Protected Areas Gap Analysis – Phase 1 Report

(North East Alberta & North West Saskatchewan)

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1.0 Summary

The boreal forest is an iconic and expansive ecological presence in Canada. It is rich in biodiversity, it holds important cultural values for Indigenous peoples, and it provides a suite of resources and economic values for society.

Implementation of a Conservation Matrix Model (CMM) framework approach is important to maintain biodiversity and ecosystem services in our boreal forest (Schmiegelow et al. 2014). Implementation of this approach includes the application of responsible forest management practices and incorporation at a landscape level of a conservation areas network (protected areas and other effective area-based conservation measures). This is the view of many including the Forest Stewardship Council® (FSC®), an international not-for-profit organization formed in 1993 to establish voluntary standards of practise for forestry companies and inform consumers about responsible forest management practices globally. FSC® -certified companies Alberta-Pacific Forest Industries Inc. (Al-Pac) and Mistik Management Ltd. (Mistik) share this vision and have committed to continuing this practice through the implementation of a suite of responsible forest management practices, including the identification and protection of important native ecosystems in the areas where they operate.

In the fall of 2017, Al-Pac and Mistik initiated a project to advance implementation of the Conservation Matrix Model through an update to their respective protected areas gap analyses. The project team, made up of representatives from Al-Pac, Mistik, the Canadian Parks and Wilderness Society's Northern Alberta and Saskatchewan Chapters, Ducks Unlimited Canada; and project management by Kris McCleary Consulting, devised a work plan for a multi-phased project to assess the amount of, and representativeness within, the current protected areas network in northeast Alberta and northwest Saskatchewan.

The goal of Phase 1 was to assess the existing conservation areas network in, and around, the Al-Pac and Mistik forest management agreement areas and identify potential gaps in the current conservation areas network in an area of ecological influence (AEI, see Figure 1 in section 4.1). This AEI was the focus area for the analysis and was defined by the boundary of all ecodistricts (Ecological Stratification Working Group, 1995) that intersect the forest management areas of both forestry companies. Information on landscape-scale environmental features was gathered for this part of the analysis. This included surficial geology, land cover, gross primary production, soil organic carbon, lake-edge density[1], caribou ranges, and waterfowl abundance. Existing protected areas identified in the Conservation Areas Reporting and Tracking System (CARTS) database (Canadian Council on Ecological Areas, 2010) and some selected from the Government of Alberta's Lower Athabasca Regional Plan (Government of Alberta, Land Use Framework, 2012) were considered as the existing protected areas network. Calculations were completed for each feature within the existing protected areas and within the AEI. To assess representation, these values were compared against each other to see if the same level of representation was found in existing protected areas as compared to the AEI, as well as a comparison with defined threshold values ranging from 5% to 30% representation of a feature compared to what was found within the AEI.

[1] "Lake-edge density is a measure of the density of terrestrial/aquatic edge and represents the abundance of habitat along large waterbodies (lakes and wide rivers)." (The Canadian BEACONs Project, n.d.).

Upon completion of the analysis for each of the 33 conservation features, the results of Phase 1 demonstrated that there is a gap in the existing protected areas network in northeast Alberta/northwest Saskatchewan. We found that only four features were represented consistently in all threshold assessment options. Five features were never adequately represented in any threshold assessment option and approximately one third of all features did not reach the project team's mid-range 10% threshold target.

As we look forward to Phase 2, we plan to take the results from Phase 1 and undertake a Marxan-based analysis to find suitable areas within the AEI to recommend for various conservation options to fill these gaps. With Indigenous and government awareness and potential input/engagement, the project team hopes to provide recommendations that will meet the requirements of the Forest Stewardship Council® (FSC®) Canada's pending national forest management standard (FSC® Canada 2018), assist the provinces of Saskatchewan and Alberta with their conservation goals, contribute to achieving Canada's international conservation obligations, and most importantly maintain a thriving boreal forest for future generations.

2.0 Introduction

A Conservation Matrix Model (CCM) is a conservation planning model seeking to produce an integrated plan covering large regions (Schmiegelow, 2014), considering elements such as site-specific protected areas and active management areas. Working to implement a CMM framework approach, includes the application of responsible forest management practices and the incorporation at a landscape level of a conservation areas network. As part of their voluntary commitments as Forest Stewardship Council® (FSC®)[2] certified companies, both Mistik Management Ltd. (Mistik) and Alberta-Pacific Forest Industries Inc. (Al-Pac) are committed to identifying and protecting representative sample areas of native ecosystems within a landscape encompassing their Forest Management Areas as part of a Conservation Areas Network. To achieve these objectives, the companies are examining existing protected areas and their contribution to the maintenance of biodiversity and social/cultural values within their tenures and the broader region.

Legislatively designated protected areas and other forms of special management areas comprise an important component of land use zonation (i.e., Conservation Areas Network) at a provincial, national, and international level. In response to 'Aichi Targets' established under the 2010 Strategic Plan for Biodiversity (United Nations, 2010), Canada adopted a suite of national targets (Environment and Climate Change Canada, 2016). Goal 'A' Target 1 for Canada states "By 2020, at least 17% of terrestrial areas and inland waters, and 10% of marine and coastal areas of Canada are conserved through networks of protected areas and other effective area-based measures". This target is equivalent to Aichi Target 11. Among the project objectives is to "encourage efforts among governments and land management partners to contribute to Canada Target 1" and to consider conservation where the network "includes areas of importance to biodiversity, and ecosystem services that together achieve ecological representation". Canada has renamed the process specific to achieving their Target 1 for terrestrial and inland waters "A Pathway to Target 1". Similarly, at a provincial level, both Alberta and Saskatchewan recognize protected areas as components of a provincial suite of tools for combining conservation of biodiversity with economic and social aspects of societal demands.

Working together with Ducks Unlimited Canada (DUC) and Canadian Parks and Wilderness Society (CPAWS), Al-Pac and Mistik formed a collaborative team to evaluate representation of existing protected areas and provide recommendations on potential candidate protected areas if gaps were found in the area of ecological influence (AEI). Obtaining support from both Indigenous Peoples and interested/affected stakeholders for recommendations on candidate protected areas and special management areas was also an important aspect of the project. Given that candidate protected areas and special management areas would not be identified until Phase 2 of the project, the focus of Phase 1 has been on the technical component of the work, led by DUC, with foundational work completed on government and Indigenous engagement. The technical methodology is highlighted in sections 4.0 and 5.0, while the engagement components of this work are highlighted in section 3.0.

[2] The Forest Stewardship Council® (FSC®) is an international not-for-profit organization formed in 1993 to establish voluntary standards of practise for forestry companies and inform consumers about responsible forest management practices globally.

2.1 Objectives

Two primary objectives have been developed for this project and divided into two phases. Phase 1 will be the focus of this report, while Phase 2 has an anticipated completion date of March 2019.

Phase 1 Objective: Complete a gap analysis that focuses on ecological representation of various conservation features in existing protected areas within the project area of ecological influence.

Should existing protected areas not meet the conservation goals and targets identified by the project team, Phase 2 will be initiated to collaboratively identify and agree upon a suite of candidate protected areas and other effective area-based conservation measures to fill those representation gaps.

Phase 2 Objective: Propose a network of candidate areas for terrestrial and inland waters (including existing protected areas) representing the landscape through a range of scenarios that can be conserved through various mechanisms including protected areas and other effective area-based conservation measures.

2.2 Key Definitions

Some of the key definitions for terminology used throughout this report and within the project objectives come from the following Forest Stewardship Council (FSC®)-adapted definitions. These have been updated to include the latest FSC® standards, FSC-STD-CA-01 (D3-0) EN (FSC Canada 2018, Draft 3).

- Area of Ecological Influence: Includes the entire area of ecological influence encompassed by ecological units (e.g., Ecodistrict) that occur, at least partly, within the forest management areas in order to incorporate a broader landscape perspective in consideration of candidate areas. (Adapted FSC® Definition)
- Coarse Filter Features: Broad landscape-level conservation features representing the land base. Traditionally, a coarse-filter does not include species-specific information but for the purposes of this project, our coarse-filter includes information on caribou and waterfowl.
- Conservation Areas Network: Is the sum of protected areas and designated conservation lands with the area of ecological influence for which conservation is the primary and, in some circumstances, the exclusive objective.
- Conservation Matrix Model: Adaptive management framework integrating conservation and resource management that manages natural patterns of species distributions and abundance and the processes that support them to achieve landscape sustainability. (Adapted Definition from Schmiegelow et al. 2014)
- Ecological Representation: A measure of how well diversity and biodiversity within an ecosystem or group of ecosystems is covered by a subset of regions, an example being a network of protected areas.
- Gap Analysis: An analysis used to identify gaps in the representation of the existing protected areas network within the area of ecological influence. This includes addressing various conservation features such as intact forest landscapes. (Adapted from FSC® Definition)
- Landscape: A geographical mosaic composed of interacting ecosystems resulting from the influence of geological, topographical, soil, climatic, biotic, and human interactions in a given area. (FSC® Definition)
- Other Effective Area-based Conservation Measures: A geographically defined space, not recognized as a protected area, which is governed and managed over the long-term in ways that

deliver the effective in-situ conservation of biodiversity, with associated ecosystem services and cultural and spiritual values. (IUCN WCPA, 2018 - Draft Definition, Phase 2 review required)

- Protected Areas: An area protected for conservation purposes by legislation, regulation, or government land-use policy to permanently control human occupancy or activity. (FSC® Definition)
- Scenarios: Developed using decision support tools, such as Marxan, to align the representation of selected conservation features using the assignment of percentage targets to select specific areas where the representation needs of each conservation feature are met.
- Special Management Areas: Areas that are managed by an organization or in collaboration with various partners, primarily to safeguard species, habitats, ecosystems, natural features, or other site-specific values because of their natural environmental or cultural values. (Adapted FSC® Definition)

2.3 Project Team Members

The project team consists of representatives from Ducks Unlimited Canada, Canadian Parks and Wilderness Society, Alberta-Pacific Forest Industries Inc. and Mistik Management Ltd. Kris McCleary, from Kris McCleary Consulting, served as project manager (see table 1).

Table 1: PAGA Project Team Members

Alberta-Pacific Forest Industries Inc.	Elston Dzus Sandra Cardinal Matthew Smith (VERLO Spatial Services)
Mistik Management Ltd.	Kevin Gillis Karl Schulz
Ducks Unlimited Canada (DUC)	Kevin Smith Alain Richard Lindsay McBlane
Canadian Parks and Wilderness Society (CPAWS), Northern Alberta (NAB) or Saskatchewan (SK) Chapter	Kecia Kerr (NAB) Ellyn Davidson (NAB) Gord Vaadeland (SK)
Project Management	Kris McCleary

3.0 Government and Indigenous Engagement

The government and Indigenous engagement components of the Phase 1 portion of our project focused primarily on awareness and information gathering. Throughout Phase 1, information on planning processes was gathered while focusing on the primary engagement goal of creating awareness with representatives of provincial governments and Indigenous Peoples within Alberta and Saskatchewan.

3.1 Government Engagement

The primary goals for government engagement for the project were:

Goal 1: Gain understanding of, and create receptivity for, conservation areas network recommendations produced by this project within the Saskatchewan and Alberta governments.

> ***Strategy 1:*** Encourage the view within the Saskatchewan and Alberta governments that the project is developing defendable, robust, science-based recommendations on gaps in the conservation areas network.
>
> ***Strategy 2:*** Create awareness within government staff about the project and create a forum for dialogue about the project.
>
> ***Strategy 3:*** Foster awareness of and alignment with government on the engagement plans for Indigenous communities.

Goal 2: Learn about implementation opportunities for new conservation areas network recommendations in various current and future Alberta and Saskatchewan land use planning initiatives.

3.1.1 Alberta

During Phase 1, government engagement primarily focused on building awareness of the project's goals and aspirations within various departments in the Alberta Government (GoA) and learning about implementation opportunities for new conservation area network recommendations in government planning initiatives. Members of the project team had introductory meetings with representatives from Alberta Agriculture and Forestry (AAF), Alberta Environment and Parks (AEP), the Land Use Secretariat (LUS) and Indigenous Relations in January and February 2018 to provide an overview of the project objectives and aspirations and inquire about GoA's plans for Indigenous engagement.

