BEAVER HILLS INITIATIVE

STATE OF THE BEAVER HILLS REPORT

Submitted to:

Research and Monitoring Working Group
Beaver Hills Initiative
Sherwood Park, AB

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EE26361

EXECUTIVE SUMMARY

Introduction

The Beaver Hills is a distinct glacial moraine located in central Alberta just east of the Edmonton Capital Region. It encompasses portions of five counties and includes Elk Island National Park in its entirety. The Beaver Hills Initiative (BHI) was formed in 2002 in response to rapid economic growth and activity in and around the Beaver Hills and a desire to foster collaboration among stakeholders to ensure the maintenance of ecological conservation and sustainable use of the Beaver Hills. Presently, the Beaver Hills Initiative is pursuing a Biosphere Reserve designation for the Beaver Hills under the United Nations Education, Scientific and Cultural Organization's (UNESCO's) Man and the Biosphere Programme.

The Beaver Hills Initiative has defined the State of the Beaver Hills reporting as a critical component in monitoring the change of the landscape, including land use patterns and impacts of land management practices. As a first step in establishing the monitoring program, the Beaver Hills Initiative developed a preliminary set of 35 indicators intended to define the State of the Beaver Hills reporting. A cost-benefit evaluation was conducted on the preliminary list of indicators which weighed the cost of the indicator against its benefit in terms of understanding the impact of management actions on the ecological, economic and social state of the Beaver Hills. Based on the results of the cost-benefit evaluation, a total of 23 indicators were selected for inclusion in the initial State of the Beaver Hills report.

This initial State of the Beaver Hills report provides a focused presentation on the status of indicators selected to track changes within the Beaver Hills. The report provides a 'snap-shot' of existing conditions in the Beaver Hills through these indicators. The State of the Beaver Hills reporting will be updated every five years to provide on-going documentation of changes in the landscape, land management practices, socio-economic conditions and policy direction to allow periodic assessment of management activities

Land Indicators

The BHI's guiding principle for land management is to "encourage an appropriate mix of agricultural, industrial and residential development in areas with lower environmental sensitivity and maximum potential for sustainable business operations" (BHI 2015). Twelve indicators related to land management were assessed, and the status of these indicators is summarized in Table EX1 following.

Table EX1: Status of Land Indicators

Indicator	Status
Shorelines and streambanks with development	Within the Beaver Hills, less than two percent of watercourse streambanks and water body (lakes and wetlands) shorelines overlap developed areas.
Streambanks and shorelines protected by permanent vegetation	A substantial portion (73 %) of the watercourse streambanks and water body shorelines within the Beaver Hills are protected by permanent vegetation cover.
Areal extent of land use sectors	In the Beaver Hills, Agriculture is the dominant land use zone (51%), followed by conservation areas (26%) and country residential zones (12%). All other land use zones combined account for 11% of the Beaver Hills.
Intact quarter sections and linear development	Approximately 504 parcels have areas of 155 acres to 165 acres, indicating that they are intact or nearly intact quarter sections (an intact quarter section is 160 acres). Over 4,000 km of linear developments with an overall density of 256 km/km^2 exists within the Beaver Hills.
Wetland distribution	Wetlands account for 33% of the total area of the Beaver Hills.
Habitat extent	Natural habitats occupy 57% of the Beaver Hills with 29% classified as semi-natural habitats. Anthropogenic areas account for a very small portion (2%) of the total area.
Habitat fragmentation	Natural habitats have an average patch size of 8 ha and a patch density of 10 patches/100 ha. Semi-natural habitats have an average patch size of 11 ha and patch density of 8 patches/100 ha. Anthropogenic areas have small patch sizes (2 ha) and high patch densities (42 patches/100 ha).
Soil cover	Less than 1% of the total area of the Beaver Hills, was classified as bare soils.
Soil capability related to land cover and land use	A majority (92%) of soils within the Beaver Hills are considered to have moderately severe to very severe limitations for agricultural capability, or capable only of producing perennial forage crops. Agriculture accounts for greater than 50% of the extent of most soil capability classes. The proportion of other land use zones (country residential and conservation zones) generally increases as soil capability decreases. Natural habitats more commonly occur on soils that have lower capability classes. As land capability class increases, the proportion of the land cover class that is occupied by semi-natural habitats decreases.

Air Indicators

The guiding principle behind the air indicators is “industrial growth in the region will maintain air quality standards” and “air quality in Beaver Hills requires monitoring to ensure recommendations can be made to maintain or improve air quality” (BHI 2015). The status of the two indicators assessed, ambient air quality and drought index, relating to the air guiding principle are summarized in Table EX2.

Table EX2: Status of Air Indicators

Indicator	Status
Ambient air quality	Based on analysis of most recent 12-month air quality data for fine particulate levels, ozone, nitrogen dioxide, and sulphur dioxide, compared against the Air Quality Health Index (AQHI), the air quality health risk is rated as Low Risk or Moderate Risk categories for the majority of the time.
Drought Index	Based on Palmer Drought Index, conditions ranged from severe drought to slightly wet conditions from 2009 to 2014. Although conditions varied from year to year, there appears to be a general trend of conditions becoming increasingly wet from 2009 to 2014.

