fern dominants the understory. Rare wetlands are either located on lower fluvial benches along rivers or in swampy depressions. Willows and mountain alder dominate these sites.

The site units include:

- SBSmh/07;
- SBSmh/08;
- SBSdw3/Ws03 and SBSmk1/Ws03;
- SBSmh/Fl03; and
- SBSmh, SBSdw3 and SBSmk1/Fl05.

SBSmh/07 (SxwEp – Devil's club): This unit occurs on lower to toe slopes, especially adjacent to small streams and often on north aspects. These high productivity forests are generally open and dominated by hybrid white spruce and Douglas-fir, often with a component of paper birch and black cottonwood. Devil's club and ferns dominate the understory.

SBSmh/08 (Sxw – Ostrich fern): This unit occurs in small pockets primarily on medium- to fine-textured fluvial soils at the toe of slopes and on floodplains of streams. These open highly productive forests are usually a mix of hybrid white spruce, subalpine fir and black cottonwood. Ostrich fern dominates the understory.

SBSdw3 and SBSmk1/Ws03 (Bebb's willow – Bluejoint): This unit occurs on level areas that are influenced by a water table. They have standing water in the spring that draws down to very moist soil conditions by late summer. The tall shrub canopy is generally a mix of Bebb's willow and mountain alder and the understory is often contains bluejoint grass and horsetails.

SBSmh/Fl03 (Pacific Willow – Red-osier Dogwood – Horsetail): – This unit occurs on gently sloping fluvial, low bench sites subjected to annual flooding along the Fraser River. The tall shrub layer is dominated by Pacific willow and mountain alder and understory generally contains red-osier dogwood and horsetails.

SBSmh, SBSdw3 and SBSmk1/Fl05 (Drummond's Willow – Bluejoint): – This unit occurs along small low gradient streams in areas subjected to spring flooding. The tall shrub layer is dominated by Drummond's willow and the understory generally contains black twinberry and bluejoint grass.

3.4.3.2 Value

Functioning riparian areas and wetlands improve the quality of local water and can provide natural stormwater management by slowing down and storing large volumes of excess water. Riparian forests and wetlands provide important habitat and corridors for animal movement. The riparian forests often contain high value wildlife trees, particularly large black cottonwood. Large mammals including bears will use these trees and they also provide important bird and bat habitat. The riparian forests are shrub rich and contain high value browse such as red-osier dogwood. The wetlands provide key habitat for moose. Trails are common in the riparian forests and lower bench fluvial wetlands as they provide access to the water and views of the rivers (e.g., Cottonwood Island Park).

3.4.3.3 Risks

The greatest risk for rare riparian forests is land clearing for development, especially when the forests are above the normal flood zone. The greatest risk to the rare wetlands is alteration of the water flow and pollution from upstream developments. Minor changes in hydrology put the entire wetland at risk of being irreparably damaged. Heavy use trails will also reduce wildlife value especially if dogs are allowed on the trails. If water tables drop as a result of climate change the riparian forests and wetlands may be at risk due to drought impacts.

3.4.3.4 Management of Rare Riparian Areas and Wetlands

Management of provincially sensitive ecosystems depends on the ecological value of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value rare riparian areas and wetlands in CPG have been mapped as those areas:

- In the RPDP or GPDP zones; OR
- Larger than 1ha; and
- Containing intact forest.

Area Summaries

There are 285 sites totaling 435 ha where rare riparian areas and wetlands dominate the ecological polygon. The area summaries of high and standard value ecosystems by designated areas in the OCP are provided below in Table 3.5.

Table 3.5: Rare Riparian Areas and Wetland Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	7	14.26	4	5.7	11	19.96
Agricultural Land Reserve	17	48.9	27	125.61	44	174.51
Existing/ Proposed Parks	17	33.7	7	5.45	24	39.15
Riparian Protection	30	62.79	9	2.55	39	65.34
Groundwater Protection	3	33.08	1	0.74	4	33.82
Landslide Hazard	4	2.69	82	18.52	86	21.21
Flood Hazard	0	0	12	8.36	12	8.36
Other - Rural Resources	2	0.1	20	9.74	22	9.84
Other - Rural Areas	0	0	11	37.81	11	37.81
Other - Proposed Urban	1	2.15	1	0.33	2	2.48
Other - Urban	3	0.34	27	22.03	30	22.37
Total	**84**	**198.01**	**201**	**236.84**	**285**	**434.85**

Areas designated as ALR in the OCP have the largest area of rare riparian forest and wetlands, about half of which have a high value. Most of the 39 hectares in existing parks have a high value. There are 65 hectares of rare riparian and wetlands already in areas designated as Riparian Protection. Determining the proximity of high value sites, in particular areas currently designated as ALR, adjacent to the existing protected areas would be useful to see what additions could be made to park space to improve protection of these ecosystems.

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with target buffers as follows:
   - Target buffers for wetlands:
     - A 150m buffer if found within intact forest areas or in rural resources areas;
     - A 100m buffer if found in rural areas; and
     - A 30m buffer if found in urban or proposed urban areas.
   - Target buffers for riparian areas:
     - A 60m buffer if found within intact forest areas, in rural resources areas or in rural areas; and
     - A 30m buffer if found in urban or proposed urban areas.
2. Maintain connectivity corridors between wetlands and riparian areas
3. Developments upstream or upslope of rare riparian areas or wetlands must not alter downstream hydrological characteristics
4. Remove invasive species found within 1km of these sites

Objective 2 – Manage standard value rare riparian and wetland areas based on OCP zone designations

Regardless of the particular zone a riparian area or wetland is found in, all activities need to be compliant with the different legislation that protects them. Legislation that applies to development in or near riparian areas and wetlands includes:

- Water Act;
- Fish Protection Act;
- Riparian Areas Regulation;
- Wildlife Act;
- Wildlife Amendment Act;
- Forest and Range Practices Act;
- Environmental Assessment Act;
- Environmental Management Act;
- Canada Fisheries Act;
- Canada Species at Risk Act; and
- Canada Migratory Birds Convention Act.