We received information on potential implementation opportunities from staff from various branches, divisions and sections within Environment and Parks that are involved in conservation planning including Parks Land-Use Framework Parks Planning and Biodiversity and Ecosystem Services via a series of presentations in fall 2017. Opportunities for implementation of recommendations created by this project in Alberta include the 5-year review of the Lower Athabasca Regional Plan (LARP) and creation of new conservation areas to achieve Canada Target 1 through Alberta's Land use Framework process. The exact mechanism to provide input via the update of LARP remains unclear, however, Alberta will be working between now and 2020 to achieve conservation of at least 17% of terrestrial lands in the province. A plan to meet Canada Target 1 through protected areas, Indigenous Protected and Conserved Areas (IPCAs) and other effective area-based conservation measures (OECMs) is being developed via the 'Pathway to Target 1' initiative[3]. The plan is expected to be released in 2018 and the project team will update the government engagement strategy with an approach for

[3] http://www.conservation2020canada.ca/home/

providing recommendations to the government of Alberta that aligns with the steps and timelines the province will be taking to meet Target 1 once this information is released.

3.1.2 Saskatchewan

Contact was made with several Government of Saskatchewan staff with responsibilities related to identification of protected areas or the Pathways to Target 1 initiative when the project launched in the fall of 2017. The project team received a presentation on Saskatchewan's Representative Areas Network (RAN) program and how the province is contributing to the Pathways to the Target 1 initiative during the fall. Although the RAN Program is going through a program review this year to assess relevance, effectiveness and future opportunities, it appears that the province is interested in receiving advice and direction on conservation areas and encouraged the project team to provide a proposal for new conservation areas via the RAN Program.

3.2 Indigenous Engagement

FSC®-certified companies must work cooperatively with Indigenous Peoples toward conformance with FSC® standards including Principle 6- Environmental Values and Impacts (FSC Canada 2018, Draft 3). The Principle states that "*The Organization shall maintain, conserve and/or restore ecosystem services and environmental values of the Management Unit, and shall avoid, repair or mitigate negative environmental impacts."*[4]

Indicator 6.5.1 under Principle 6 dictates that "*An efficient process is used to engage Indigenous Peoples whose traditional territory overlaps the Management Unit and self-identified interested and affected stakeholders, regarding the identification and management of designated conservation lands."*

The project team's Indigenous engagement approach was designed to meet compliance with FSC® principles 3, 6, and 9 (and the criteria and indicators therein; FSC® Canada 2018).

3.2.1 Alberta

Al-Pac's primary goal in Phase 1 of the project with regards to Indigenous engagement in Alberta was to create awareness of the project and maintain the good relationships they have established with both communities and the government. They introduced the project to communities via the General Development Plan (GDP) consultation process, developed presentation materials for meetings, and held initial meetings with Indigenous communities around Cold Lake, Lac la Biche and Ft. McMurray in April 2018.

3.2.2 Saskatchewan

Several local Indigenous communities, including A Le Baie Metis Local #21, Buffalo Narrows, the Canoe Lake Traditional Resources User Board, Meadow Lake Metis Local #31, Metis Nation – Sask (Northern Region #3), Waterhen First Nation, Beauval Co-Mgt Board & Commercial Fishers, Big Island Lake Cree Nation, Saulteaux First Nation and the Buffalo River Dene First Nation are represented on the Mistik Public Advisory Committee. An introduction to the project was provided at the November 2017 Public Advisory Group. Additionally, meetings were held with the 3 communities of the Canoe Bay Traditional Resource Users Group (Canoe Lake First Nation and the Cole Bay and Jans Bay Metis communities). All 3 communities expressed interest in participating in the project.

[4] https://ca.fsc.org/en-ca/standards/forest-management-standard-revision-01

4.0 Technical Methodology

The first step taken by the project team was to establish a technical subcommittee. This subcommittee had representatives from each of the organizations on the larger project team. The intent of this smaller group was to evaluate analytical options and provide recommendations to the project team for approval to ensure consistency, efficiency, and understanding throughout the process. The technical subcommittee also engaged Kim Lisgo (Scientist with the Boreal Ecosystems Analysis for Conservation Networks Initiative) for her expert advice on selecting features, setting goals and targets, selecting datasets, and designing the AEI. The subcommittee met frequently, approximately once or twice a month, while the project team met once every four to six weeks. Project team meetings focused on key milestones to ensure that there was agreement from the project team for each of the major decision points.

The project team reviewed existing conservation area analyses to understand methodological approaches, conservation features and datasets used in other conservation planning initiatives: CPAWS Conservation Blueprint (Pendlebury & Ronson, 2015), BEACONs Pan-Boreal Assessment (Kim Lisgo, personal communication), and the Northern Alberta Conservation Areas Working Group Project (Schneider & Pendlebury, 2016). Upon completion of that review and following advice acquired from published conservation planning frameworks, (Strittholt & Leroux, 2012) a work plan was developed focusing on six key milestones to achieve in Phase 1 (see Table 2).

Table 2: Phase 1 Milestones

1. Develop project objectives, define conservation goals, identify key definitions (see section 2.0)
2. Select the Area of Ecological Influence (see section 4.1)
3. Identify conservation features, goals, and targets (see section 4.2)
4. Spatial data collection and processing for conservation features identified in step 2 (see section 4.3)
5. Evaluate conservation features found within existing protected areas (see section 4.4)
6. Complete Phase 1 report

Following the completion of the Phase 1 Report in April 2018, the project team had a peer review of the report completed by Dr. Shawn Leroux. He was asked to review the technical methodology and results providing feedback to the project team to improve and expand on the report. His advice and knowledge has been built into this updated Phase 1 report.

4.1 Area of Ecological Influence

The Area of Ecological Influence (AEI) extends across the Alberta and Saskatchewan border using the forest management area tenures of Al-Pac and Mistik as anchors for a larger, ecologically-based, area of ecological influence.

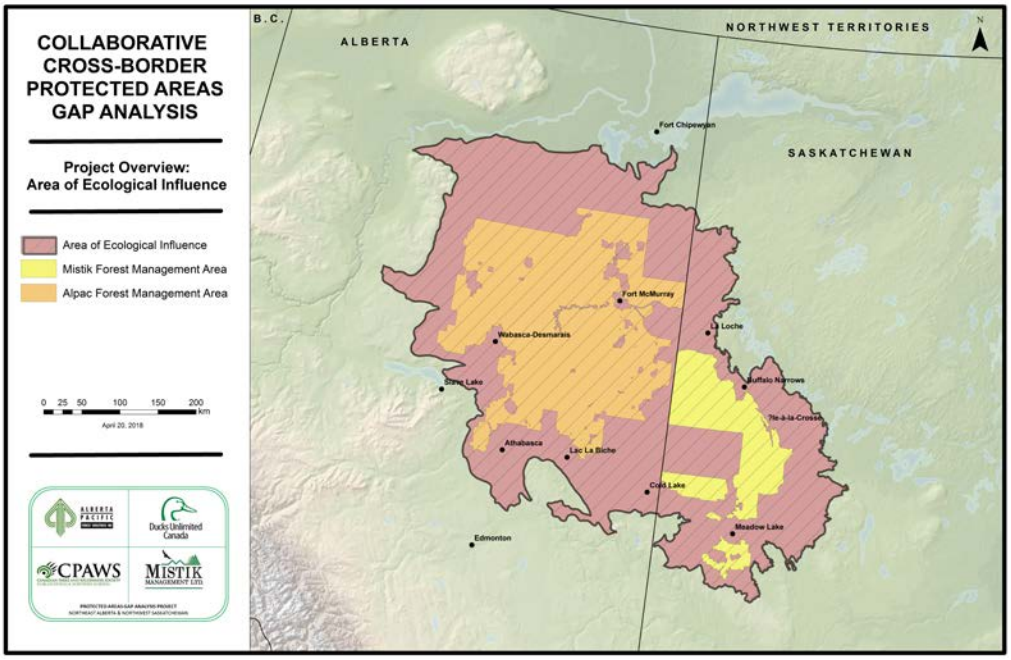

Figure 1: Protected Areas Gap Analysis Area of Ecological Influence (AEI).

Throughout the boundary delineation process, the project team considered various different options including focusing on intersecting Ecozones, Ecodistricts, or Ecoprovinces, highlighting intersecting fundamental drainage areas, and considering minimum dynamics reserve sizes[5]. In the end, the project team decided to use Ecodistricts (Ecological Stratification Working Group, 1995) as the base because they were not as large as other options, worked well within the project sphere of influence, included areas with existing working relationships held by project partners, and supported the project team desire to select an AEI where we could effectively engage in a meaningful way.

4.2 Conservation Features, Goals, and Targets

The project team decided to focus on coarse filter conservation features in Phase 1. Coarse filter features are generally intended to represent large-scale features and processes on the landscape such as surficial geology, while fine filter features are often species-specific, rare species, or areas of particular interest. Our coarse filter approach encompassed a less traditional definition as we have expanded it to include some information on caribou and waterfowl which are typically considered fine filter features. Fine filter features will be considered by the project team in Phase 2.

The project team required existing datasets that covered the extent of the AEI, which limited the choice of datasets to those that crossed the Alberta-Saskatchewan border. The team acknowledged the existence of datasets that are available that could have provided a greater level of detail in specific areas

[5] Minimum Dynamic Reserve (MDR) is defined as the minimum reserve area required to incorporate natural disturbance and maintain ecological processes (Leroux et al. 2007).

throughout the AEI; however, if no comparable dataset was available to cover the extent of the AEI, the team chose to use datasets with complete coverage.

The project team considered and selected conservation features, goals, targets, and datasets throughout the fall of 2017. Table 3 provides a summary of the coarse filter features selected and the rationale as to why they were included within this project. Appendix A identifies all base features, coarse filter features, and preliminary fine filter features considered by the project team and the rationale for their inclusion or exclusion in the Phase 1 work.

Table 3 – PAGA coarse filter features, goals, targets, and potential datasets

COARSE FILTER FEATURES			
Conservation Feature	**Goal**	**Target**	**Datasets**
Land Base	The natural landscape variation is maintained within the AEI	A sufficient area of each feature is represented within existing protected areas within AEI	Surficial Geology
			Land Cover
			Gross Primary Production
Carbon	Maintaining natural carbon stores (sources and sinks) within the natural landscape within the AEI	A sufficient amount of carbon can be held within the existing protected areas within AEI	Soil Organic Carbon
Hydrology	The natural hydrologic variability is maintained within the AEI	A sufficient area of high lake edge density is represented within existing protected areas within AEI	Lake Edge Density
Caribou	Persistence of caribou and representation of caribou habitat within the AEI following provincial leads	A sufficient area of caribou habitat is represented within existing protected areas within AEI	Caribou Ranges
			High Use Caribou Habitat
Waterfowl	Persistence of waterfowl and representation of waterfowl habitats within the AEI	A sufficient area of high density waterfowl habitats are represented within existing protected areas within AEI	Waterfowl Abundance

4.3 Data

Data was collected primarily from publicly-available sources and reviewed by the technical subcommittee and project team. Some additional processing and analysis was completed as needed. This section describes the main data considerations taken by the project team, an overview of the base data collected, individual dataset sources and processing methods, and a spatial correlation assessment between the conservation features selected.

4.3.1 Data Considerations

The project team considered many datasets and processing options throughout Phase 1 discussing the potential limitations of those options as needed throughout the process. A complete list of data considerations is available in Appendix A.