Water Indicators

The guiding principle behind water management is "maintaining function of local watersheds to sustain regional surface and groundwater systems; and sustaining local watersheds to maintain the water quality of surface and groundwater systems" (BHI 2015). Of these five indicators initially proposed for inclusion, two were determined to be highly applicable with sufficient supporting data available, making them feasible for inclusion in the State of the Beaver Hills Report. Three indicators were excluded based on data limitations, including: 1) nitrogen and phosphorous levels, contaminants, sediment load; 2) stormwater management systems – natural or man-made; and 3) supply and demand (water footprint analysis). The status of the water indicators evaluated for this report are summarized in Table EX3.

Table EX3: Status of Water Indicators

Indicator	Status
Trend in lake levels	For those lakes with available lake level data, lake levels have been consistently rated as 'Below Normal' or 'Much Below Normal" from 2004-2008 and have remained 'Much Below Normal" since 2008.
Well siting, well abandonment and well density	Water well density ranges from 0 wells per section to 122 wells per section within the Beaver Hills. A total of 184 sections (27% of the total number of sections) do not currently contain a water well. Seventy-seven percent of the sections have fewer than 12 water wells located within. Oil and gas well density by section ranges from 0 to 28 wells per section within the Beaver Hills. In terms of distribution, 54% of the quarter sections have no oil or gas wells and 96% of the quarter sections have four or fewer wells.

Biodiversity Indicators

The guiding principle behind biodiversity in the Beaver Hills is "existing natural wetlands and associated riparian upland margins will be conserved, both in regards to their biodiversity and their ecological functioning habitats; development will retain native upland habitats prominently featured within the Beaver Hills to maintain the majority of the existing green space and its associated biodiversity (BHI 2015). The status of the four indicators assessed are summarized in Table EX4.

Table EX4: Status of Biodiversity Indicators

Indicator	Status
Protected habitats	In total, protected areas occupy approximately 27% of the total area of the Beaver Hills.
Natural and human created edges	Human-created edges are more common than natural edges in the Beaver Hills, where human-created edges account for 56% of the total length of edges and natural edges account for the remaining 44%.
Invasive species	Fifteen noxious weed species and four prohibited noxious (as defined by the *Alberta Weed Control Act*) weed species are noted within the counties comprising the Beaver Hills. No aquatic invasive species or invasive animals were found to occur within the Beaver Hills.
Species of conservation concern	A total of 37 bird species, six mammals, three amphibians and three reptiles were reported as occurring within the Beaver Hills. A total of 38 plants that are tracked by ACIMS have previously been reported within the Beaver Hills of which 16 are listed by provincial or federal conservation lists. No listed fish species were reported to occur within the Beaver Hills.

Quality of Life

The BHI guiding principle behind quality of life is the "unique essential character of the Beaver Hills will be conserved in its natural beauty" (BHI 2015). The status of the six indicators selected are presented in Table EX5.

Table EX5: Status of Quality of Life Indicators

Indicator	Status
Community/Stewardship groups	The BHI has identified 40 various community/stewardship groups located or operating in the Beaver Hills.
Population	The population density is between zero and 1000 people per square kilometre for the majority of the Beaver Hills. A small area that overlaps with Sherwood Park has population density ranges between 1000 and 4000 people per square kilometre.
Employment	The five counties that overlap the Beaver Hills have representation in all employment sectors; however, there are some sectors that are over or under-represented relative to employment by sector for the Province of Alberta. Four of the five counties that overlap the Beaver Hills have unemployment rates that are lower than the unemployment rate for the Province of Alberta.
Access to natural areas and recreation facilities	Within the Beaver Hills there is one national park; eleven provincially-identified recreational areas, natural areas or bird sanctuary, one municipal wilderness recreational facility as well as a variety of smaller conservation areas and crowns reservations. All residentially-zoned areas are within 10 km of at least one natural area or recreational facility.
Tourism	Tourist visits data for Elk Island National Park, Miquelon Provincial Park, Strathcona Wilderness Centre and the Ukrainian Cultural Heritage Village indicate that these facilities are well visited.
Regional Planning	There are at least 27 regional planning mechanisms to manage land use overlapping the Beaver Hills.

Conclusion

Through the analysis of the selected indicators, this report highlights the unique environmental, social and economic conditions that exist within the Beaver Hills. As is evident through the land and biodiversity indicators, the landscape of the Beaver Hills retains a high proportion of areas of little to no human development, within a substantial portion of the Beaver Hills (27%) contained within a variety of conservation areas. The mix of natural, semi-natural and anthropogenic habitats offers a unique mosaic of habitats and land cover types. The quality of life indicators reflect the agricultural nature of the Beaver Hills, in terms of population density, employment, and land use zoning of the overlapping counties. The Beaver Hills provides for a number of cultural, ecotourism and recreational opportunities which are well attended, as reflected by the tourism visitor statistics.