Best Management Practices:

1. Wildfire Interface DP areas:
   - Wetlands and riparian areas should remain as undisturbed as possible in the wildfire interface zone; and
   - Wildfire management upstream or within 100m upslope of a rare riparian area or wetland must not alter hydrological characteristics.
2. ALR:
   - Inform and educate ALC and, where applicable, the landowner about the presence of a rare ecosystem on property;
   - Maintain buffer of at least 30m between rare riparian areas / wetlands and agricultural activities;
   - Do not allow cattle to use these areas; and
   - Control spread of invasive species from agricultural areas into rare mature forest.
3. Parks and Proposed Parks:
   - Use these sites to educate the public about the ecological values of rare riparian areas and wetland ecosystems;
   - Actively remove invasive species from park area; and
   - Allow for natural successional pathways.
4. Riparian Protection:
   - These ecosystems contribute to wildlife corridors and fish habitat in riparian protection areas;
   - Maintain minimum 10m buffer no-development areas around these sites; and
   - Ensure adjacent development has appropriate soil and sediment control measures.
5. Groundwater Protection:
   - Follow guidelines for GPDP areas;
   - If new permanent structures are planned within GPDP, do not develop within 30m of rare riparian areas and wetlands; and
   - consider acquisition for new park.

6. Landslide Hazard Area:
   - Avoid developing areas prone to landslides that may affect the hydrology of local riparian areas and wetlands; and
   - Stabilize slumping areas with vegetation native to these ecosystems.
7. Flood Hazard Area:
   - Floods are an important component of rare riparian and wetland ecosystem succession; and
   - Allow natural flooding to occur in these areas.
8. Other Areas:
   - Maintain buffer of at least 30m between rare riparian areas / wetlands, and future development.

3.4.4 Rare Grasslands

Rare grasslands are usually quite small in size (often less than 1 hectare), are on steep slopes with coarse soils and are dominated by grasses.

3.4.4.1 Description

These grasslands occur on very steep slopes on coarse soils where not enough soil moisture is available for tree survival. Native grasses are sparse in sites within city limits and are now dominated by introduced grasses. Grasslands that are artificial such as areas planted with stabilizing grasses, or have minimal native vegetation are not considered rare grasslands. Two areas on the Nechako cutbanks have been identified as rare grasslands.

The site units include:

- SBSdw3/82;
- SBSmh/82; and
- SBSmk1/82.

3.4.4.2 Value

These grasslands often have high value for wildlife foraging as they are some of the first sites to lose snow and grasses and their seeds are high value forage. These ecosystems provide bank stability on steep slopes.

3.4.4.3 Risks

These sites are at low risk for development as they are on steep slopes. If they dry out further with climate change, the grass species on the sites will likely tolerate the drier conditions. Invasive species and erosion / slumping are their largest threat.

3.4.4.4 Management of Rare Grasslands

There are only 2 main sites in Prince George city limits that require management. There are several other sites west of Prince George that have a higher conservation value.

High Conservation Values

Both sites along the Nechako cutbanks are considered high value because of their rarity and status as red-listed.

Area Summaries

There are 7 sites totaling 11.09 ha where rare grassland ecosystems are an important component of the ecological polygon. The area summaries are provided below in Table 3.6.

Table 3.6: Rare Grasslands Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	0	0	0	0	0	0
Agricultural Land Reserve	0	0	0	0	0	0
Existing/ Proposed Parks	0	0	0	0	0	0
Riparian Protection	1	0.25	0	0	1	0.25
Groundwater Protection	0	0	0	0	0	0
Landslide Hazard	2	10.74	0	0	2	10.74
Flood Hazard	0	0	0	0	0	0
Other - Rural Resources	4	0.1	0	0	4	0.1
Other - Rural Areas	0	0	0	0	0	0
Other - Proposed Urban	0	0	0	0	0	0
Other - Urban	0	0	0	0	0	0
Total	**7**	**11.09**	**0**	**0**	**7**	**11.09**

Areas designated as Landslide Hazard comprise almost all the area in rare grassland and thus are protected from many developments. Maintaining them in a natural state and avoiding replacement with invasive and agronomic mixes for bank stabilization are the main considerations.

Objective – Maintain rare grasslands in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with a 100m no disturbance buffer;
2. Encourage the public to avoid these areas;
3. Stabilize slumping areas with vegetation native to these ecosystems;
4. Actively remove invasive species found on these sites; and
5. Support activities that will restore native grasses.

3.5 Locally Sensitive Ecosystems

Locally sensitive ecosystems include areas that are not considered at risk provincially but are locally important because they provide important wildlife habitat, they are adjacent to watercourses, or they are highly vulnerable to loss due to climate warming.

3.5.1 Sensitive Dry Forests

Locally sensitive dry forests are highly susceptible to the effects of climate warming, are often found in upper slope positions and are typically dominated by lodgepole pine.

3.5.1.1 Description

Sensitive dry forests are similar to rare dry forests but are more common on the landbase. These forests generally occur in upper to crest slope positions or on coarse textured level sites. Forest canopies are generally dominated by lodgepole pine with varying amounts of Douglas-fir and white spruce. Younger forest canopies often contain paper birch or trembling aspen. Common shrubs are soopolallie and velvet-leaved blueberry. Common herbs are kinnikinnick, prince's pine, and twinflower.

The site units include:

- SBSdw3/03 and SBSmk1/03;
- SBSdw3/04;
- SBSmk1/02; and
- SBSmk1/05.

SBSdw3/03 and SBSmk1/03 (Pl – Feathermoss – Cladina): This unit occurs in level or crest positions on coarse-textured upper fluvial or glaciofluvial benches. These low productivity forests are dominated by lodgepole pine and have an understory that contains soopolallie and kinnikinnick. Velvet-leaved blueberry can often be abundant. A carpet of feathermosses and reindeer lichens covers the forest floor.

SBSdw3/04 (SxwFd – Ricegrass): This unit generally occurs in mid to upper slopes on medium to coarse-textured soils. The canopy is often a mix of lodgepole pine, Douglas-fir and hybrid white spruce. Prickly rose often dominates the understory and soopolallie and prince's pine are indicative species for this unit.

SBSmk1/02 (Pl – Cladina – Step moss): This unit occurs on shallow soils associated with bedrock outcrops. These low productivity forests are dominated by lodgepole pine and have an understory that contains soopolallie and twinflower. A carpet of feathermosses and reindeer lichens covers the forest floor.

SBSmk1/05 (SxwFd – Toad-flax): This unit occurs in mid to upper slopes on medium to coarse-textured soils, often on warm aspects. The forest canopy is often a mix of lodgepole pine, hybrid white spruce and often Douglas-fir. The diverse moderately well-developed understory often includes black huckleberry, birch-leaved spirea, bunchberry and queen's cup.

3.5.1.2 Value

These forests often have high value for wildlife foraging as they are some of the first sites to lose snow and they are often open stands promoting growth of understory plants. They also often contain large Douglas-fir trees and snags which represent very high value wildlife trees.

When these sites occur along ridges they offer easy trail building as animals have already created a trail and there is little undergrowth and less logs to clear. They also offer good viewing as they tend to be above surrounding terrain. The rocky outcrops that occur in this unit are often picturesque with the combination of large Douglas-fir and rocky areas with rock garden plants such as stonecrop.