Creating a comprehensive gap analysis that serves as a foundation for the Phase 2 objectives with minimal re-evaluation of data-related decisions was important for moving forward in an efficient manner. The three key data decisions by the project team are as follows:

- Data collected must span both the Alberta and Saskatchewan portions of the AEI
    - The project team identified a comprehensive extent as a key decision early in the process to ensure ease of data collection and processing but also to ensure consistency in assessments across jurisdictions. Due to this decision, some datasets were eliminated from the analysis that may have provided more detail or unique data for the analysis. An example of this would be natural subregions, which are available in Alberta but not in Saskatchewan and are utilized by the Government of Alberta in many of their planning processes.
- The use of a modified coarse filter definition
    - Although the traditional coarse filter approach does not usually incorporate species-specific information, the project team decided to include data to assess the representation of both caribou and waterfowl (specifically ducks) at the outset of the gap analysis. These were included to provide a more comprehensive perspective on the data being represented within the existing protected areas and to ensure that a range of features were considered as part of the gap analysis.
- Exclusion of the Intact Forest Landscape dataset
    - Land use planning efforts highlight the need for maintaining intactness as a key concept. This can be done in various ways; the most common approach to considering intactness is by including an intact forest landscapes dataset. The project team discussed including the Intact Forest Landscapes (IFL) dataset in the analysis in the early phases of the project and decided that due to limitations in data quality, the technical requirements for Forest Management operations within the IFL, and the ongoing international efforts to define IFLs, that it not be included in the Phase 1 analysis. The concept of intactness will be considered when designing solutions in the Phase 2 analysis by highlighting areas based on the amount and distribution of human disturbances.

4.3.2 Base Data

Various base datasets were collected to delineate the AEI (see section 4.1), to assess existing protected areas, and to evaluate the landscape. The project team collected the base data shown in Table 4.

Table 4 – PAGA Base Data

BASE DATA			
Base Data	**Datasets**	**Source**	**Data Extent**
Al-Pac	Alpac Forest Management Area	Provided by Al-Pac	Alberta
	Alpac High Conservation Value Areas		Alberta
Mistik	Mistik Forest Management Area	Provided by Mistik	Saskatchewan
	Mistik Candidate Protected Areas		Saskatchewan
Protected Areas	Existing Protected Areas	Canadian Council on Ecological Areas	National
	LARP Conservation & Recreation Tourism Areas	Land Use Secretariat, GoA	Alberta
	5 New Alberta Protected Areas (announced May 15, 2018)	GoA	Alberta
Other	Ecodistricts	National Framework of Canada	National
	Alberta Land Use Framework Areas	Alberta Environment and Parks, GoA	Alberta
	Alberta's Natural Subregions	Alberta Parks, GoA	Alberta

4.3.3 Coarse Filter Data

4.3.3.1 Surficial Geology

Surficial Geology is an attribute within the National Ecological Framework for Canada (Marshall, Schut, & Ballard, 1999). The data is based on ecodistricts and identifies the nature of the surficial materials, derived from the Surficial Materials Map of Canada (Fulton, 1995). "The National Ecological Framework for Canada was developed between 1991 and 1999 by the Ecosystems Science Directorate of Environment Canada, and the Center for Land and Biological Resources Research, of Agriculture and Agri-Food Canada. Over 100 federal and provincial agencies, non-governmental organizations, and private sector companies contributed to its development." (Agriculture and Agri-Food Canada, 2013).

The AEI contains 12 surficial geology classes (shown in Figure 2): Alluvial Deposits, Coarse-grained Glacio-Lacustrine, Eolian Deposits, Fine-grained Glacio Lacustrine, Fine-grained Glacio-Lacustrine (hummocky), Glaciofluvial Complex, Glaciofluvial Plain, Organic Deposits, Till Blanket, Till Blanket (hummocky), Till Veneer, and Water.

Several modifications were made to this dataset. The water class was removed as it was already included as part of the land cover dataset. The Till Blanket and Till Blanket (hummocky) classes were combined into one Till Blanket (combined) class. And, the Fine-grained Glacio-Lacustrine and Fine-grained Glacio-Lacustrine (hummocky) classes were combined into one Fine-grained Glacio-Lacustrine (combined) class. The combination of the classes was vetted through a soils expert at Mistik, Roger G. Nesdoly (BSA RPF SK). This resulted in nine surficial geology classes being considered for the analysis.

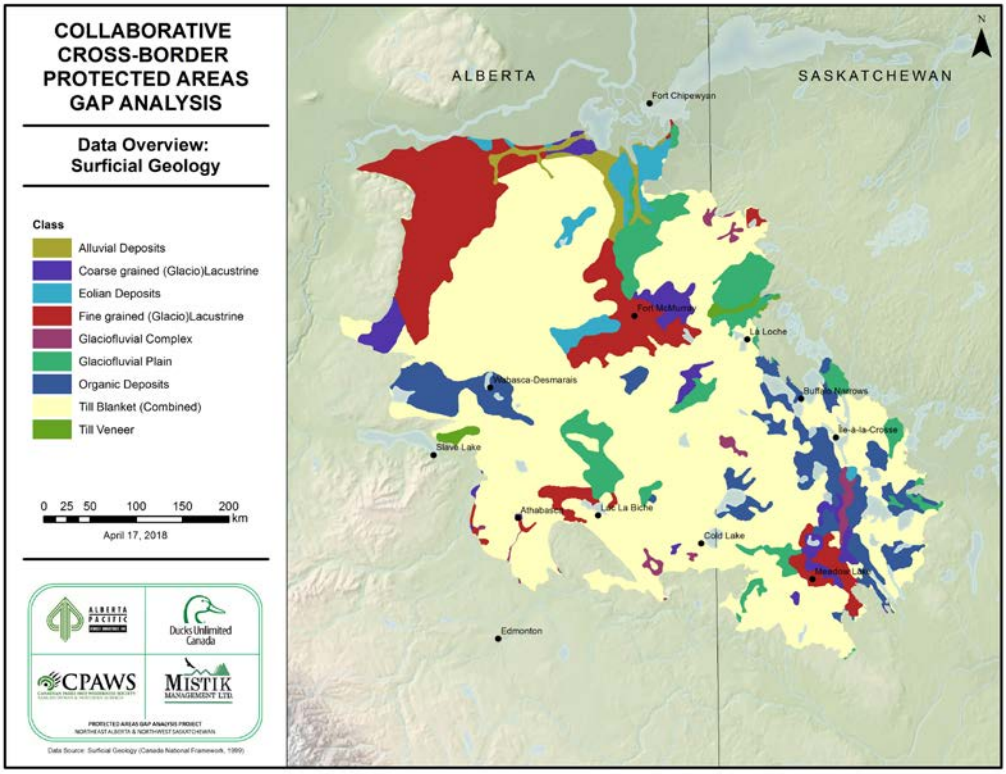

Figure 2: Surficial Geology data distribution within the project AEI.

4.3.3.2 Land Cover

The Land Cover dataset was derived from multiple sources including Duck's Unlimited Canada's Enhanced Wetland Classification (EWC) and Hybrid Wetland Layer (HWL), Natural Resources Canada's (Canadian Forest Service) Earth Observation for Sustainable Development of Forests (EOSD) forest cover data, and Agriculture and Agri-Food Canada's (AAFC) 2010 land use data.

To merge the datasets into one comprehensive land cover dataset, all land cover categories within the separate layers were reviewed and then cross-walked to a common classification scheme to maintain a consistent nomenclature across the layers. DUC's EWC was used as the base layer since it provides a comprehensive classification which includes a detailed wetland classification. Any 'no data' pixels within the classification were then replaced with classes from DUC's HWL which incorporates EOSD's forest cover classes and a general wetland class. Then, the AAFC's land use layer was used to fill in any remaining 'no data' regions and to replace EOSD's 'Herbs' class with more detailed classes.

The Area of Ecological Influence contains 24 land cover classes (shown in Figure 3): Agricultural/Crop, Bare Rock, Gravel, & Sand, Broadleaf – closed, Broadleaf – open, Broadleaf – general, Coniferous – closed, Coniferous – open, Coniferous – general, Developed, Mixedwood – closed, Mixedwood – open, Mixedwood – general, Native Grassland, No Data, Pasture/Forage, Recent Burns, Shrub, Snow/Ice, Water, Wetland – Bog, Wetland – Fen, Wetland – Marsh, Wetland – Swamp, and Wetland – general.

The project team made various modifications to this dataset for analysis purposes. The Broadleaf-closed, -open, and -general classes were combined into a single Broadleaf (combined) class. The Coniferous -closed, open, and general classes were combined into a Coniferous (combined) class. The Mixedwood -closed, open, and general classes were combined into a Mixedwood (combined) class. We also created an Other (combined) class which combined Agriculture/Crop, Bare Rock/Gravel/Sand, Developed, Native Grassland, No Data, Pasture/Forage, Recent Burns, and Snow/Ice. This resulted in eleven land cover classes being considered for the analysis.

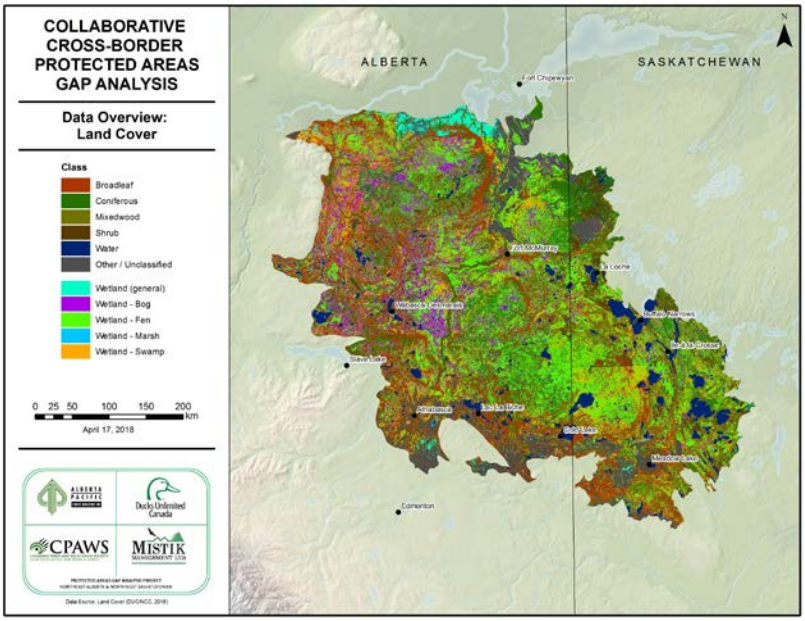

Figure 3: Land Cover data distribution within the project AEI.