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1.0 INTRODUCTION

The Beaver Hills is a distinct glacial moraine located in central Alberta just east of the Edmonton Capital Region. It encompasses portions of five counties and includes Elk Island National Park in its entirety (Figure 1). Rapid economic growth and activity in and around the Beaver Hills has placed unprecedented pressure on the landscape and its resident wildlife and plant communities. In 2002, the Beaver Hills Initiative (BHI) formed to recognize that government, academia, industry, environmental non-governmental organizations and residents are all stakeholders in the continued ecological conservation and sustainable use of the Beaver Hills. Presently, the Beaver Hills Initiative is pursuing a Biosphere Reserve designation of the Beaver Hills under the United Nations Education, Scientific and Cultural Organization's (UNESCO's) Man and the Biosphere Programme.

The BHI has defined the State of the Beaver Hills reporting as a critical component in monitoring the change of the landscape, including land use patterns and impacts of land management practices. Understanding the state of environmental, economic and social conditions in the Beaver Hills, and how these factors change over time, will aid the BHI and stakeholders in evaluating the effectiveness of management and policy implemented in the region. Additionally, it will help identify areas of focus for future research, management and policy direction.

In consideration of the BHI's Biosphere reserve application, the State of the Beaver Hills reporting is intended to support, in part, Biosphere Reserve Designation Periodic Review requirements (UNESCO 2013). Biosphere Reserves are intended to support three primary functions: a conservation function, intended to contribute to the conservation of landscapes, ecosystems, and biodiversity; a development function, which should promote and foster sustainable human development; and a logistic function, which should enable education and training, research and monitoring as well as support for demonstration projects related to conservation and sustainable development (UNESCO 2013). Tracking of indicators relating to the human and social environment within the Beaver Hills will support the periodic review requirements as they relate to all three biosphere reserve functions.

This initial State of the Beaver Hills is not intended to be a comprehensive baseline assessment or description of the environment of the Beaver Hills; instead, this report is a focused presentation on the status of key indicators selected as benchmarks to track changes within the Beaver Hills. The report provides a 'snap-shot' of existing conditions in the Beaver Hills through these indicators. The State of the Beaver Hills reporting will be updated every five years to provide on-going documentation of changes in the landscape, land management practices, socio-economic conditions and policy direction to allow periodic assessment of management activities.

Figure 1: Beaver Hills Initiative Area

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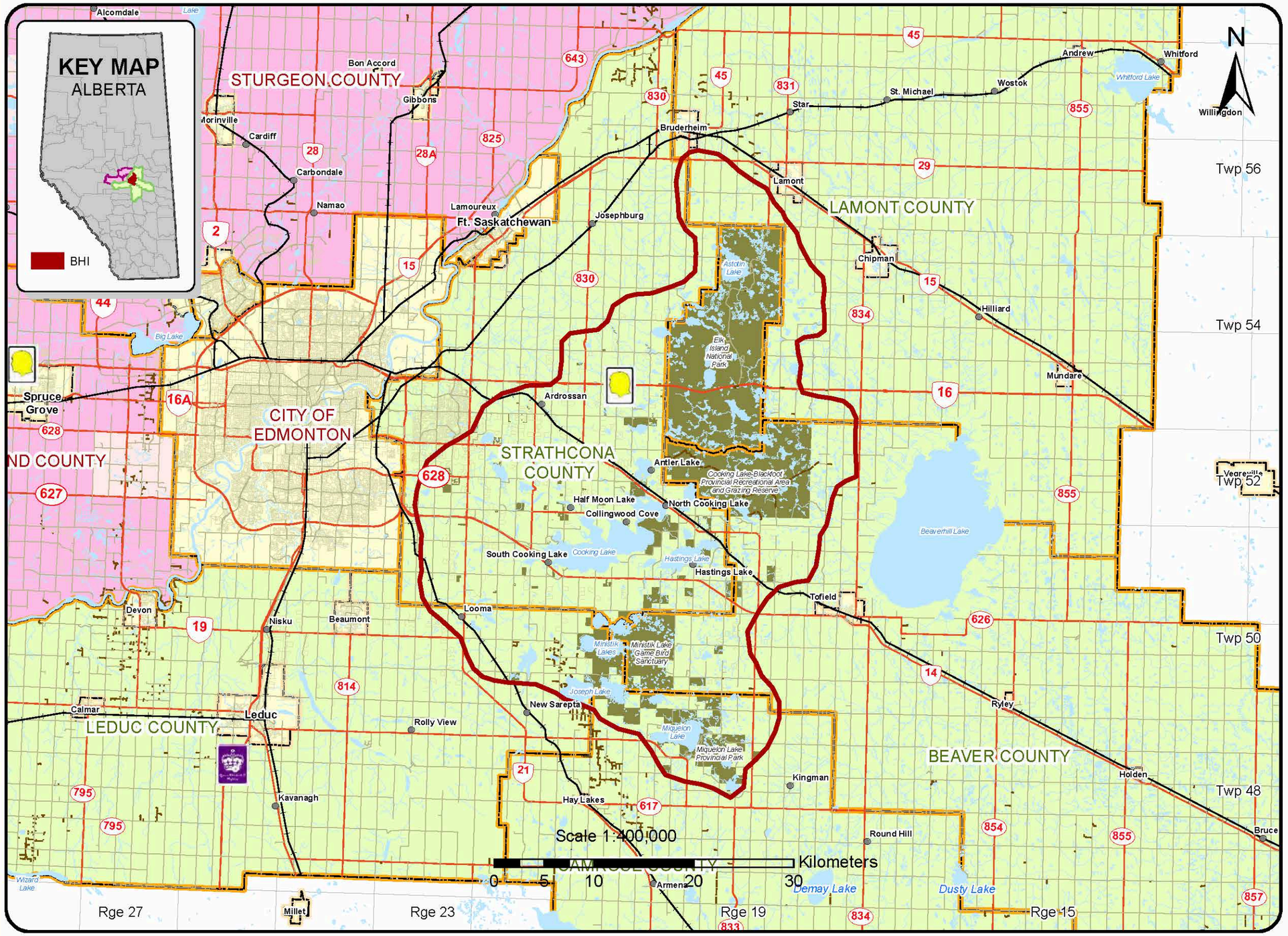