3.5.1.3 Risks

The greatest risk to these ecosystems is climate warming, as modelling suggests these areas will have high mortality over the next 50 years. Climate warming will reduce moisture availability on these sites causing drought related mortality of subalpine fir, white spruce, lodgepole pine and possibly Douglas-fir.

Clearcut harvesting is also a threat since tree removal will significantly reduce values associated with the large trees. Heavy use trails in these ecosystems can also reduce wildlife value, especially if dogs are allowed on the trails. These open ecosystems are susceptible to dry, weedy invasive species in the understory.

3.5.1.4 Management of Sensitive Dry Forests

Management of locally sensitive ecosystems depends on the ecological value of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value sensitive dry forests in CPG have been mapped as areas:

- Older than 80yrs;
- Larger than 2ha;
- Containing intact forest; and
- Fd leading.

Area Summaries

There are 439 sites totaling 421 ha where rare dry ecosystems are an important component of the ecological polygon. The area summaries of high and standard value rare dry ecosystems by designated areas in the OCP are provided below in Table 3.7.

Table 3.7: Sensitive Dry Forests Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	0	0	18	28.2	18	28.2
Agricultural Land Reserve	0	0	10	26.84	10	26.84
Existing/ Proposed Parks	2	0.75	24	51.79	26	52.54
Riparian Protection	0	0	20	7.49	20	7.49
Groundwater Protection	0	0	0	0	0	0
Landslide Hazard	3	4.72	208	129.11	211	133.83
Flood Hazard	0	0	0	0	0	0
Other - Rural Resources	8	0.3	79	88.29	87	88.59
Other - Rural Areas	0	0	28	28.7	28	28.7
Other - Proposed Urban	0	0	12	44.87	12	44.87
Other - Urban	0	0	27	10.76	27	10.76
Total	**13**	**5.77**	**426**	**416.05**	**439**	**421.82**

Areas designated as Landslide Hazard have the largest area of sensitive dry forests, a relatively small proportion of which is high value. There are 52 hectares in existing parks most of which is standard value. Efforts to plan for green space that include the 45 ha within proposed urban areas and 88 ha in rural resource areas would be beneficial for maintaining this sensitive ecosystem.

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible;
2. If this site is in a wildfire interface area, maintain live Douglas-fir component of stand; and
3. Remove invasive species from these sites.

Objective 2 – Manage standard value sensitive dry forests based on OCP zone designations

Best Management Practices:

1. Wildfire Interface DP areas:
   - Maintain live Douglas-fir component of stand where possible; and
   - Underplant with Douglas-fir or other drought-tolerant species.
2. ALR:
   - Sensitive dry forested ecosystems are poor potential agricultural areas;
   - Inform and educate the landowner about the presence of sensitive dry ecosystems on property and potential impacts from climate warming.
3. Parks and Proposed Parks:

- Use these sites to educate the public about the ecological values of dry ecosystems;
- Actively remove invasive species from park area; and
- Allow for natural successional pathways.

4. Riparian Protection:
   - Where these ecosystems are found within RPDP areas, they have increased value as they provide natural wildlife trails and habitat adjacent to riparian areas. Extend riparian setbacks to include this polygon.
5. Groundwater Protection:
   - There are no sensitive dry ecosystems within the Groundwater Protection areas of CPG.
6. Landslide Hazard Area:
   - Where forest health issues are prevalent, underplant these slopes with Douglas-fir; and
   - Stabilize slumping areas with drought resistant vegetation native to these ecosystems such as soopolallie, juniper and velvet-leaved blueberry.
7. Flood Hazard Area:
   - There are no sensitive dry ecosystems within the flood hazard area of CPG.
8. Other Areas:
   - Maintain live Douglas-fir where possible, especially advanced regeneration; and
   - Plan for removal of pine, spruce, etc when new diseases or pests attack these vulnerable trees.

3.5.2 Sensitive Dry Non-Forested Areas

In the Prince George area, sensitive dry non-forested ecosystems are primarily shrub-dominated, sparsely-vegetated or highly disturbed cutbanks.

3.5.2.1 Description

These ecosystems occur on very steep slopes on coarse soils where not enough soil moisture is available for tree survival. Native grasses are sparse in sites within city limits and are now dominated by introduced grasses and shrubs. Grasslands that are artificial such as areas planted with stabilizing grasses, or have minimal native vegetation are included in this ecosystem type. These areas are considered sensitive because they are rare on the landbase and provide potential areas that could be restored to a more natural state.

3.5.2.2 Value

These areas often have high value for wildlife foraging as they are some of the first sites to lose snow and remaining grasses and their seeds are high value forage. These ecosystems provide bank stability on steep slopes.

3.5.2.3 Risks

These sites are at low risk for development as they are on steep slopes. The biggest risk to these areas is further soil movement down the cutbanks. As they are primarily either anthropogenic or sparsely-vegetated ecosystems, there is little risk of further ecological degradation.

3.5.2.4 Management of Sensitive Dry Non-forested Areas

These sites in the Prince George area should be managed similar to the rare grasslands as they could potentially develop into or be restored to a natural grassland state.

High Conservation Values

All sensitive dry non-forested ecosystems are considered a high conservation value.

Area Summaries

There are 40 sites totaling 14.54 ha where sensitive dry non-forested ecosystems are an important component of the ecological polygon. The area summaries are provided below in Table 3.8.

Table 3.8: Sensitive Dry Non-Forested Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	11	0.58	0	0	11	0.58
Agricultural Land Reserve	5	4.31	0	0	5	4.31
Existing/ Proposed Parks	4	7.2	0	0	4	7.2
Riparian Protection	4	0.28	0	0	4	0.28
Groundwater Protection	0	0	0	0	0	0
Landslide Hazard	9	2.17	0	0	9	2.17
Flood Hazard	0	0	0	0	0	0
Other - Rural Resources	2	0	0	0	2	0
Other - Rural Areas	0	0	0	0	0	0
Other - Proposed Urban	0	0	0	0	0	0
Other - Urban	5	0	0	0	5	0
Total	**40**	**14.54**	**0**	**0**	**40**	**14.54**

Almost all the area of this ecosystem is contained in areas designated as Parks or Landslide Hazard and therefore should be fairly well protected. Using native species for bank stabilization is likely the most important consideration.

Objective – Maintain sensitive non-forested areas in a natural state

Best Management Practices:

1. Stabilize slumping areas with vegetation native to these ecosystems;
2. Actively remove invasive species found on these sites;
3. Support activities that will restore native grasses; and
4. Plan to restore portions of these ecosystems into natural grasslands over time.