4.3.3.3 Gross Primary Production

Gross Primary Production (GPP) is a measure of the growth of terrestrial vegetation represented by the sum of carbon mass. The GPP dataset, 2017, is downloaded from MODIS (Moderate Resolution Imaging Spectroradiometer) via NASA's (National Aeronautics and Space Administration) website. "Primary … Production is determined by first computing a daily net photosynthesis value which is then composited over an 8-day interval of observations for a year. The product is a cumulative composite of GPP values based on the radiation use efficiency concept that may be used as inputs to data models for calculating terrestrial energy, carbon, water cycle processes, and biogeochemistry of vegetation." (NASA, 2017)

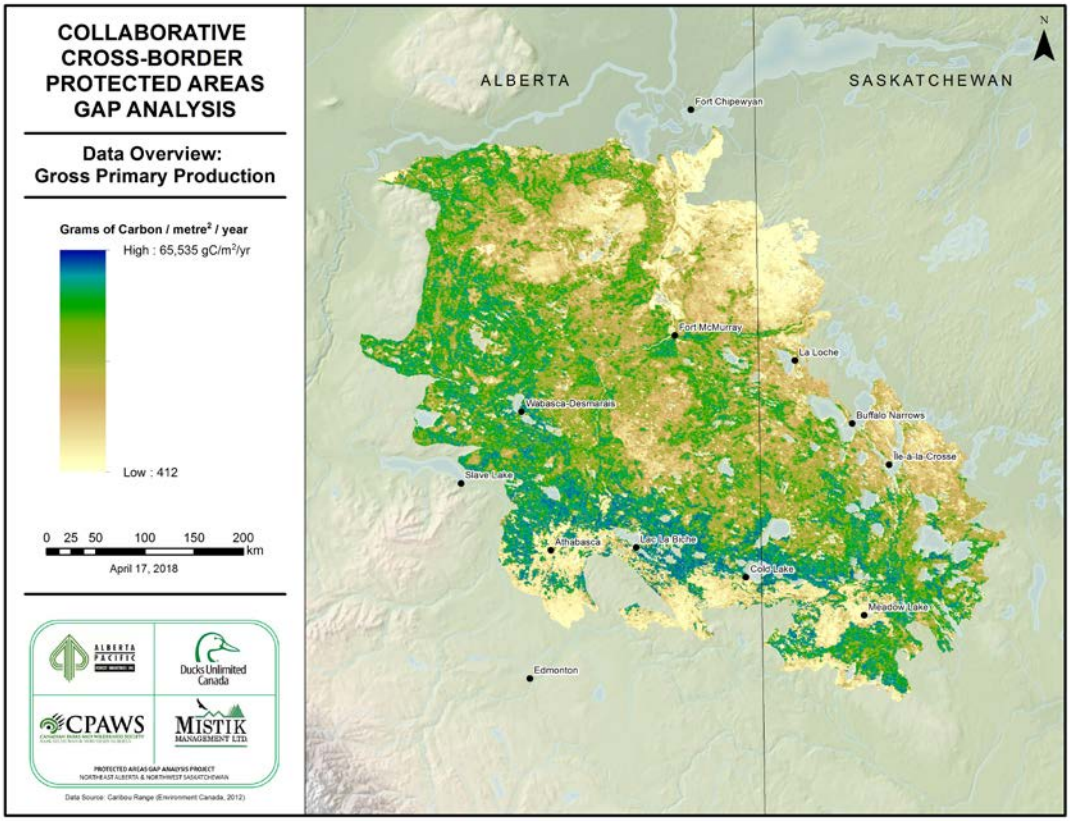

Figure 4: Gross Primary Production data distribution in the project AEI.

4.3.3.4 Soil Organic Carbon

The Soil Organic Carbon of Canada dataset was initiated in 1991 to determine the amount of organic carbon in Canadian soils. The dataset is based on the Soil Landscapes of Canada version 2 and consists of polygons delineated by various land features most visible on Landsat imagery. A soil component table summarizes the soil features in each polygon, which is used to calculate total soil carbon for a polygon in kg/m^2 (Tarnocai, C. and B. Lacelle, 1996).

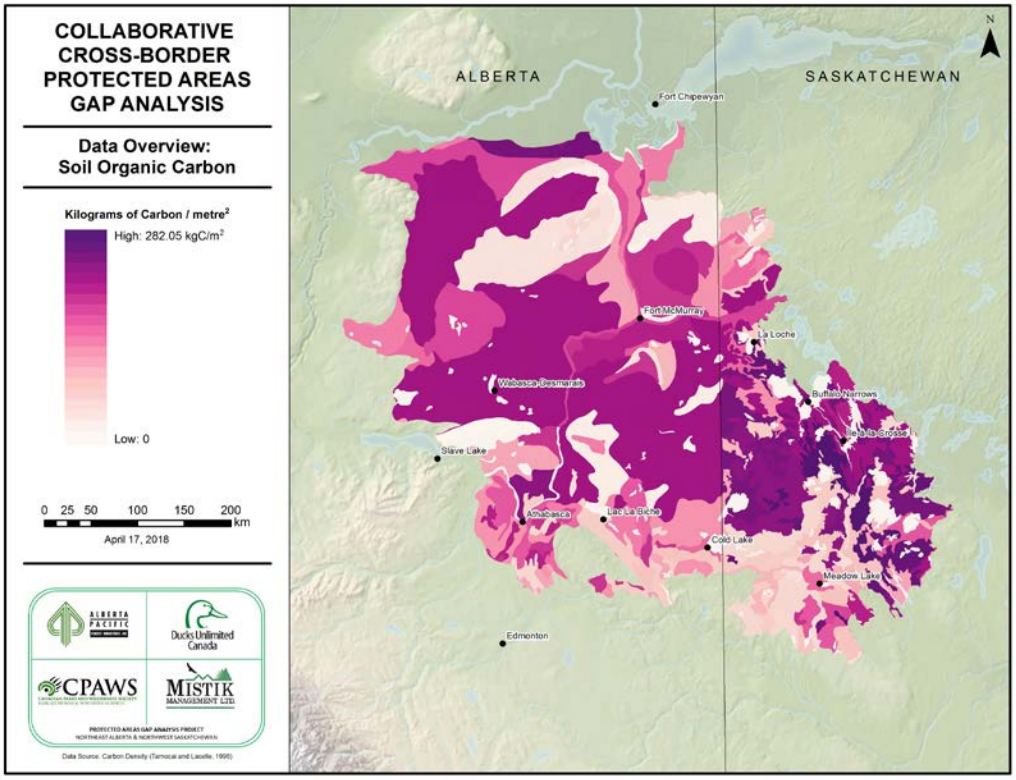

Figure 5: Soil Organic Carbon data distribution within the project AEI.

4.3.3.5 Lake-Edge Density

"Lake-edge density is a measure of the density of terrestrial/aquatic edge and represents the abundance of habitat along large waterbodies (lakes and wide rivers)." (The Canadian BEACONs Project, n.d.). A Lake-Edge Density (LED) dataset was created using the BEACONs methodology and using Canvec's Hydrographic Features to ensure a scale relevant to our project's needs.

We originally acquired the BEACONs Pan Boreal Assessment (The Canadian BEACONs Project, n.d.) dataset which was derived from the National Scale Framework HYDROLOGY, Version 6.0 Drainage Network (Natural Resources Canada, 2009). However, the base hydrology data set used was missing some key hydrographic features because of the scale (lower resolution) of the data. We used the BEACONs methodology, substituted in the Canvec's Hydrographic Features as the base dataset (keeping all features except for liquid waste in the analysis), and created a final output cell size of one hectare.

Since lake edge-density is a continuous dataset with units of km/km^2 thereby making area-based calculations difficult, the project team agreed to accept the classification of the dataset into three groups based on quantiles (equal sized groups) for low, medium, and high lake-edge density to represent the range of data across the AEI.

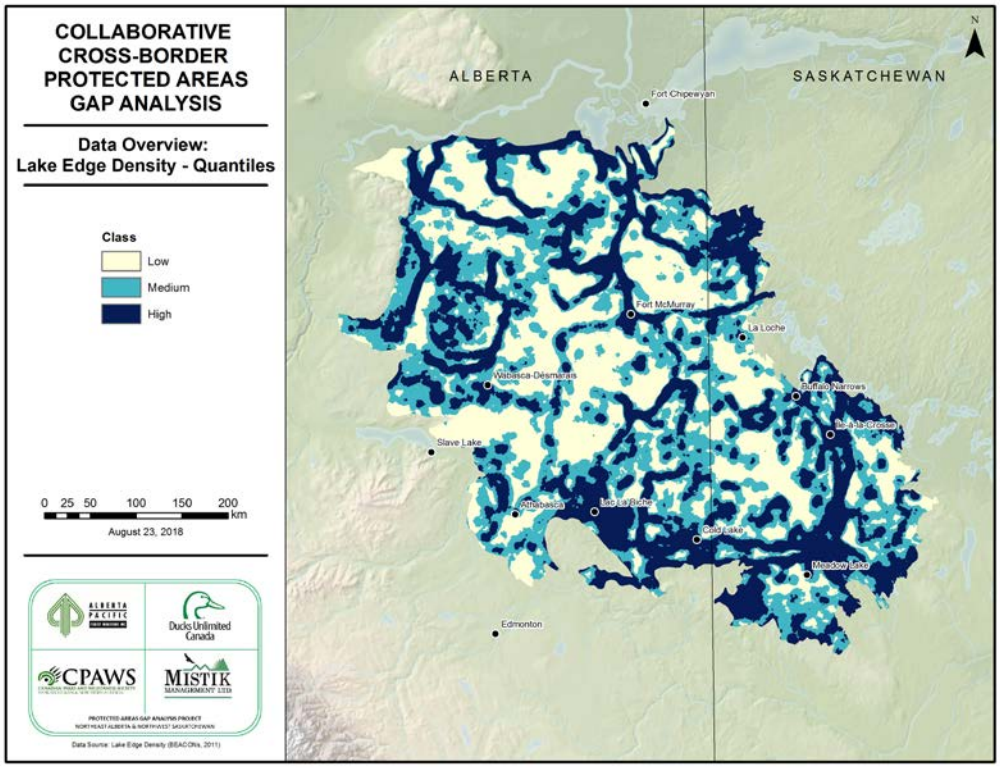

Figure 6: Lake-Edge Density within the project AEI.

4.3.3.6 Caribou Ranges

The Caribou Range dataset depicts the range boundaries of caribou herds and was supplied by provincial governments to Environment and Climate Change Canada, updated in 2012.

The project team is aware that the Draft SK2 West Caribou Habitat Management Areas were presented publicly as of August 9th, 2018. As access to the spatial files is not yet available, Phase 1 continues to use the Saskatchewan Boreal Plains caribou planning region as released in the 2012 documentation. It is anticipated that the final SK2 West spatial files will be released during Phase 2 and they will be incorporated at that time.

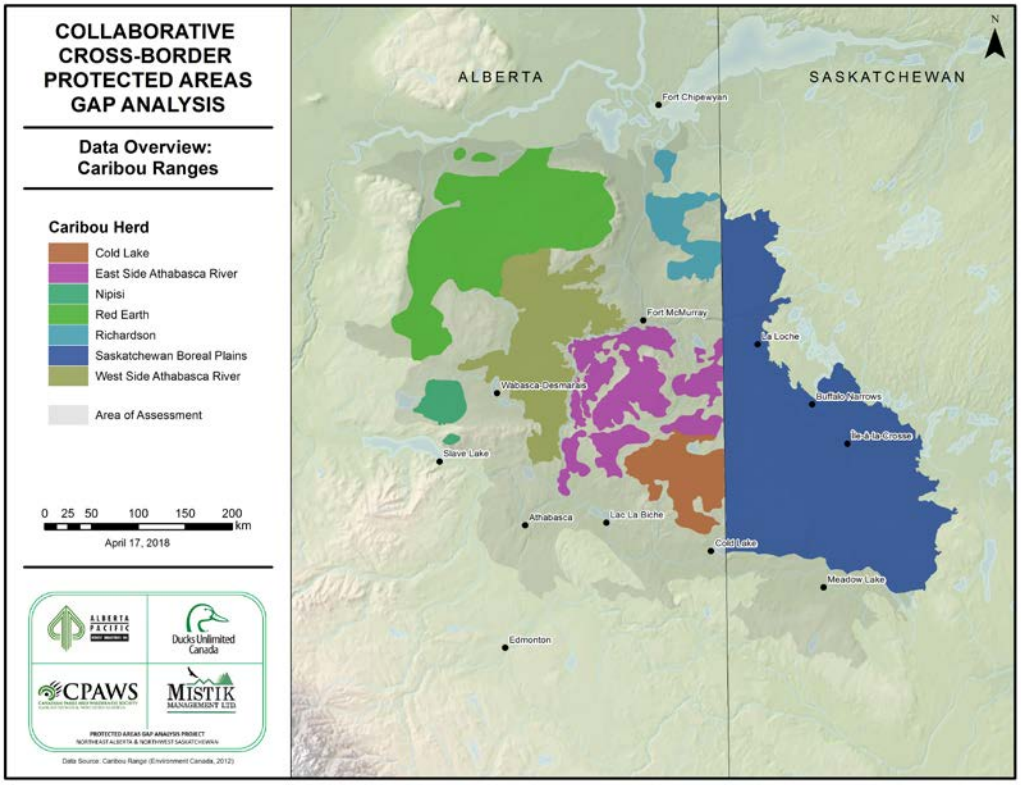

Figure 7: Caribou Range distribution within the project AEI.