Legend

- Beaver Hills Initiative Area
- Populated Place

Roads / Railways

- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Waterbody
- Stream
- Protected Areas

Local Governments

- Urban
- Indian Reserve
- Adjacent Municipalities
- Nearby Municipalities

References:
Base Features from AltaLIS
BHI Boundary from Parks Canada
NRN/NRWN from Geobase

Projection:
NAD 1983 UTM Zone 12

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2.0 ENVIRONMENT AND SOCIO-ECONOMIC SETTING

The Beaver Hills is a portion of the Dry Mixedwood Natural Subregion within the Central Parkland Natural Subregion (Downing and Pettapiece 2006). This regionally distinct zone combines biophysical characteristics of both the Boreal and Parkland natural regions, contributing to higher biodiversity compared to the surrounding landscape. The Dry Mixedwood Natural Subregion is generally characterized by undulating plains and hummocky uplands, with aspen-dominated forests in upland areas, and wetlands in lowland areas. The Central Parkland Natural Subregion consists of lands altered through cultivation and other agricultural practices, interspersed with aspen, wetlands and prairie vegetation on remnant native parkland areas, which are typically associated with hummocky till or eolian materials.

The Beaver Hills moraine is a distinct geomorphological feature. The moraine is comprised of hummocky “knob and kettle” terrain, typical of stagnant ice marginal conditions during the last glaciation. This landscape supports the development of many wetlands and small lakes, in combination with dry upland sites, which results in a diversity of ecological communities. In addition, the rough terrain of the Beaver Hills has inhibited intensive agricultural activities (especially cultivation) at the large scale, resulting in an area of extensively treed mixedwood which stands out from the surrounding landscape. This combination of regionally unique landforms and the diversity of ecological communities make the Beaver Hills an area of biophysical importance.

The Beaver Hills consists of five different rural municipalities, including: Strathcona County, Lamont County, Leduc County, Camrose County, and Beaver County. It is also home to Elk Island National Park, one provincial park, one provincial recreation area and six natural areas. Proximity to the urban center of the City of Edmonton (less than an hour away) and the Alberta Capital Region, currently the second fastest growing metropolitan region in Canada, makes it an attractive place to reside and recreate. As a result, the area faces increasing pressures from various types of developments, including residential, industrial, commercial, tourism and recreation.

3.0 APPROACH AND METHODS

As human development continues to place increasing pressure on biophysical resources, increased efforts to monitor and assess the status and trends of changing environmental conditions have been implemented, both locally and globally. In an effort to practice sustainable development, both the biophysical and socioeconomic conditions must be understood through ongoing monitoring and assessment, such that the results provide effective long term planning.

Indicators are parameters that can be tracked to provide information on one or more aspects of a complex socio or ecological system, in order to provide insight into the status and functioning of these systems (Heink and Kowarik 2010). Indicators should also be reflective of changes in policy and management practices, and as such, provide a means to monitor that change. Prior to initiating the State of the Beaver Hills reporting, the BHI developed a set of indicators intended to monitor the status of environmental and social aspects of the landscape, land use patterns, and land management practices within the Beaver Hills. The indicator selection was guided by the pressure-state-response framework, which places indicators in a policy and management context where indicators measure pressures on resources, the effects of the pressures upon the state of the resource quality, and the response of society to the changes (Pieri et al. 1995).

The first step of developing this initial State of the Beaver Hills report was to undertake a cost-benefit evaluation of the preliminary suite of indicators selected by the BHI. The evaluation weighed the cost of the indicator against its benefit in terms of understanding the impact of management actions on the ecological, economic and social state of the Beaver Hills. In this context, the cost is the commitment in terms of money and personnel time for collecting, managing, and interpreting data related to an indicator, while the benefit is related to how well the indicator reflects a measure of interest. Based on the cost-benefit evaluation of the preliminary indicators selected by the BHI, a subset of indicators were selected for inclusion in the initial State of the Beaver Hills report. More information on cost-benefit evaluation and the full suite of indicators initially considered is provided in the *Beaver Hills Initiative State of the Beaver Hills Report Indicator Cost Benefit Analysis* report (AMEC 2014).