3.5.3 Sensitive Riparian Areas and Wetlands

Locally sensitive riparian forests and wetlands are either long linear ecosystems around water courses or small, very wet ecosystems occurring on poorly drained soils.

3.5.3.1 Description

These are relatively common ecosystems occurring along water courses (riparian areas) or in depressions with poorly drained soils (wetlands). The riparian forests occur on lower to toe slopes associated with major and minor drainages. Older riparian stands are usually dominated by white spruce while black cottonwood often dominates younger stands. The understory of the lower slope riparian forests is dominated by oak fern, horsetail and devil's club. Wetlands are either located on lower fluvial benches along rivers or in swampy depressions. Willows and mountain alder may dominate these sites.

The main SITE units include:

- Riparian Areas:
  - SBSdw3/08;
  - SBSmk1/08;
  - SBSdw3/09 and SBSmk1/09.

- Wetlands (all zones)
  - Fl06;
  - Wb01, Wb05; and
  - Wf01, Wf02, Wf04, Wf06.

SBSdw3/08 (Sxw – Oakfern): This unit occurs on lower to toe slopes, often adjacent to small streams and on north aspects. These high productivity forests are dominated by hybrid white spruce and subalpine fir. Highbush-cranberry and black twinberry often dominate the shrub layer and a carpet of oakfern covers the forest floor.

SBSmk1/08 (Sxw – Devil's club): This unit occurs at the toe of long seepage slopes or near streams. These open, highly productive forests are generally a mix of hybrid white spruce and subalpine fir. Devil's club dominates the shrub layer.

SBSdw3/09 and SBSmk1/09 (Sxw – Horsetail): This unit occurs on level areas that are influenced by a water table. They can be extensive on fluvial benches along the Nechako or Fraser Rivers. These open, highly productive forests are generally a mix of hybrid white spruce, subalpine fir and black cottonwood. The well-developed diverse shrub layer usually contains black twinberry and red-osier dogwood, and horsetails often cover the forest floor.

Fl06 (Sandbar Willow): This unit occurs adjacent to the Nechako and Fraser Rivers on sandbars that are generally flooded each year. Sandbar willow may be the only species present but upper benches above the river sites may contain mountain alder and black cottonwood.

Wb01 (Sb – Creeping snowberry – Peat-moss bog): This unit occurs in closed basins with little groundwater influence. These open black spruce forests have a well-developed shrub layer dominated by Labrador tea and the herb layer generally contains creeping snowberry and bog cranberry. The forest floor is covered with a mix of feathermosses and peat mosses.

Wb05 (Sb – Water sedge – Peat-moss bog): This unit occurs in small closed basins with some groundwater influence. These open black spruce forests have a well-developed shrub layer dominated by Labrador tea and scrub birch and the herb layer generally contains water sedge. The forest floor is covered with a mix of feathermosses, glow moss, and peat mosses.

Wf01 (Water sedge – Beaked sedge fen): This unit occurs in gently sloping depressions, often adjacent to bogs and where there is slow groundwater movement. These non-forested wetlands are dominated by water sedge and beaked sedge.

Wf02 (Scrub birch – Water sedge fen): This unit occurs in gently sloping depressions often adjacent to bogs and where there is some water table fluctuation. These non-forested wetlands are often hummocky and are dominated by scrub birch and water sedge.

Wf04 (Barclay's Willow –Water Sedge – Glow moss fen): This unit occurs in frost prone depressions along streams or adjacent to fens. These non-forested wetlands are often hummocky and are dominated by scrub birch and water sedge.

Wf06 (Slender Sedge - Buckbean Fen): This unit occurs on floating mats adjacent to small lakes. Slender sedge and mosses occur on hummocks while buckbean occurs in depressions.

3.5.3.2 Value

Functioning riparian areas and wetlands improve the quality of local water and can provide natural stormwater management by slowing down and storing large volumes of excess water. Riparian forests and wetlands provide important habitat and corridors for animal movement. The riparian forests often contain high value wildlife trees, particularly large black cottonwood. Large mammals including bears will use these trees and they also provide important bird and bat habitat. The riparian forests are shrub rich and contain high value browse such as red-osier dogwood. The wetlands provide key habitat for moose. Trails are common in the riparian forests and lower bench fluvial wetlands as they provide access to the water and views of the rivers (e.g., Cottonwood Island Park).

3.5.3.3 Risks

The greatest risk for riparian forests is land clearing for development, especially when the forests are above the normal flood zone. The greatest risk to wetlands is alteration of the water flow and pollution from upstream developments. Minor changes in hydrology put the entire wetland at risk of being irreparably damaged. Heavy use trails will also reduce wildlife value especially if dogs are allowed on the trails. If water tables drop as a result of climate change the riparian forests and wetlands may be at risk due to drought impacts

3.5.3.4 Management of Sensitive Riparian Areas and Wetlands

Management of locally sensitive ecosystems depends on the ecological value of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value sensitive riparian areas and wetlands in CPG have been mapped as those areas:

- In the RPDP or GPDP zones; or
- Larger than 1ha; and
- Containing intact forest.

Area Summaries

There are 8808 sites totaling 7360 ha where rare riparian areas and wetlands dominate the ecological polygon. The area summaries of high and standard ecosystems by designated areas in the OCP are provided below in Table 3.9.

Table 3.9: Sensitive Riparian Areas and Wetland Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	128	43.35	258	90.7	386	134.05
Agricultural Land Reserve	173	778.51	446	1155.6	619	1934.11
Existing/ Proposed Parks	163	245.79	200	139.76	363	385.55
Riparian Protection	163	1920.84	45	12.16	208	1933
Groundwater Protection	8	5.43	5	0.71	13	6.14
Landslide Hazard	913	410.99	2629	830.47	3542	1241.46
Flood Hazard	2	0	46	78.1	48	78.1
Other - Rural Resources	571	227.93	1514	640.68	2085	868.61
Other - Rural Areas	15	11	253	182.38	268	193.38
Other - Proposed Urban	92	86.14	347	199.26	439	285.4
Other - Urban	51	7.33	786	293.42	837	300.75
Total	**2279**	**3737.31**	**6529**	**3623.24**	**8808**	**7360.55**

There is a considerable amount of sensitive riparian and wetland areas that have some form of protection in areas designated as Parks and Riparian Protection, much of which is high value. Maintaining areas in other designations (e.g., ALR or Rural Resources) that provide continuous corridors or widening of existing corridors is an important planning consideration.