4.3.3.7 High-Use Caribou Habitat

The project team wanted to consider high use caribou habitat in addition to the designated caribou ranges as a result of reviewing some existing analysis on caribou habitat, such as Arsenault (2014) as well as some unpublished work looking at caribou telemetry points and DUC's Enhanced Wetland Classification. The project team used existing caribou telemetry points acquired from the Government of Alberta for northeast Alberta and northwest Saskatchewan for the Mistik FMA boundary in Saskatchewan, as well as Ducks Unlimited Canada's Enhanced Wetland Classification (EWC) dataset for the assessment.

The project team considered a use versus availability ratio to identify high use caribou habitat within the AEI. The percent of all telemetry points within a specific habitat class were used to represent use of that class compared to the percent of that same habitat class with the AEI, which represented the availability of that habitat class. The habitat types with a use versus availability ratio greater than 1.0 were selected as high use caribou habitat. Selected high use caribou habitat includes Graminoid Poor Fens, Graminoid Rich Fens, Shrubby Bogs, Shrubby Poor Fens, Shrubby Rich Fens, Treed Bogs, Treed Poor Fens, and Treed Rich Fens.

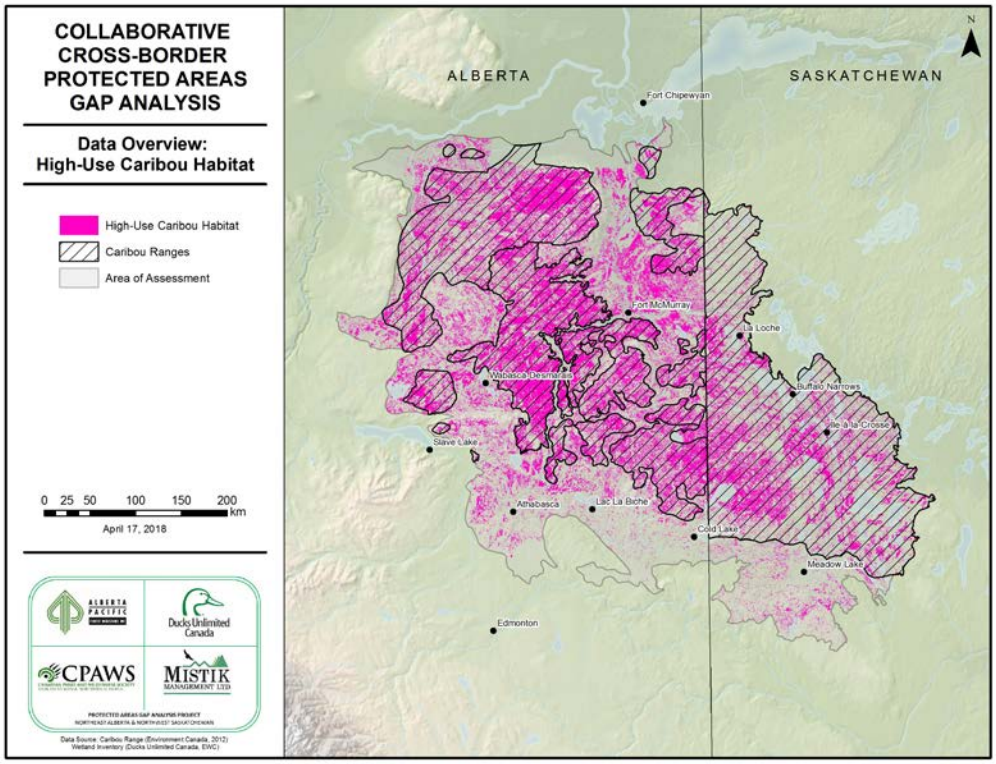

Figure 8: High-Use Caribou Habitat data distribution within the project AEI.

As a result of the existing correlation, see section 4.3.4, between the high-use caribou areas and the land cover, the project team decided to remove the high-use caribou habitat dataset from this phase of the analysis.

4.3.3.8 Waterfowl Abundance

Waterfowl Abundance was assessed using Nicole Barker's predictive relative waterfowl abundance models (Barker, Cumming, & Darveau, 2014). The model considered 17 duck species (or species groups) at a near-national scale using predictive models built on boosted regression tree analysis. The data was compiled from the Waterfowl Breeding Population and Habitat Survey aerial transects as well as 78 climatic, hydrological and landscape variables. The resulting raster cells represent the predicted average number of waterfowl pairs per km^2. (Barker, Cumming, & Darveau, 2014)

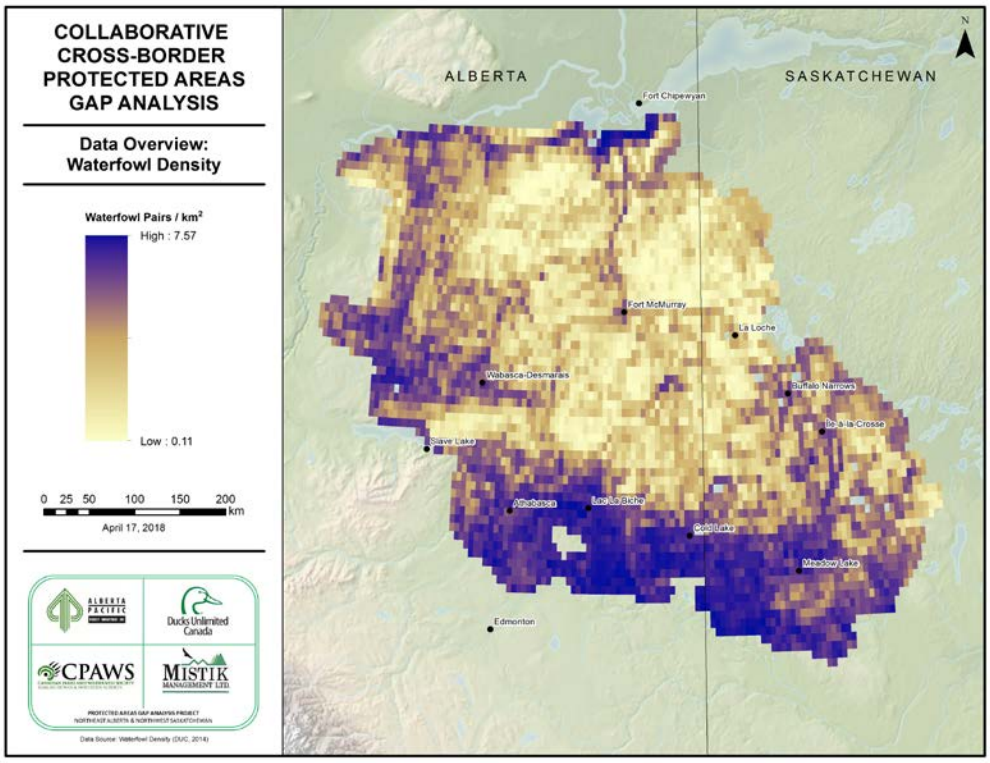

Figure 9: Waterfowl Abundance data distribution within project AEI.

4.3.4 Spatial Correlation

Spatial autocorrelation is a method to calculate geographic similarity between datasets in order to understand if there is potential for over representation of any conservation features within the analysis. We used ArcGIS 10.5's band collection statistics (Pearson's R) to evaluate correlation between the 8 coarse filter conservation feature datasets. To complete this analysis, each layer was converted into a 30m^2 resolution raster dataset with the exact same extent covering the full area of ecological influence.

The results of this analysis indicated that there was only one pair of datasets that had a noticeable correlation, see Figure 10. The two datasets highlighted by the first analysis, high-use caribou habitat and land cover, were then tested for statistical significance outside of ArcGIS in the R programming language. Overall, high-use caribou habitat and land cover had a Pearson's R value of 0.72 (closer to 1 means more correlated) and a calculated probability (p-value) of 0.049. This essentially means that these two datasets have a relationship of statistical significance which the project team needs to consider moving forward with the analysis.

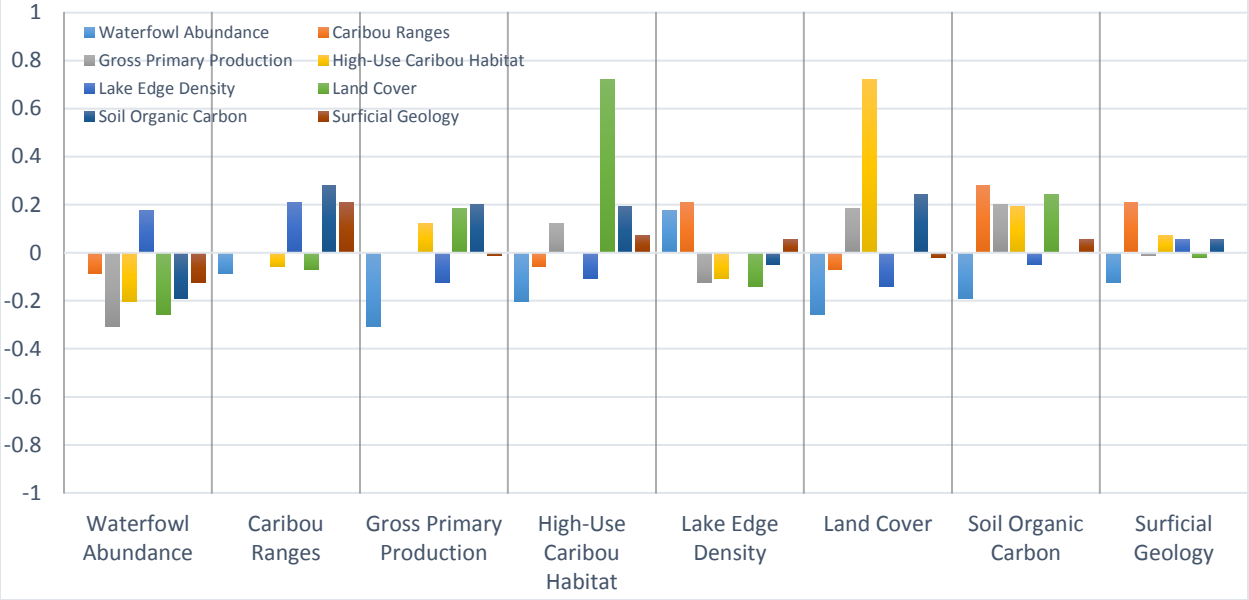

Figure 10: Spatial correlation results for all Phase 1 coarse filter features.

As a result of the existing correlation between the high-use caribou areas and the land cover, the project team decided to remove the high-use caribou habitat dataset from this phase of the analysis.

4.4 Gap Analysis

For the gap analysis, the project team assessed the value of each coarse filter feature within the AEI as well as the base data features.

4.4.1 Assessment within AEI

Total area in hectares (ha) within the AEI was calculated for all area-based datasets including surficial geology, land cover, lake-edge density quantiles, and caribou ranges. For features that were not area-based, a weighted sum was calculated based on their designated values. Therefore, gross primary production was calculated as a sum of carbon mass; soil organic carbon was calculated as a sum of total carbon mass; and waterfowl abundance was calculated as a sum of estimated number of pairs.

4.4.2 Assessment within Protected Areas

For assessment within protected areas, the project team decided it was important to distinguish between International Union for Conservation of Nature (IUCN) categories, given the varying levels of protection between categories. The IUCN provides widely accepted, globally recognized classifications of protected areas based on the protected areas management objectives. Table 5 highlights each category (International Union for Conservation of Nature, 2018).