The overall intent to the initial State of the Beaver Hills report is to determine the current status of the selected indicators. To achieve this, existing datasets collected and compiled or those from publicly available and accessible sources were utilized. Some of the indicators required geographical information systems (GIS) analysis to evaluate the status of the indicator. When selecting data to be used for indicator analysis, preference was given to datasets that are updated on a regular basis or re-produced frequently and prepared using standardized methods. This will enable future re-calculation of the indicator status and allow comparison over time. Due to the variety of methods used to analyze the different indicators, each indicator is discussed separately in terms of specific data sources and analysis methods.

4.0 STATE OF BEAVER HILLS

The following presents the current status of each of the indicators chosen for inclusion from the five principles of the BHI: Land, Air, Water, Biodiversity, and Quality of Life. The status of each of these indicators provides an overview of the current State of the Beaver Hills.

4.1 LAND

The BHI's guiding principle for land management is to "encourage an appropriate mix of agricultural, industrial and residential development in areas with lower environmental sensitivity and maximum potential for sustainable business operations" (BHI 2015). Sustainable development on the land base is vital as land resources provide several essential ecological goods and services. By tracking land based indicators, effects of land management practices can be tracked and land management practices can be changed if desired outcomes are not being met. The following indicators were chosen to represent different aspects of the guiding principle and to track success in meeting land management goals.

Twelve indicators related to land were proposed for analysis by the BHI based on the cost-benefit analysis. Of the 12, the following nine indicators were selected for inclusion in this report based on the availability of consistent and up to date data:

- Shoreline and streambanks with development
- Shorelines and streambanks with permanent vegetation cover
- Areal extent of land use sectors
- Intact quarter sections and density of linear development
- Wetland distribution
- Habitat types and connectivity
- Habitat fragmentation
- Soil cover
- Soil capability related to land cover and land use

Three indicators including: 1) Area and number of beneficial management practices adopted by multiple land use sectors, 2) Results of riparian health assessments, informed by the number of sites or km of riparian zone assessed, and 3) Carbon sequestration and carbon stocks were determined to not be feasible for inclusion in this report due primarily to data limitations. Some data for agricultural beneficial management practices exist, however, the data limitations range from currently not having available data for all land use sectors for analysis, to requiring too many resources for data analysis. Refer to the *Beaver Hills Initiative State of the Beaver Hills Report Indicator Cost Benefit Analysis* (AMEC 2014) report for the details of this evaluation. The nine indicators presented in this report were chosen on the basis of available and appropriate data sets and applicability of the indicator, and are presented and discussed in the following section.

4.1.1 Shorelines and Streambanks with Development

In general, waterbodies not impacted by anthropogenic development are typically healthier in terms of water quality and habitat attributes than waterbodies with a significant amount of human development immediately adjacent to, or in close proximity to, the shorelines. Tracking the length of shoreline with adjacent human development provides an indication of waterbody protection, and can be a proxy for waterbody health. Monitoring this indicator over time will indicate if land use pressures are resulting from development adjacent to shores of waterbodies, and land management plans and policies can be adjusted, if necessary, to meet BHI goals.