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with target buffers as follows:
- Target buffers for wetlands:
    - a 150m buffer if found within intact forest areas or in rural resources areas;
    - a 100m buffer if found in rural areas; and
    - a 30m buffer if found in urban or proposed urban areas.
- Target buffers for riparian areas:
    - a 60m buffer if found within intact forest areas, in rural resources areas or in rural areas; and
    - a 30m buffer if found in urban or proposed urban areas.
2. Maintain connectivity corridors between wetlands and riparian areas;
3. Developments upstream or upslope of rare riparian areas or wetlands must not alter downstream hydrological characteristics; and
4. Remove invasive species found within 1km of these sites.

Objective 2 – Manage standard value sensitive riparian and wetland areas based on OCP zone designations

Best Management Practices:

Regardless of the particular zone a riparian area or wetland is found in, all activities need to be compliant with the different legislation that protects them. Legislation that applies to development in or near riparian areas and wetlands includes:

- Water Act;
- Fish Protection Act;
- Riparian Areas Regulation;
- Wildlife Act;
- Wildlife Amendment Act;
- Forest and Range Practices Act;
- Environmental Assessment Act;
- Environmental Management Act;
- Canada Fisheries Act;
- Canada Species at Risk Act; and
- Canada Migratory Birds Convention Act.

1. Wildfire Interface DP areas:
   - Wetlands and riparian areas should remain as undisturbed as possible in the wildfire interface zone; and
   - Wildfire management upstream should have soil and sediment controls identified in plan.
2. ALR:
   - Inform and educate the landowner about the values of riparian areas;
   - Control spread of invasive species from agricultural areas into riparian areas and wetlands; and
   - Follow ALR / urban development best management practices for riparian areas
3. Parks and Proposed Parks:
   - Use these sites to educate the public about the ecological values of riparian areas and wetlands;
   - Actively remove invasive species from park area; and
   - Allow for natural successional pathways.
4. Riparian Protection:
   - Maintain wildlife corridors along entire length of riparian and wetland network;
   - Maintain minimum 30m buffer no-development areas around these sites; and
   - Ensure adjacent development has appropriate soil and sediment control measures.
5. Groundwater Protection:
   - Follow guidelines for GPDP areas;
   - If new permanent structures are planned within GPDP, do not develop within 30m of sensitive riparian areas and wetlands; and
   - Consider acquisition for new park.
6. Landslide Hazard Area:
   - Avoid developing areas prone to landslides that may affect the hydrology of local riparian areas and wetlands; and
   - Stabilize slumping areas with vegetation native to these ecosystems.
7. Flood Hazard Area:
   - Floods are an important component of sensitive riparian and wetland ecosystem succession; and
   - Allow natural flooding to occur in these areas.
8. Other Areas:
   - Maintain buffer of at least 30m between sensitive riparian areas / wetlands, and future development.

3.5.4 Sensitive Old Forests

Locally sensitive old forests are areas where the trees are generally older than 100yrs and the stand has a typical moisture regime (not very dry or wet).

3.5.4.1 Description

These are forests that have a complex structure due to old deciduous / seral species or mature to old coniferous / climax species. Unlike provincially sensitive forests, these ecosystem units are not rare on the broader landscape, even though the old forest condition of the unit may be locally uncommon. They occur where the site and soil conditions result in only short moisture deficits during the growing season.

The site units include:

- SBSdw3/01;
- SBSdw3/07;
- SBSmk1/01;
- SBSmk1/06; and
- SBSmk1/07.

SBSdw3/01 (SxwFd – Pinegrass): This unit occurs in mid to lower or cool upper slope positions on a wide variety of soil types. The canopy is often a mix of lodgepole pine, Douglas-fir and hybrid white spruce. Prickly rose and birch-leaved spirea often dominate the understory. Thimbleberry and queen's cup are indicative species of this unit. A carpet of red-stemmed feathermoss covers the forest floor.

SBSdw3/07 (Sxw – Twinberry): This unit generally occurs on level or gentle cool slopes on lake deposited soils. The canopy is often a mix of hybrid white spruce and trembling aspen. Black twinberry and highbush-cranberry often dominates the well-developed understory and palmate coltsfoot typifies the herb layer. A carpet of feathermosses covers the forest floor.

SBSmk1/01 (Sxw – Huckleberry – Highbush-cranberry): This unit generally occurs in mid slope positions on medium to moderately-coarse soils. The canopy is often a mix of lodgepole pine and hybrid white spruce with occasional subalpine fir. Thimbleberry and black huckleberry often dominate the understory. Queen's cup and a low cover of oakfern typify the herb layer. A carpet of feathermosses covers the forest floor.

SBSmk1/06 (Sb – Huckleberry – Spirea): This unit occurs on compact glacial or lake deposited soils on level or gentle cool slopes. These low productivity forests are dominated by lodgepole pine, with a subcanopy of black spruce. Black huckleberry and black twinberry are common in the understory. Dwarf blueberry and bastard toad-flax typify the herb layer and the forest floor is carpeted with feathermosses.

SBSmk1/07 (Sxw – Oakfern): This unit occurs in mid to toe slopes on a variety of soil types. The canopy is dominated by hybrid white spruce and subalpine fir. Black twinberry and highbush-cranberry often dominate the well-developed understory and oakfern typifies the herb layer. A carpet of feathermosses covers the forest floor.

3.5.4.2 Value

Old forests contain trees, snags, and logs which have high wildlife value for foraging, protection from predators and nesting/denning sites. These stands are critical for many species at risk and are sensitive because they are becoming less common on the landbase due to anthropogenic disturbances, wildfires and forest disease / pest outbreaks. Old forests often contain trees that have high aesthetic value. Due to the lower risk from climate change impacts and the presence of large trees, these forests represent important carbon sinks.

3.5.4.3 Risks

The greatest risks are land clearing and over-harvesting. Sustainable harvesting of these ecosystems allows the forest to recover to its original old forest condition over time. Heavy use trails can also reduce wildlife value especially if dogs are allowed on the trails. Drought risk due to climate change is moderate to low on these sites.

3.5.4.4 Management of Sensitive Old Forests

Management of locally sensitive old forests depends on the ecological value of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value old forests in CPG have been mapped as those areas:

- Containing intact forest.

Area Summaries

There are 6184 sites totaling 4286 ha where old forests dominate the ecological polygon. The area summaries of high and standard ecosystems by designated areas in the OCP are provided below.