Table 5 – IUCN Protected Areas Categories (International Union for Conservation of Nature, 2018)

IUCN Protected Areas Classification		
IUCN Category		**Definition**
IA	Strict Nature Reserve	"…strictly protected areas set aside to protect biodiversity and possibly geological/geomorphical features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of conservation values."
IB	Wilderness Area	"…are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition."
II	National Park	"...are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristics of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, education, recreational, and visitor opportunities."
III	Natural Monument or Feature	"…are set aside to protect a specific natural monument…they are generally quite small protected areas and often have high visitor value."
IV	Habitat/Species Management Area	"…aim to protect particular species or habitats and management reflects this priority."
V	Protected Landscape/Seascape	"…where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values."
VI	Protected Areas with Sustainable Use of Natural Resources	"…conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area."
N/A		Not Assigned

The project team focused on the IUCN categories as defined within the Conservation Areas Reporting and Tracking System (CARTS, Canadian Council on Ecological Areas, 2016) dataset, opting not to change any of the predefined categorizations within the dataset. Each of the coarse filter features were assessed in the same manner as the AEI but within IUCN categories IA, IB, II, & III (combined), categories IV, V, & VI (combined), and in the N/A (Not Assigned) category. The project team decided to include two

additional areas identified within the Lower Athabasca Regional Plan (LARP, GoA 2012) in the N/A category as they were considered to be far enough along in their planning stages to be potential omissions from the CARTS dataset. These areas were Gregoire Lake Park Expansion Area and Crow Lake Park Expansion Area. Additionally, on May 15th, 2018 the Government of Alberta announced 5 new protected areas within the LARP boundaries: Birch Mountains Wildland Provincial Park Expansion, Dillon River Wildland Provincial Park, Kazan Wildland Provincial Park, Richardson Wildland Provincial Park, and Birch River Wildland Provincial Park. They were identified as IUCN category IB by the GoA and have been classified as such in the analysis. Figure 11 shows the assigned protected areas designations used in the analysis.

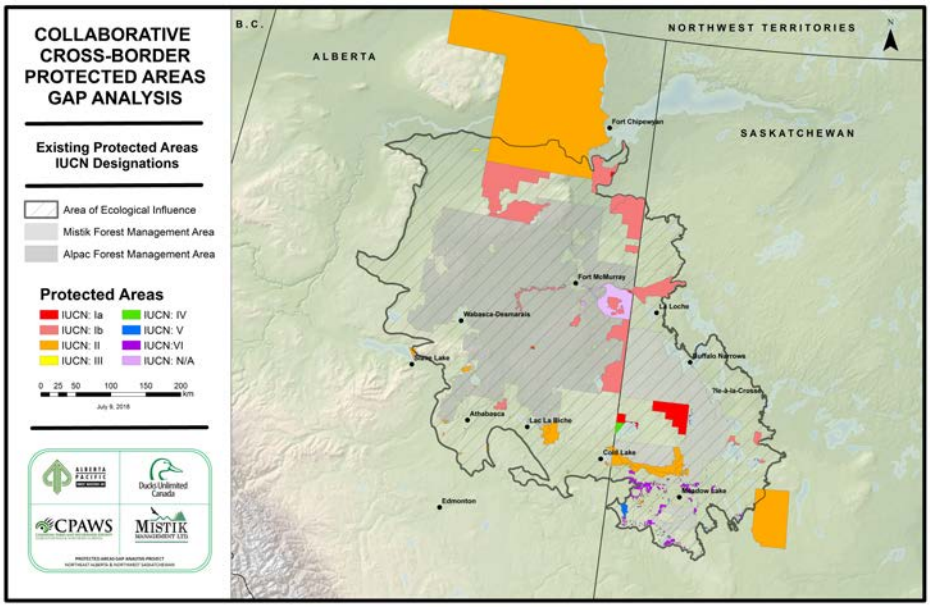

Figure 11: Existing Protected Areas intersecting the AEI shown by designated IUCN category.

4.4.3 Representation Assessment

Once all the values were calculated for each coarse filter feature within the AEI and the existing protected areas, the project team considered five options for assessing the representation.

The team considered assessing proportional representation of a conservation feature in the AEI compared to the existing protected areas. For example, if a feature covered 7% of the area in the AEI, then to be considered represented within the existing protected areas that same feature needed to have a 7% representation in the existing protected areas. This comparison was completed for all area-based features within our analysis. It was not statistically possible to consider the same variable for features that were not area–based (e.g., gross primary production, soil organic carbon, and waterfowl abundance).

The team also considered minimum representation of features within the existing protected areas as defined thresholds at the following levels: 5%, 10%, 15%, and 30%. The 5% threshold was chosen as a low representation value, the 10% threshold and 15% threshold were chosen as mid-range threshold options and 30% was chosen by the project team as a highest level of representation for assessment. Representation of all conservation features was considered against the four defined threshold values.

5.0 Results and Discussion

A total of 33 features, from 7 coarse feature categories, were analyzed. The area of each feature was summarized within the AEI, in the combined IUCN classes, and in the total existing protected areas. The results from each coarse feature category summarized within total existing protected areas can be seen in Table 5 and Figure 12.

Some coarse filter feature categories had more than one feature associated with it. For example, surficial geology had 9 classes that were evaluated, land cover had 11 classes, lake-edge density had 3 classes, and caribou ranges had 7 classes; while other features such as gross primary production, soil organic carbon, and waterfowl abundance only had one feature. Individual results for each of the 7-coarse filter feature category can be found in Appendix B along with the summary results by combined IUCN classes in Appendix C.

Table 5 – All Existing Protected Areas Representation Assessment Summary Table

GAP ASSESSMENT SUMMARY	**Protected Areas (all combined)**				
COARSE FILTER FEATURES	**Proportional**	**5%**	**10%**	**15%**	**30%**
Surficial Geology	6/9	8/9	6/9	4/9	3/9
Land Cover	7/11	10/11	8/11	2/11	0/11
Gross Primary Production	n/a	1/1	1/1	0/1	0/1
Soil Organic Carbon	n/a	1/1	1/1	0/1	0/1
Lake-Edge Density	2/3	3/3	3/3	0/3	0/3
Caribou Ranges	4/7	4/7	3/7	2/7	1/7
Waterfowl Abundance	n/a	1/1	0/1	0/1	0/1
TOTAL FEATURES REPRESENTED	19/30	28/33	22/33	8/33	4/33
% OF FEATURES REPRESENTED	63.3%	84.8%	66.7%	24.2%	12.1%

Considering all existing protected areas together, the surficial geology classes had the best representation on average across all assessment options. The lowest representation on average was waterfowl abundance. The assessment option with the highest number of feature categories meeting representation thresholds was the 5% option and the scenario with the lowest representation was the 30% scenario. When considering all 33 conservation features in all representation assessment options, there were between 12% and 85% of features being represented in any given option.

Since full representation of all features is not reached in any option (Figure 12), the project team concluded that there is a gap in representation within the existing protected areas considered for this project.

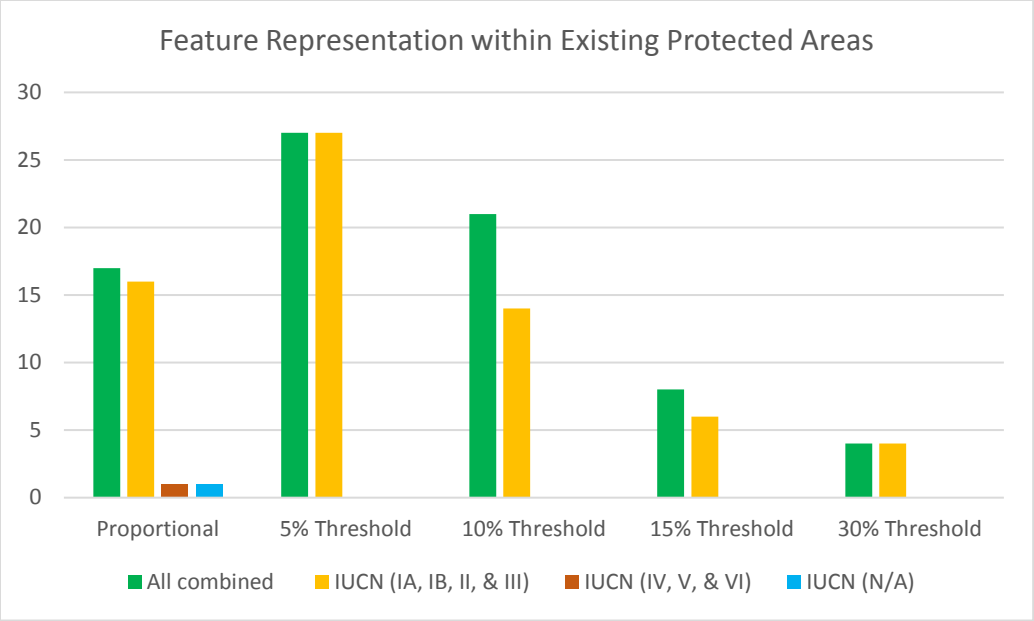

Figure 12: Number of features (out of 32 total) that are represented within existing protected areas under each of the assessment options.

Overall, there were only 4 features that were fully represented consistently in all assessment options: 3 surficial geology classes - Alluvial Deposits, Eolian Deposits, and Till Veneer, and the Richardson Caribou Range. There were also 5 features that were never fully represented in any assessment option: Organic Deposits (from surficial geology), wetland – bogs and other – combined (both from land cover), and both the Nipisi and West Site Athabasca River Caribou Ranges. And approximately 1/3rd of all features did not reach the 10% threshold. These include

- Surficial Geology (see Figure 13): Fine-grained Glacio Lacustrine (combined), Glaciofluvial Complex, Organic Deposits, and Till Blanket (combined)
- Land Cover (see Figure 14): Shrub, Wetland – Bog, Wetland – Fen, Wetland – Swamp, and Other (combined)
- Caribou Ranges (see Figure 15): Cold Lake, Nipisi, Saskatchewan Boreal Plains, and West Side Athabasca River
- Other Features: Gross Primary Production, Soil Organic Carbon, and Waterfowl Abundance

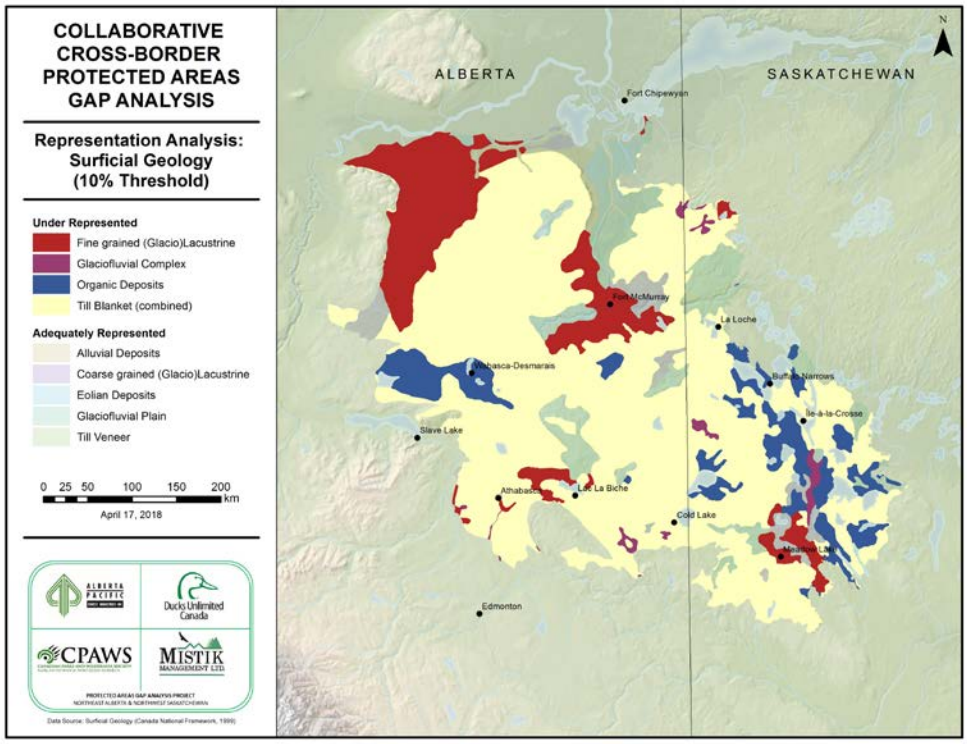

Figure 13: 10% Threshold Representation Analysis Results for Surficial Geology.