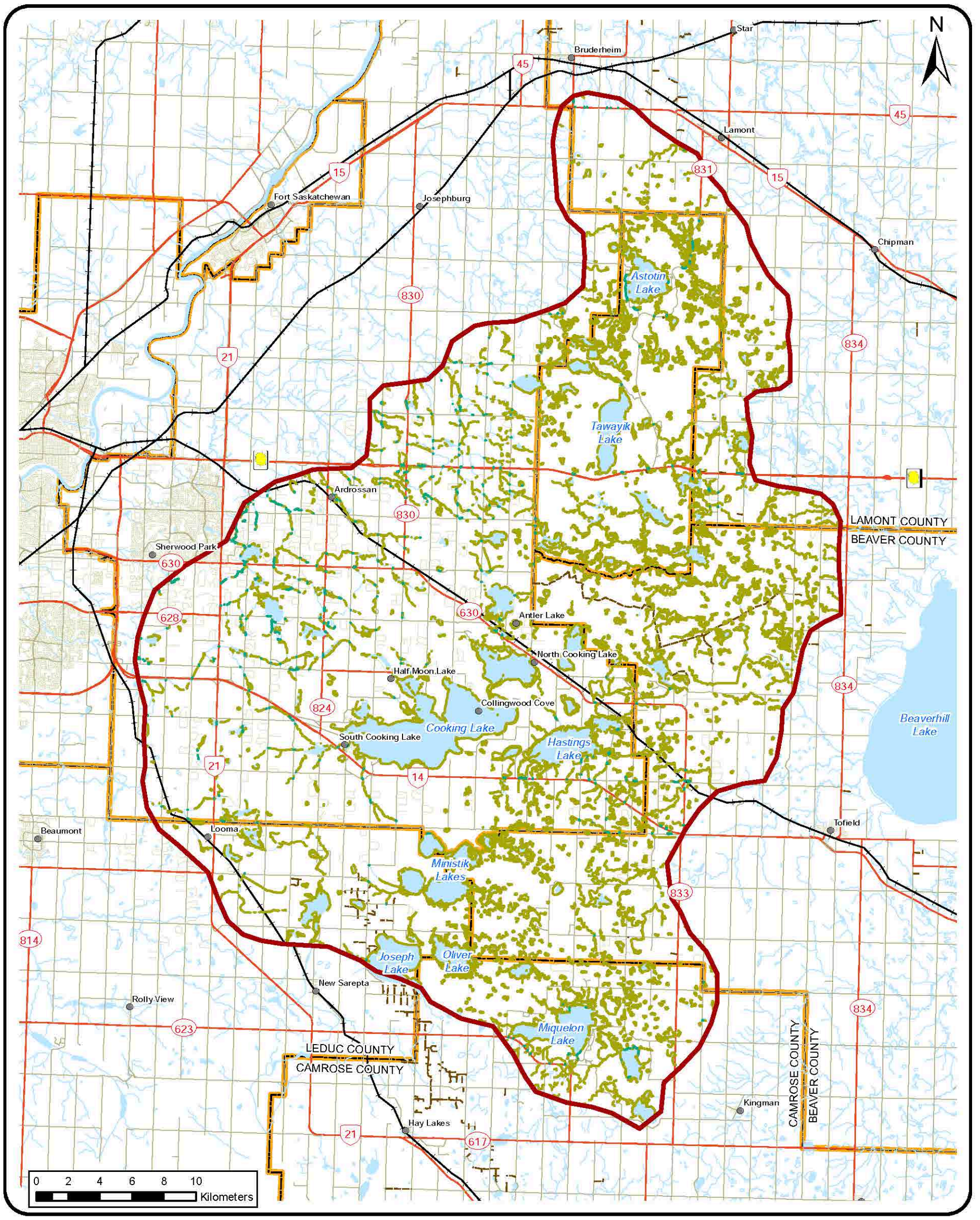
The length of shoreline or streambank with adjacent human development was estimated by calculating stream and shoreline lengths that occur within anthropogenic areas. Buffer widths were not defined as these widths are dependent on type of stream, adjacent land use, adjacent land cover, and vary between municipalities. For this analysis, anthropogenic areas were derived from 2013 Agriculture and Agri-Food Canada (AAFC) Annual Crop Inventory data (which classifies the landscape into both crop and non-crop land cover types; AAFC 2013), where the following land cover classes were interpreted as 'developed': bare-earth and urban/built-up. Using hydrology base data (1:20,000 scale hydrography) the linear length of water body (lake and pond) shoreline and watercourse length overlapping 'developed' areas was calculated. Results of the analysis are summarized in Table 1 and shown in Figure 2.

Within the Beaver Hills, less than two percent of watercourse streambanks and water body (lakes and wetlands) shorelines overlap developed areas. Proportionally, more development within the Beaver Hills has occurred adjacent to watercourses (2% of total watercourse shoreline) as compared to lakes (<1 % of total lake shoreline).

Table 1: Summary of Shoreline and Streambank Length with Development

	Watercourse Streambanks	Water Body Shorelines	Watercourse Streambanks and water Body Shorelines
Total Shoreline Length in Beaver Hills (km)	2,622	1,100	3,721
Shoreline Length with Development (km)	47	6	53
Shoreline Length with Development (% of total shoreline length)	2	<1	2

Figure 2: Shorelines and Streambanks



Legend

- Beaver Hills Initiative Area
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Stream
- Waterbody
- Lake Shoreline or Streambank Development
- Shoreline or Streambank Protected with Vegetated Buffer

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References:
Base Features from AltaLIS
NRN/NRWN from Geogratis/Geobase
AAFC Land Cover Crop Inventory, 2013
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Projection:
NAD 1983 UTM Zone 12N

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4.1.2 Shorelines and Streambanks with Permanent Vegetation Cover

Retaining riparian areas or permanent vegetation adjacent to water bodies helps to maintain healthy aquatic ecosystems through a variety of ways including: they can function to improve water quality, through filtering and cycling of nutrients and sediments; provide water storage and facilitate groundwater recharge; stabilize banks and reduce erosion; and contribute to aquatic and terrestrial habitat (ESRD 2012b). Similar to Lake Shoreline and Streambank Development, tracking this indicator can provide insight into the general aquatic health of an area. In addition, it is useful for tracking land management practices and policies as they relate to effective riparian area management.

The length of shoreline or streambank with permanent vegetative cover was estimated by calculating stream and shoreline lengths that occur in areas with permanent vegetation. Permanent vegetation polygons were derived from 2013 AAFC Annual Crop Inventory land cover data (AAFC 2013), forested (mixed, deciduous, and coniferous), shrubland, grassland, wetland, and forages cover classes. Using hydrology base data (1:20,000 scale hydrography) the linear length of water body (lake and pond) and watercourse shorelines overlapping permanent vegetation polygons areas was calculated. Results of the analysis are summarized in Table 2 and shown in Figure 2.

The results of the analysis show that a substantial portion (73%) of the watercourse streambanks and water body shorelines within the Beaver Hills are protected by permanent vegetation cover. Proportionally, a higher percentage of watercourse streambanks are protected by permanent vegetation cover (75% of total) as compared to water body shorelines (68 % of total lake shoreline).