Table 3.10: Sensitive Old Forests Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	29	5.23	120	75.6	149	80.83
Agricultural Land Reserve	160	343.49	323	575.79	483	919.28
Existing/ Proposed Parks	25	32.13	92	167.55	117	199.68
Riparian Protection	96	29.32	290	101.39	386	130.71
Groundwater Protection	0	0	7	3.52	7	3.52
Landslide Hazard	745	303.02	1525	646.28	2270	949.3
Flood Hazard	3	1.34	18	18.72	21	20.06
Other - Rural Resources	607	322.7	1146	869.82	1753	1192.52
Other - Rural Areas	17	23.02	167	275.49	184	298.51
Other - Proposed Urban	73	124.18	180	199.04	253	323.22
Other - Urban	81	19.88	480	148.64	561	168.52
Total	**1836**	**1204.3**	**4348**	**3081.84**	**6184**	**4286.15**

Areas designated as Rural Resources, Landslide Hazard, and ALR in the OCP have the largest areas of sensitive old forests, a relatively high proportion of which is high value. There are 200 ha in existing parks that is generally standard value. Attempting to secure additional park area that would include some of the high value sites from lands in other designations as above would be an important planning consideration. Efforts to plan green space that includes some of the 124 ha within proposed urban areas would be beneficial for maintaining sensitive old forests.

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with a 100m no disturbance buffer;
2. Sites over 250yrs old should be considered for a new park or protected area; and
3. Remove invasive species found within 1km of these sites.

Objective 2 – Manage standard value sensitive mature forests based on OCP zone designations

Best Management Practices:

1. Wildfire Interface DP areas:
   - Follow all guidelines in 'The Home Owners Fire Smart Manual.
2. ALR:
   - Inform and educate the landowner about the presence of valuable old growth forest on property;
   - Avoid converting forests over 100 yrs old to agricultural land where possible; and

- Control spread of invasive species from agricultural areas into old forest.

3. Parks and Proposed Parks:
   - Use these sites to educate the public about the ecological values of old growth forested ecosystems;
   - Actively remove invasive species from park area; and
   - Allow for natural successional pathways.
4. All other areas:
   - Wherever possible, retain healthy veteran trees; and
   - Use these areas to buffer high conservation value ecosystems.

3.6 Common Ecosystems

Common ecosystems are not considered at risk provincially or locally. They provide habitat to numerous wildlife species and are especially important in areas where they provide connectivity between rare or sensitive ecosystems.

3.6.1 Description

These forests occur in a variety of slope positions and on a variety of soil types. They are the most common forests and agricultural areas within and adjacent to the City.

3.6.2 Value

Common ecosystems in the CPG area provide wildlife habitat for common and uncommon species, and provide for many recreational opportunities for residents.

3.6.3 Risks

High conservation value areas provide important wildlife corridors and habitat within city limits. They are at risk from land clearing and over-harvesting. Drought risk due to climate change is moderate to low on these sites. Sustainable harvesting of these ecosystems allows the forest to recover to its original old forest condition over time.

3.6.4 Management of Common Ecosystems

Management of common ecosystems depends on the intactness of each individual occurrence of that ecosystem on the landbase.

High Conservation Values

High conservation value common ecosystems in CPG have been mapped as those areas that:

- Contain intact forest; and
- Are greater than 10ha.

Area Summaries

There are 18,316 sites totaling 17,591 ha where common ecosystems and urban areas dominate the polygon. These account for just over half of the CPG area. The area summaries of high and standard values by designated areas in the OCP are provided below. 850 hectares of common ecosystems are considered high conservation value.

Table 3.11: Common Forests Area Summaries

Designated Area in OCP	High Value		Standard Value		Total	
	# Sites	Hectares	# Sites	Hectares	# Sites	Hectares
Wildfire Interface	35	38.51	733	461.9	768	500.41
Agricultural Land Reserve	11	119.44	881	2817.73	892	2937.17
Existing/ Proposed Parks	20	73.99	1127	1026.23	1147	1100.22
Riparian Protection	26	22.53	872	528.33	898	550.86
Groundwater Protection	0	0	53	257.3	53	257.3
Landslide Hazard	329	269.4	6938	1790.95	7267	2060.35
Flood Hazard	0	0	119	485.74	119	485.74
Other - Rural Resources	215	221.22	3342	1867.67	3557	2088.89
Other - Rural Areas	4	3.12	806	1564.37	810	1567.49
Other - Proposed Urban	30	93.43	721	933.13	751	1026.56
Other - Urban	19	8.36	2035	5007.47	2054	5015.83
Total	**689**	**850**	**17627**	**16740.82**	**18316**	**17590.82**

Objective 1 – Maintain high conservation value areas in a natural state

Best Management Practices:

1. These sites should remain as undisturbed as possible, with a 50m no disturbance buffer; and
2. Sites over 250yrs old should be considered for a new park or protected area.

3.7 Monitoring Framework

There are several statements in the 2011 draft OCP (CPG, 2011) concerning the environment that summarize the importance of the environment to resident of Prince George. The Environment section of the OCP starts with the following declarations:

- "Residents continue to express the great value of the natural environment";
- "This strong sense of stewardship and desire to protect the environment has been identified"; and
- "The City of Prince George is committed to a community approach to maintaining a healthy environment."

Monitoring the effects of climate change and the impacts of best management practices on the structure, composition and function of natural areas over time is clearly important to meet the various OCP objectives concerning the environment.

Prior to developing a monitoring framework, it is important to identify what type of monitoring is being completed and the objectives of the monitoring plan. There are several forms of monitoring that are typically undertaken for ecological diversity and health of ecosystems. The appropriate type and level of monitoring should be selected based on several factors including the project area, management objectives, biotic and abiotic risk factors, and general management practices being used in the area. Typical forms of monitoring include:

The following descriptions of the monitoring types are based on Chapter 9 of Noss and Cooperrider (1994):

- **Compliance monitoring** is used to evaluate if legislation, regulations, regional standards or other legislated requirements are being followed. For example, the Province of BC designates areas that are to be protected from resource extraction, and compliance monitoring is used to ensure that particular area does not have any development occurring within its boundaries;

- **Implementation monitoring** is used to evaluate if specific best management practices are being carried out across the landbase. This type of monitoring evaluates the extent to which non-legally binding actions are undertaken;

- **Effectiveness monitoring** is used to evaluate if the objectives of particular management decisions are being met. Effectiveness monitoring evaluates whether management decisions are impacting the actual values that are being managed; and

- **Validation monitoring** is used to evaluate whether there is a link between specific management practices and the overall results of ecological conservation. For example, if effectiveness monitoring determines that a

wildlife population is declining, validation monitoring may evaluate whether this decline is resulting from forest management, access management, wildlife harvesting management, etc.

Compliance and implementation monitoring is typically completed through everyday processes within the context of a municipality. For example, a development permit will not be issued until the developer has satisfied the city that they have met all legal requirements and have incorporated best management practices into their development.