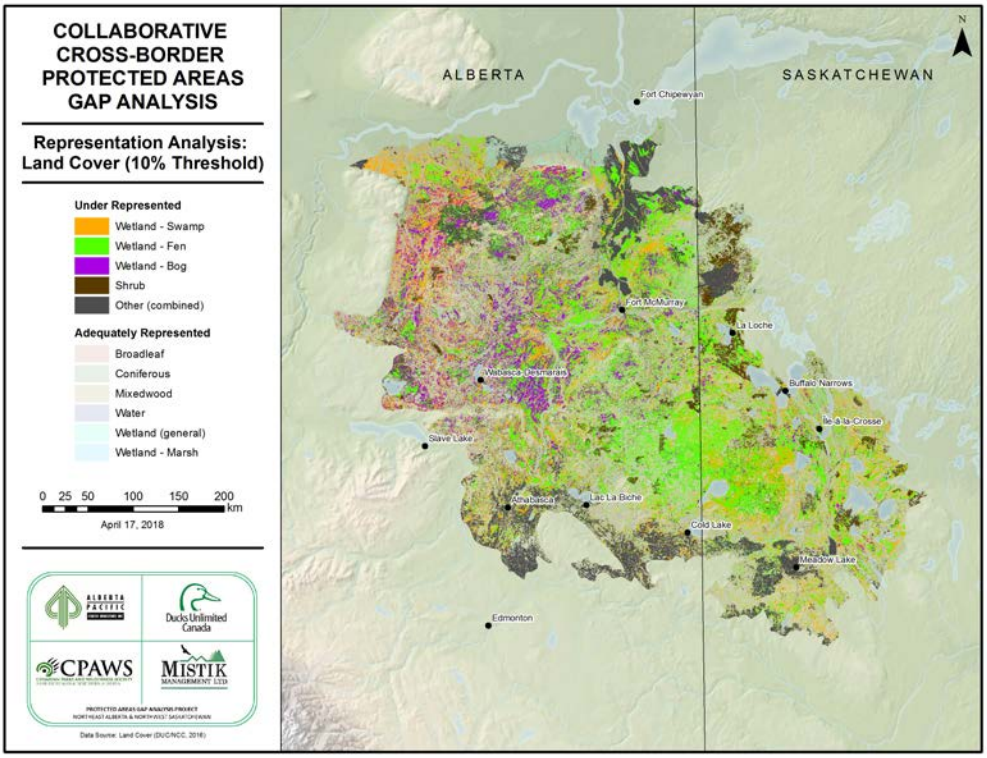

Figure 14: 10% Threshold Representation Analysis Results for Land Cover.

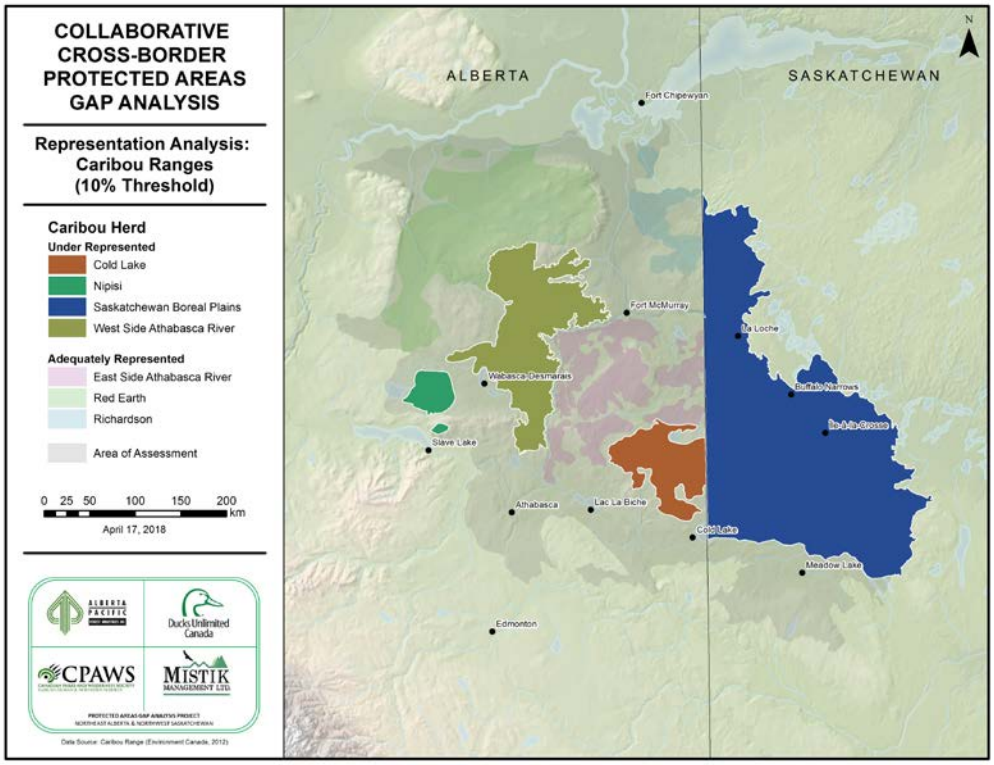

Figure 15: 10% Threshold Representation Analysis Results for Caribou Ranges.

Since the majority of features did not reach representation thresholds, the project team will be moving to Phase 2 of the work. The goal of Phase 2 is to increase the representation of each feature and recommend an expansion to the existing protected areas network with proposed areas that could be conserved under various conservation management mechanisms. Since all of the features are important (see rationale, section 4.2, and detail of each feature, section 4.3), effort will be made to increase feature representation within the proposed expanded protected areas network. Representation targets will be a key discussion point in Phase 2.

6.0 Next Steps

In Phase 2, the project team will identify and propose a network of candidate areas (including existing protected areas) which represent the landscape through a range of scenarios that can be conserved through various mechanisms including protected areas and other effective area-based conservation measures.

This work will be completed by the project team, leveraging the expertise of both the technical and engagement subcommittees. The engagement subcommittee will be focusing on raising awareness and assembling input from Indigenous Peoples and interested/affected stakeholders as defined in section 3.0. Periodic updates will be provided to Alberta, Saskatchewan, and federal government representatives on project progress. The technical subcommittee will lead identification of additional fine filter features, complete additional processing, and utilize the decision support tool Marxan, to address the project team's Phase 2 objective.

The technical work will include the following general steps:

1. Preparation of Marxan files for analysis (e.g. finalize any outstanding Phase 1 features, compile and evaluate fine filter features, develop the spatial evaluation units, create input files, etc.) and completion of sensitivity testing on the Marxan model
2. Use of Marxan to identify new candidate protected areas networks to meet the project goals
3. Refine Marxan results with supplementary data, expert opinion, etc.
4. Complete final Phase 2 report

To date, a draft work plan for Phase 2 has been completed, funding options are being reviewed, and timelines are being considered. Phase 2 has an estimated interim completion date of March 31, 2019.

7.0 Acknowledgements

We gratefully acknowledge the financial support of Natural Resources Canada, Alberta-Pacific Forest Industries Inc. and Mistik Management Ltd, with lead industry representation and support from Elston Dzus and Kevin Gillis. We appreciate the support of Cheryl Miltimore, Annette Clemens, and Etienne Belanger of the Forest Products Association of Canada, who served as the fiscal agent for a portion of this project. Lindsay McBlane from Ducks Unlimited Canada and Ellyn Davidson from the Northern Alberta Chapter of the Canadian Parks and Wilderness Society led the technical analysis, with support from the Technical Sub Committee (Kevin Gillis, Matthew Smith and Kris McCleary). Darrell Kovacz and James Guindon from Ducks Unlimited Canada as well as Nick Wilson from the Northern Alberta Chapter of the Canadian Parks and Wilderness Society, also provided additional technical support for data processing and technical analyses. Kim Lisgo provided valuable guidance and advice on the technical analysis. Sandra Cardinal led Indigenous engagement efforts in Alberta, while Kevin Gillis led Indigenous engagement efforts in Saskatchewan. We would also like to acknowledge Dr. Shawn Leroux, our peer reviewer, who provided an independent expert peer review of the Phase 1 work..

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Appendix A. Data Reviewed for Inclusion/Exclusion in Phase 1

These tables provide an overview of the base data and coarse filter data that was considered for use in the Phase 1 analysis. Decisions identified in tables A1 and A2 were based on project team discussions held in November 2017. Datasets listed as 'Include' depicts data that was used in some capacity for Phase 1 or has the potential to be used in some capacity moving into Phase 2. Datasets listed as 'Exclude' includes datasets that will be excluded from Phase 1 and Phase 2. Datasets listed as 'Potentially' identifies datasets that may have some utility and require additionally processing and/or review. And 'post-hoc/comparison' are datasets to consider for comparison purposes at the end of Phase 2.

A.1 Base Data Reviewed for Phase 1

Table A1: Base Data Reviewed for Phase 1

BASE DATA			
Base Data	**Datasets**	**Decision**	**Rationale**
Forest Management Areas	Alpac FMA	include	Used to help delineate project Area of Ecological Influence
	Mistik FMA	include	
Boundaries	Ecodistricts	include	Used to help delineate project Area of Assessment and could be used for stratification purposes in Phase 2
	Ecoregions	exclude	Excluded as not used in the delineation of boundaries for this project, focused on Ecodistricts instead
	Natural Subregions	include	Used for evaluation purposes only to consider representation in AB, maintains consistency with GoA approach. Not presented in Phase 1
	Treaty Boundaries	include	Have on hand for mapping purposes, serves as a communication tool
Protected Areas	CARTS Existing Protected Areas	include	Used CARTS as the basis for understanding representation within the project AEI that has existing protection. Supplement with Gregoire Lake and Crow Lake from LARP. Have all LARP data on hand for evaluation purposes
	LARP Conservation & Recreation Tourism Areas	include	
Planning Boundaries	Alberta Land Use Framework Areas	include	Used for evaluation purposes to understand representation within the project AEI. Not presented in Phase 1 report
	Miskisew Ronald Lake Biodiversity Area	include	
	Moose Lake	exclude	No spatial boundary available

BASE DATA			
Base Data	**Datasets**	**Decision**	**Rationale**
Forestry Tenures	Mistik Candidate Protected Areas	include	Used for evaluation purposes to understand representation. Not presented in Phase 1 report
	Alpac HCV's	include	
Existing Analysis	CPAWS Conservation Blueprint	post-hoc / compare	Existing analyses provide an example of what has been done, what can be done, and allows for a source of comparison once we have a final product. Due to scale, these analyses were not used in Phase 1. But will likely be used for post-hoc comparisons in Phase 2
	BEACONs Catchments	post-hoc / compare	
	Northern AB Conservation Areas	post-hoc / compare	
Climate	Climate Moisture Index	potentially	Potential utility, recommendation to look into climate velocity and climate refugia in post-hoc analyses
	Climate - NORM, 2020, 2050, 2080	post-hoc / compare	Good national overview of climate patterns now and into the future / Recommend using in post-hoc evaluations
	Climate Refugia	potentially	Alberta specific, could use the climate NORM, 2020, 2050, 2080 data to look at potential patterns
	Land Facets	potentially	Potential utility in Phase 2, only Alberta specific so not used in Phase 1
Other	Enduring Features	exclude	Problems with cross-border dataset - so likely too much to deal with for Phase 1, therefore exclude

A.2 Coarse Filter Data Reviewed for Phase 1

Table A2: Coarse Filter Data Reviewed for Phase 1

COARSE FILTER FEATURES			
Conservation Feature	**Datasets**	**Decision**	**Rationale**
Land Base	Surficial Geology	include	Used in Phase 1 to provide the broad scale geology classes within the AEI
	Combined Land Cover (EWC & EOSD)	include	Used in Phase 1 to provide the broad scale land cover classes within the AEI