Table 2: Summary of Shorelines Protected with Permanent Vegetation Cover

	Watercourse Streambanks	Water Body Shorelines	Watercourse Streambanks and water Body Shorelines
Total Shoreline Length in Beaver Hills (km)	2,622	1,100	3,722
Shoreline Length Protected with Permanent Vegetation Cover (km)	1,967	748	2,715
Shoreline Length Protected with Permanent Vegetation Cover (% of total shoreline length)	75	68	73

4.1.3 Areal Extent of Land Use Sectors

The term 'land use' refers to human activities on the landscape. Land use affects the biophysical, social, and economic conditions of the Beaver Hills. Evaluating the current spatial distribution of land use sectors, and conducting regular monitoring and updating, enables the tracking of land use change, both spatially and temporally. This can help guide future land use planning and land management efforts, as well as, highlight land development trends in the Beaver Hills.

Land use is generally classified into broad categories or sectors, including: agriculture; energy and resource extraction; forestry; transportation; and recreation or tourism. Resolving the distribution and areal extent of land use sectors within a landscape can be difficult, as the use of a given area may not be evident directly from the land cover. Further, multiple land uses may occur within one land cover type (i.e., forested areas may be used for forestry and recreation). Although recent advances in geographic information systems and availability of geospatial data has resulted in improved methods to more accurately estimate the areal extent of land uses in a given landscape, these methods are data intensive, and generally reflect a combined analysis of land use and land cover. Based on these limitations, alternative data sets that could be used to spatially represent land use within the Beaver Hills were sought.

The majority of the lands within the Beaver Hills fall under jurisdiction of the respective local municipal governments; the remainder fall under jurisdiction of the provincial government (e.g. provincial parks and other provincially protected areas, provincial transportation networks) or in the case of Elk Island National Park, federal jurisdiction. The provincial legislation in the *Municipal Government Act* delegates authority for land use planning to local governments, who in turn, ensure that statutory and non-statutory plans guiding land use are in place. Statutory plans include municipal development plans, area structure plans and inter-municipal development plans which are updated every 10 years. Non-statutory plans include land use bylaws which are updated every five years and describe the types of, and criteria related to, the municipality's land use zoning. The land use bylaws provide a frequently updated and reasonably accurate picture of the current status of land use zoning within a given area.

Land use zoning is generally used by planning authorities (in the case of the Beaver Hills, the local municipal governments) as a tool for regulating development within the land use zoning plan area. The land use zoning provided in the land use bylaws can provide an indication of existing and intended land use within the bylaw area, and is suggested for inclusion in state of the watershed reporting in Alberta (Government of Alberta 2008). It is recognized that the land use zoning may not reflect all land use sectors, particularly, in the case of the Beaver Hills, energy uses relating to oil and gas development. However, the land use zoning bylaw data is readily available from the municipalities within the Beaver Hills and is updated every 5 years, providing a data set and analysis that can be updated and compared over time in future state of the Beaver Hills reporting.

Each county has developed its own land use zoning classifications. The existing land use zones for each municipality were reviewed and grouped into broader land use zones, as described following and summarized in Table A1, Appendix A.

- Agriculture – land zoned for agricultural use. While other uses may be permitted (i.e., associated residential uses or some industrial uses), the majority of the land in these zones is under agricultural use.
- Country Residential – land zoned primarily for low-density residential uses with lot sizes ranging from one hectare (1 ha) to greater than 8 ha and typically serviced with water wells and septic systems. Direct control land use zones were also included in this category.
- Residential – areas zoned for single family dwellings, multiple and high-density residential uses. Hamlet and rural center mixed land use zones were also included in this category.
- Commercial – areas zoned for various types and densities of commercial development.
- Industrial – areas zoned for industrial developments (e.g., this category includes the Heartland Industrial land use zone).
- Tourism/Recreational – areas zoned for recreational uses such as golf courses.
- Conservation – areas of the land with conservation protection restrictions. Although not included in municipal bylaws, Elk Island National Park and provincially designated parks and protected areas, were included in the conservation category. Although some grazing and recreation is permitted in the Blackfoot - Cooking Lake provincial recreation area, the overall use of the area is considered conservation and was included in this category for the purpose of this report.
- Transportation – land zoned for transportation, including provincial rights-of-ways for highways and statutory local road allowances.

Land use bylaw zoning data sets provided by the municipalities varied in terms of the spatial scale to which land use zones are delineated. For example, land use zoning data for Strathcona County was differentiated for individual title map parcels, whereas land use zoning for Camrose County differentiates land use zones at variable scales, depending on the zone, and does not exclude statutory road allowances. To create a consistent and unified land use zone data set, the title map data set (current to 2011, AltaLIS 2011) was used as the basis. Each parcel in the title map layer was manually classified based on reference to the land use bylaw zoning data sets and provincial and national datasets for municipal parks, protected areas, and recreation areas[1].

Table 3 summarizes the extent of each land use zone within the Beaver Hills, based on total area for each sector. Figure 3 depicts the spatial distribution of land use zoning categories. Agriculture, country residential and conservation land uses, combined, account for 90% of the total area of the Beaver Hills. Agriculture is the predominant land use zone, with 51% of the total

[1] See section 4.4.1 for further discussion and sources for parks, protected areas and recreation areas.