Therefore, effectiveness monitoring of legislated requirements and best management practices for environment values is an appropriate form of monitoring natural areas in Prince George over time.

It should be noted that monitoring individual species in a small area such as Prince George is not considered appropriate because the city itself is not expected to have a significant effect on landscape-level population dynamics of most species. However, species' habitat and the natural areas found within the city boundaries are still used by many species and are appropriate to be monitored over time.

A network of permanent sample plots would be very useful for monitoring the effects of climate change on the natural areas. There are no permanent sample plots set up by the city; however, CPG should consider working with UNBC and perhaps some volunteer naturalist groups to establish and monitor the vegetation, water and wildlife throughout the city. By collecting data on a regular basis, steps can be taken to maintain the overall health of the most sensitive areas. Should the city decide to move toward having a network of sample plots to monitor over time, the monitoring plan presented here should be updated to include the results of field monitoring changes in native and introduced vegetation, forest health outbreaks and changes in hydrological characteristics.

The general landscape level values to monitor are captured in the OCP in the existing Environment Strategy for Open Space. Several environmental values are identified in the OCP; however, the following 3 values have been identified for protection in the OCP and are the most relevant landscape values that require monitoring in the face of climate change and municipal development:

- Environmentally sensitive areas;
- Key wildlife habitat; and
- Riparian areas.

The objective of this monitoring plan is to monitor if the best management practices for natural areas are effective in maintaining an appropriate structure, composition and function of environmentally sensitive areas, key wildlife habitat, and riparian areas.

The monitoring framework for each of these landscape values is designed as follows:

1. Value Description;
2. State Objective;
3. Indicators;

- Sensitivity to climate change;
- 2012 Baseline Data;

4. Targets; and
5. Schedule Future Monitoring Activities.

Areas that have multiple values (for example, a sensitive area that is also key wildlife habitat) are monitored under each relevant value.

3.7.1 Value 1 – Environmentally Sensitive Areas

3.7.1.1 Value Description

For the purposes of the monitoring plan, environmentally sensitive areas (ESA's) are all rare ecosystems (provincially sensitive) identified as having a high conservation value. In addition, ESA's include other high conservation value areas most at risk due to climate change, including sensitive dry forests and sensitive dry non-forested ecosystems. High conservation value areas are defined in section 3 of this report. Over time, some standard value environmentally sensitive areas can be restored back to high conservation value areas.

3.7.1.2 Objective

The objective is to have no net-loss of high conservation value environmentally sensitive areas in the City of Prince George.

3.7.1.3 Indicator 1.1: Number of hectares of high conservation value ESA's

Sensitivity to Climate Change

As climate change and city development effects ESA's, some of the high value areas may be disturbed and reduced to standard value, or destroyed through catastrophic events. Following the BMP's and assessing the status of the ESA's on a regular schedule allows for the city to evaluate whether the existing ESA's are being maintained on the landbase.

Baseline Data

Using the high conservation value simplified ecosystem map, there are 431 ha of land that meet the criteria for high conservation value environmentally sensitive area. Fewer than 12% of all environmentally sensitive areas have a high conservation value. The breakdown of the areas by ecosystem is as follows:

Table 3.12: Area Summary of High Conservation Value ESA's

Simplified Ecosystem	Total Area (ha)	High Value Areas (ha)	Standard Value Areas (ha)	% of Ecosystem in High Conservation Value
Rare Dry Forest	585.7	86.09	499.61	14.70%
Rare Grasslands	11.09	11.09	0	100.00%
Rare Mature Forests	2235.06	115.26	2119.8	5.16%
Rare Riparian Areas	434.84	198.02	236.82	45.54%
Sensitive Dry Forests	421.84	5.78	416.06	1.37%
Sensitive Dry Non-Forested Ecosystems	14.54	14.54	0	100.00%
Total	**3703.07**	**430.78**	**3272.29**	**11.63%**

There are 3,272.29 hectares of additional land that can be managed using the BMP's presented in the management plan that could potentially provide more high conservation value environmentally sensitive areas over time.

Targets

To effectively maintain the natural function of the different environmentally sensitive areas, the City of Prince George should attempt to keep at least 430ha of environmentally sensitive areas in a natural, intact state and allowing for normal successional pathways to occur. When existing areas are permanently lost due to unavoidable development or catastrophic biotic / abiotic events, other areas with similar ecosystems that have reduced conservation value should be considered for restoration. The target of 430ha equals just over 1% of the landbase of Prince George to be maintained in a high conservation value.

3.7.1.4 Indicator 1.2: The Number of Hectares of ESA's Protected in Parks

Sensitivity to Climate Change

The number of sites protected in Parks is not affected by climate change but rather long term policy of the city.

Baseline Data

Using the simplified ecosystem map and existing parks and protected areas coverage from the 2011 OCP, there are 6.42% of ESA's currently protected. This is equivalent to approximately 238ha of ESA's found in parks. The breakdown of the areas by ecosystem is as follows:

Table 3.13: Area summary of ESA's protected in parks

Simplified Ecosystem	Total Area (ha)	Total Area in Parks (ha)	% of ESA's in Parks
Rare Dry Forest	585.7	45.33	7.74%
Rare Grasslands	11.09	0	0.00%
Rare Mature Forests	2235.06	93.36	4.18%
Rare Riparian Areas	434.84	39.15	9.00%
Sensitive Dry Forests	421.84	52.54	12.45%
Sensitive Dry Non-Forested Ecosystems	14.54	7.2	49.52%
Total	**3703.07**	**237.58**	**6.42%**

Targets

The City of Prince George should use 238ha as the minimum target for protection of ESA's, and work toward protecting additional areas in the future, especially high conservation value ESA's.

3.7.1.5 Future Monitoring Activities

On an annual or bi-annual schedule, these indicators should be monitored taking the following steps:

1. Update Parks and Protected Areas Map; and
2. Complete area summaries of ESA's found within the parks.

3.7.2 Value 2 – Key Wildlife Habitat

3.7.2.1 Value Description

For the purposes of the monitoring plan, key wildlife habitat includes those areas with sensitive old forests. These are high value because they contain intact old growth forest required by many species that require the structure and composition of old forests for their life activities. In addition, key wildlife habitat includes all sensitive dry forests and common Douglas-fir forests over 80 years old, as these areas provide important winter habitat for many ungulates and other wildlife species. Intact high value riparian areas (provincially or locally sensitive) are also included as key wildlife habitat as they are critical areas used by many wildlife species for a variety of reasons.

Additional wildlife corridors have not been mapped in Prince George but these areas should also be considered key wildlife habitat when that mapping is available.

3.7.2.2 Objective

The objective is to have no net-loss of key wildlife habitat in the City of Prince George.