	Elevation (slope & aspect - would need to generate)	potentially	Would require some processing…what would we want (slope & aspect) but does this add value? / Opted not to use in Phase 1
	Canada Land Inventory	exclude	Recommend not using, many variables but broad categories are already covered with surficial geology and land cover
	Gross Primary Productivity	include	Used in Phase 1 to provide the broad scale GPP classes within the AEI, used in other comparable analyses
COARSE FILTER FEATURES			
Conservation Feature	**Datasets**	**Decision**	**Rationale**
Hydrology	Lake Edge Density	include	Used in Phase 1, data provided by BEACONs at a fairly large scale. Discussion around creating our own version but opted to use the broad data for Phase 1. Changed mid-phase 1 and created our own with more regional scale base data.
	Wetlands	exclude	5 major wetland classes are included within the land cover dataset so did not opt to include again as it would be a duplication
	Watersheds (which levels would we consider?)	exclude	Use would likely only be for stratification in Phase 2 and if desired we could do that with Ecodistricts instead for greater consistency
	Fundamental Drainage Areas	exclude	Project Team reviewed for inclusion with AEI boundary delineation and thought that our Ecodistrict approach was the best for Phase 1. May consider incorporating in Phase 2.
Human Footprint (Inverse potentially as Intact Areas)	IHS (oil & gas only)	potentially	Considered for Phase 2. Only covers oil and gas but covers both AB & SK so could be added to comprehensive human footprint layer
	Canada Access	exclude	Is the best available, comprehensive dataset. Likely not to use as older dataset with large buffer, looking to leverage newer data to create specific footprint dataset
	ABMI Human Footprint (open source component)	potentially	Only available for Alberta, looking into SK comparable dataset for Phase 2
	Environment Canada Anthropogenic Disturbance for Canada Boreal (2008 – 2010 imagery)	potentially	Considered for Phase 2. Only cover the boreal portion of study area.
	Net Present Value	potentially	Provides a good overall summary, only in AB, recommend potentially using if proxy in SK can be found. Potential for Phase 2

Caribou	Caribou Ranges	include	Used in Phase 1 as key planning & focus species of interest
	Caribou Resource Selection Function (RSF)	potentially	Was not available during Phase 1 but potential for use in Phase 2. Seeking permission for spatial data use.
	Arsenault Caribou Habitat Preferences	include / analysis	Used theory to develop high-use caribou habitat for Phase 1
	Caribou Telemetry (Alberta)	include / analysis	Used telemetry points to assist with development of high-use caribou habitat for Phase 1
	Caribou Telemetry (Saskatchewan)	include / analysis	Used telemetry points to assist with development of high-use caribou habitat for Phase 1
Waterfowl	Barker Waterfowl Abundance	include	Used to evaluate waterfowl abundance within the AEI for Phase 1
	DUC's NFWF Waterfowl Abundance	exclude	Incomplete dataset for the AEI, opted not to use moving forward
	Boreal Avian Modelling Project Song Bird Relative Density Projections	potentially	Considered for Phase 2. Consists of current and future relative density rasters for individual song bird species.

COARSE FILTER FEATURES			
Conservation Feature	**Datasets**	**Decision**	**Rationale**
Carbon	Tarnocai Soil Organic Carbon	include	Used for Canada-wide carbon estimates in Phase 1, generally accepted and published
	DUC's EWC Carbon Estimates	exclude	Preliminary subsurface wetland carbon estimates for Boreal Plains, as only in draft stages did not use for Phase 1
Biodiversity	DUC Biodiversity Tool	potentially / analysis	Alberta specific product, consider doing additional analysis to expand to SK for inclusion in Phase 2
	Bird Richness	potentially	Very broad overview data of bird species richness, may be too broad for AEI. Re-evaluate utility for fine filter in Phase 2
	Mammal Richness	potentially	Very broad overview data of mammal species richness, may be too broad for AEI. Re-evaluate utility for fine filter in Phase 2
	Tree Richness	potentially	Very broad overview data of tree species richness, may be too broad for AEI. Re-evaluate utility for fine filter in Phase 2

Appendix B. Conservation Feature Results

B.1 Surficial Geology

Table B1 – Surficial Geology summary table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Surficial Geology Classes	**AEI Value (ha)**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
Alluvial Deposits	291,379	1.40%	173,643	59.60%	0	0.00%	0	0.00%	173,643	59.60%
Coarse-grained Glacio-Lacustrine	625,513	3.00%	102,425	16.40%	12,662	2.00%	20,261	3.20%	135,348	21.60%
Eolian Deposits	477,044	2.30%	188,617	39.50%	0	0.00%	0	0.00%	188,617	39.50%
Fine-grained Glacio-Lacustrine (combined)	2,673,060	12.90%	193,009	7.20%	10,333	0.40%	48,547	1.80%	251,889	9.40%
Glaciofluvial Complex	181,612	0.90%	13,012	7.20%	140	0.10%	0	0.00%	13,152	7.20%
Glaciofluvial Plain	1,399,971	6.80%	182,805	13.10%	14,228	1.00%	1,384	0.10%	198,416	14.20%
Organic Deposits	1,522,201	7.40%	58,173	3.80%	2,104	0.10%	0	0.00%	60,277	4.00%
Till Blanket (combined)	12,755,103	61.80%	1,124,283	8.80%	93,826	0.70%	92,333	0.70%	1,310,442	10.30%
Till Veneer	99,610	0.50%	36,039	36.20%	0	0.00%	23	0.00%	36,062	36.20%

B.2 Land Cover

Table B2 – Land Cover summary table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Land Cover Classes	**AEI Value (ha)**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
Broadleaf (combined)	2,886,501	14.00%	286,821	9.90%	46,505	1.60%	22,313	0.80%	355,639	12.30%
Coniferous (combined)	3,084,249	14.90%	427,883	13.90%	4,837	0.20%	38,360	1.20%	471,080	15.30%
Mixedwood (combined)	871,652	4.20%	90,860	10.40%	11,390	1.30%	9,237	1.10%	111,487	12.80%
Shrub	720,326	3.50%	37,055	5.10%	2,694	0.40%	1,187	0.20%	40,935	5.70%
Water	1,326,949	6.40%	146,842	11.10%	5,922	0.40%	6,900	0.50%	159,665	12.00%
Wetland - Bog	1,740,904	8.40%	149,549	8.60%	438	0.00%	13,578	0.80%	163,565	9.40%
Wetland - Fen	4,189,500	20.30%	463,234	11.10%	16,154	0.40%	38,364	0.90%	517,752	12.40%
Wetland - Marsh	223,056	1.10%	18,610	8.30%	4,603	2.10%	923	0.40%	24,136	10.80%
Wetland - Swamp	2,731,808	13.20%	247,099	9.00%	13,888	0.50%	20,418	0.70%	281,406	10.30%
Wetland - general	2,024,535	9.80%	280,489	13.90%	12,099	0.60%	10,254	0.50%	302,841	15.00%
Other (combined)	851,908	4.10%	15,401	1.80%	15,939	1.90%	1,078	0.10%	32,418	3.80%

B.3 Gross Primary Production

Table B3 – Gross Primary Production Summary Table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Gross Primary Production	**AEI Value**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
Gross Primary Production	1,760,007,841	n/a	177,347,409	10.10%	11,027,365	0.60%	14,326,523	0.80%	202,701,298	11.50%

B.4 Soil Organic Carbon

Table B4 – Soil Organic Carbon Summary Table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Soil Organic Carbon	**AEI Value**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
Soil Organic Carbon	10,346,007,517	n/a	943,919,948	9.10%	23,329,840	0.20%	107,187,335	1.00%	1,074,437,123	10.40%

B.5 Lake-Edge Density

Table B5 – Lake-Edge Density Summary Table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Lake-Edge Density	**AEI Value (ha)**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
LED Low	6,684,107	10.50%	644,971	9.65%	10,996	0.16%	46,475	0.70%	702,442	10.51%
LED Medium	6,980,954	10.80%	645,166	9.24%	31,719	0.45%	79,830	1.14%	756,714	10.84%
LED High	6,986,326	14.30%	873,706	12.51%	91,755	1.31%	36,306	0.52%	1,001,768	14.34%

B.6 Caribou Ranges

Table B6 – Caribou Ranges Summary Table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Caribou Ranges	**AEI Value (ha)**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
Cold Lake	672,422	3.30%	33,002	4.90%	0	0.00%	0	0.00%	33,002	4.90%
East Side Athabasca River	1,315,980	6.40%	115,829	8.80%	0	0.00%	29,346	2.20%	145,175	11.00%
Nipisi	210,514	1.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Red Earth	2,410,960	11.70%	612,309	25.40%	0	0.00%	0	0.00%	612,309	25.40%
Richardson	464,333	2.20%	146,302	31.50%	0	0.00%	0	0.00%	146,302	31.50%
Saskatchewan Boreal Plains	5,103,308	24.70%	443,689	8.70%	17,741	0.30%	0	0.00%	461,430	9.00%
West Side Athabasca River	1,572,652	7.60%	363	0.00%	0	0.00%	0	0.00%	363	0.00%

B.7 Waterfowl Abundance

Table B7 – Waterfowl Abundance Summary Table

SUMMARY TABLE	Area of Ecological Influence		Protected Areas (IA, IB, II, III)		Protected Areas (IV, V, VI)		Protected Areas (N/A)		Combined Protected Areas	
Waterfowl Abundance	**AEI Value**	**% in AEI**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**	**PA Value**	**% of Total**
Waterfowl Abundance	160,239	n/a	12,392	7.70%	2,956	1.80%	575	0.40%	15,922	9.90%

Appendix C. Existing Protected Areas Assessment Results

C.1 IUCN Category IA, IB, II, & III

Table C1 - IUCN Category IA, IB, II, & III Summary Table

GAP ASSESSMENT SUMMARY	Protected Areas (IUCN IA, IB, II, & III)				
COARSE FILTER FEATURES	**Proportional**	**5%**	**10%**	**15%**	**30%**
Surficial Geology	6/9	8/9	5/9	4/9	3/9
Land Cover	6/11	10/11	5/11	0/11	0/11
Gross Primary Production	n/a	1/1	1/1	0/1	0/1
Soil Organic Carbon	n/a	1/1	0/1	0/1	0/1
Lake-Edge Density	0/3	3/3	1/3	0/3	0/3
Caribou Ranges	4/7	4/7	2/7	2/7	1/7
Waterfowl Abundance	n/a	1/1	0/1	0/1	0/1
TOTAL FEATURES REPRESENTED	16/30	28/33	14/33	6/33	4/33
% OF FEATURES REPRESENTED	53.3%	84.8%	42.4%	18.2%	12.1%

C. 2 IUCN Category IV, V, & VI

Table C2 – IUCN Category IV, V, & VI Summary Table

GAP ASSESSMENT SUMMARY	Protected Areas (IUCN IV, V, & VI)				
COARSE FILTER FEATURES	**Proportional**	**5%**	**10%**	**15%**	**30%**
Surficial Geology	0/9	0/9	0/9	0/9	0/9
Land Cover	1/11	0/11	0/11	0/11	0/11
Gross Primary Production	n/a	0/1	0/1	0/1	0/1
Soil Organic Carbon	n/a	0/1	0/1	0/1	0/1
Lake-Edge Density	0/3	0/3	0/3	0/3	0/3
Caribou Ranges	0/7	0/7	0/7	0/7	0/7
Waterfowl Abundance	n/a	0/1	0/1	0/1	0/1
TOTAL FEATURES REPRESENTED	1/30	0/33	0/33	0/33	0/33
% OF FEATURES REPRESENTED	3.3%	0.0%	0.0%	0.0%	0.0%

C.3 IUCN Category N/A

Table C3 – IUCN N/A Category Summary Table

GAP ASSESSMENT SUMMARY	Protected Areas (IUCN N/A)				
COARSE FILTER FEATURES	**Proportional**	**5%**	**10%**	**15%**	**30%**
Surficial Geology	1/9	0/9	0/9	0/9	0/9
Land Cover	0/11	0/11	0/11	0/11	0/11
Gross Primary Production	n/a	0/1	0/1	0/1	0/1
Soil Organic Carbon	n/a	0/1	0/1	0/1	0/1
Lake-Edge Density	0/3	0/3	0/3	0/3	0/3
Caribou Ranges	0/7	0/7	0/7	0/7	0/7
Waterfowl Abundance	n/a	0/1	0/1	0/1	0/1
TOTAL FEATURES REPRESENTED	1/30	0/33	0/33	0/33	0/33
% OF FEATURES REPRESENTED	3.3%	0.0%	0.0%	0.0%	0.0%