3.7.2.3 Indicator 2.1: The number of hectares of key wildlife habitat

Sensitivity to Climate Change

Over time, some of the key wildlife habitat that exists today may be disturbed or destroyed by pest or pathogen outbreaks, wildfire, invasive species, or other disturbance agents fueled in part by climate change. Other areas that today are young or recently disturbed may contribute to key wildlife habitat in the future.

Baseline Data

Using the VRI maps and the simplified ecosystem map, there are 6316 hectares of key wildlife habitat. The breakdown of these hectares is as follows:

Table 3.14: Area Summary of Key Wildlife Habitat

Selection	Areas (ha)
Sensitive Dry Forests over 80yrs	216
Common Douglas Fir over 80yrs	145
Sensitive Old Forest	4,286
Intact Forest with Locally Sensitive Riparian Areas and Wetlands	1,617
Intact Forest with Provincially Sensitive Riparian Areas and Wetlands	52
Total	**6,316**

Targets

Key wildlife habitat should remain within 10% of 2012 values if existing wildlife values are to be maintained over time. If large scale catastrophic events occur within city limits to key habitat, plans should be developed to restore or improve the condition of younger or poorer condition wildlife habitat. By updating disturbance layers and inventory data on a regular schedule, the city can monitor how much key wildlife habitat is present within city limits and adapt their natural areas management plans as required.

3.7.2.4 Future Monitoring Activities

On an annual or bi-annual schedule, this indicator should be monitored taking the following steps:

1. Project age of forests forward to current year;
2. Update disturbances on landbase including major invasive species outbreaks;
3. Process intact forest layer with new disturbances;
4. Process high conservation value map with new intact forest maps and new ages;
5. Complete critical corridor mapping for inclusion as key wildlife habitat; and
6. Complete area summaries of key wildlife areas.

3.7.3 Value 3 – Riparian Areas

3.7.3.1 Value Description

For the purposes of the monitoring plan, riparian areas include all rare and sensitive riparian areas found on the simplified ecosystem map.

3.7.3.2 Objective

The objective is to protect the features, function and condition of streams and wetlands. This is an ecological value that would benefit from having a field based monitoring program that tests water quality, soil stability and vegetation changes.

3.7.3.3 Indicator 3.1: The percentage of new development with appropriate setbacks from streams and wetlands

Sensitivity to Climate Change

Maintaining natural riparian areas is critical for these ecosystems to be resilient to the effects of climate change. This indicator evaluates monitors how natural riparian areas are maintained over time. Until field monitoring is an option within the city, this indicator assumes that natural riparian areas are more resilient than those areas altered by development and permanent structures.

Baseline Data

CPG requires developers to obtain a Riparian Protection Development Permit in particular areas (primarily fish-bearing streams) of the city. This indicator should be tracked starting with new developments from 2012 forward.

Targets

Ideally, all developments that affect riparian areas, streams and wetlands will have setbacks as described in the BMP's for riparian areas.

3.7.3.4 Future Monitoring Activities

On an annual or schedule, this indicator should be monitored taking the following steps:

1. Identify new developments (including harvesting) on the riparian areas map; and
2. Assess how many of these developments have identified a setback from the riparian areas in their permit papers.

4 RECOMMENDATIONS

4.1 Update SEI Maps

The original SEI maps created in phase 1 do not include many of the sensitive ecosystems later identified through phase 2 and 3 of this project. The high conservation value ecosystem maps and the simplified ecosystem maps should be used to create an all-inclusive sensitive ecosystem inventory, completed to RISC 2006 standards. This product would be more complete if the SEI were updated after a wildlife corridor map was completed (see 4.5).

4.2 Update climate change models with new sensitive ecosystem map

The climate change models (phase 2) were completed prior to the creation of the new simplified ecosystem inventory. As a result, the polygons are not consistent between the two products. In addition, several hundred new polygons were created to enhance the TEM and SEI products after phase 2 had already been completed. To make the climate change mapping linework match the sensitive ecosystem inventory, updating the phase 2 models using the simplified ecosystem data is strongly recommended.

4.3 Inventory Updates

The VRI completed for CPG is now several years old and may no longer be up to date. If CPG does not have an accurate inventory update process, the VRI should be updated in the next couple of years. Some polygons in this project may be incorrectly classified due to missing our outdated inventory data and these errors will be compounded throughout the modeling and management plans if they are not updated. For example, if there is no species or age in the inventory, we defaulted these polygons to common non-forested areas, even though it could be something else entirely. Accurate base inventories (VRI, TEM and TRIM) are critical for modeling purposes.

4.4 Network of Permanent Sample Plots

A network of permanent sample plots would be very useful for monitoring the effects of climate change on the natural areas. There are no permanent sample plots set up by the city; however, CPG should consider working with UNBC and perhaps some volunteer naturalist groups to establish and monitor the vegetation, water and wildlife throughout the city. By collecting data on a regular basis, steps can be taken to maintain the overall health of the most sensitive areas. Should the city decide to move toward having a network of sample plots to monitor over time, the monitoring plan presented here should be updated to include the results of field monitoring changes in native and introduced vegetation, forest health outbreaks and changes in hydrological characteristics.

4.5 Wildlife Corridor Mapping

CPG should consider completing wildlife corridor mapping using the simplified ecosystem data and VRI as a base. Wildlife corridors have not been captured as 'high value' ecosystems because that mapping is not available yet. Once that mapping is completed, the most critical corridors could be added as high conservation areas and make the city's sensitive ecosystem layers more complete.

4.6 Forest Health Mapping

The Mountain Pine Beetle outbreak over the past decade helped demonstrate the importance of updated forest health mapping. Understanding where endemic populations of other forest pests and pathogens allow city managers to make faster, informed decisions to prevent further epidemic outbreaks. The City of Prince George should continue to work closely with MFLNRO and MOE to determine what mapping products are currently available within city limits and how to improve those products to a scale suitable for municipal planning.

4.7 Carbon Budget Modelling

On a global level, climate change has been increasingly recognized as a significant concern. The human contribution to climate change is embodied by our impact on the atmosphere's greenhouse gasses (GHG), such as carbon. The city's forested landbase and its management influence large carbon pools, which should be considered in making management decisions. The Carbon Budget Model of the Canadian Forest Service (CBM-CFS3) can be used to understand the amount of carbon currently stored and how the various carbon pools will change over time, considering factors such as tree growth and disturbances. Initially this provides an understanding how current management decisions impact forest carbon pools, but can evolve to having forest carbon considered as part of the decision making process. Furthermore, this approach provides a strong foundation for developing forest carbon offset, which may be of interest to the city.

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