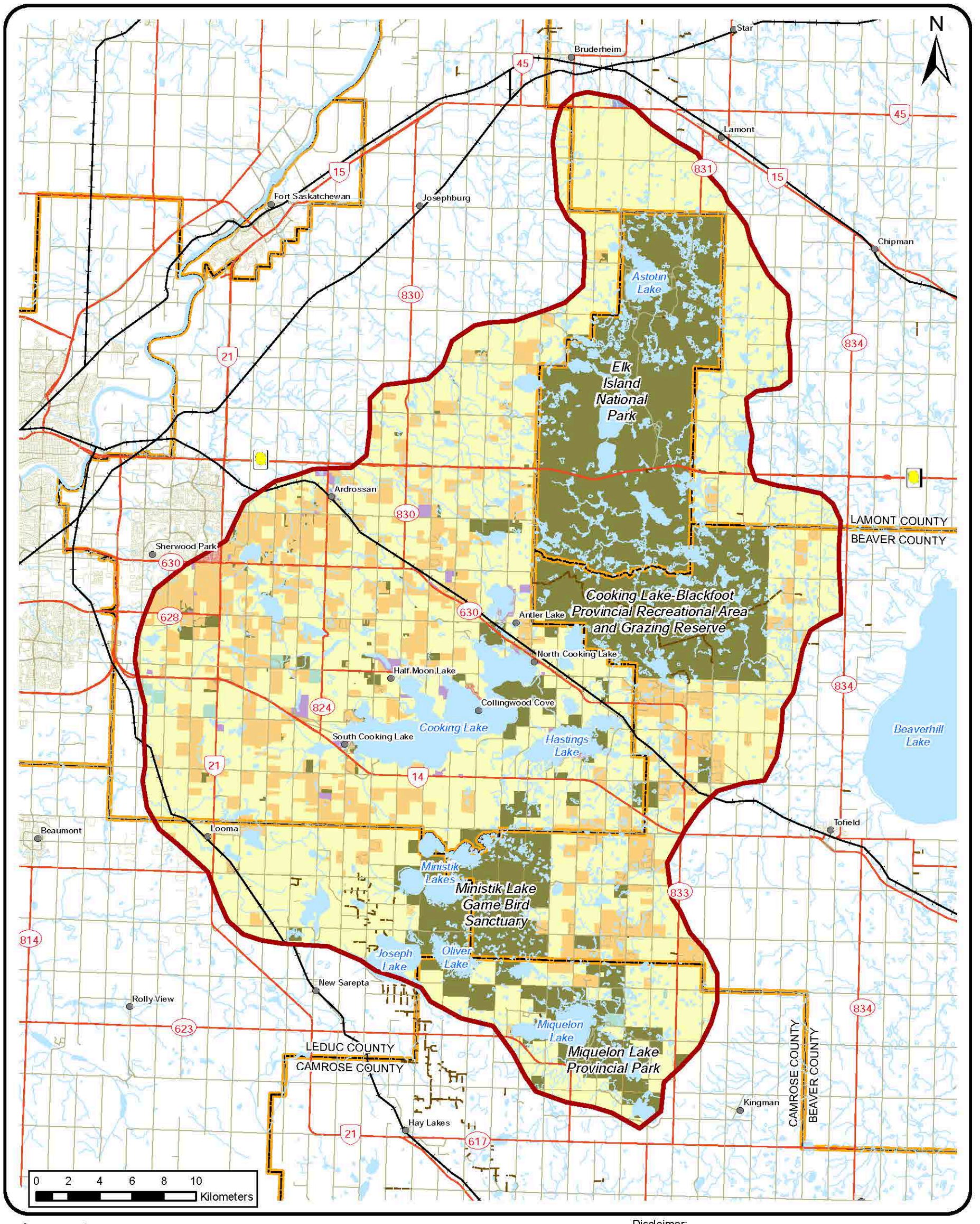
area of the Beaver Hills under agricultural land use. Conservation areas, including Elk Island National Park and provincial recreation areas and parks (e.g., Cooking Lake - Blackfoot Provincial Recreation Area) are the second largest land use zone, representing 26% of the total Beaver Hills. Country residential is the third largest land use, representing 12% of the total area of the Beaver Hills. The remaining land use zones, including commercial, residential, recreation/tourism, industrial, mixed and recreational, account for only 11% of the total area of the Beaver Hills.

Table 3: Land Use Zones within the Beaver Hills

Land Use Sector	Total Area (ha)	Percent of Total Area (%)
Agriculture	81,708	51
Country Residential	19,532	12
Residential	5,166	<1
Commercial	800	1
Industrial	58	<1
Tourism/Recreational	510	<1
Conservation	41,729	26
Transportation	5,166	3
Water Body[1]	10,107	6
Total	***159,735***	***100***

Notes: [1] Water bodies (e.g., large lakes) which were excluded from zoning on land use bylaw maps.

Figure 3: Land Use Zoning



Legend

- Beaver Hills Initiative Area
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Stream
- Waterbody

Zone

- Agriculture
- Country Residential
- Residential
- Commercial
- Industrial
- Recreation
- Conservation
- Transportation

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4.1.4 Intact Quarter Sections and Density of Linear Developments

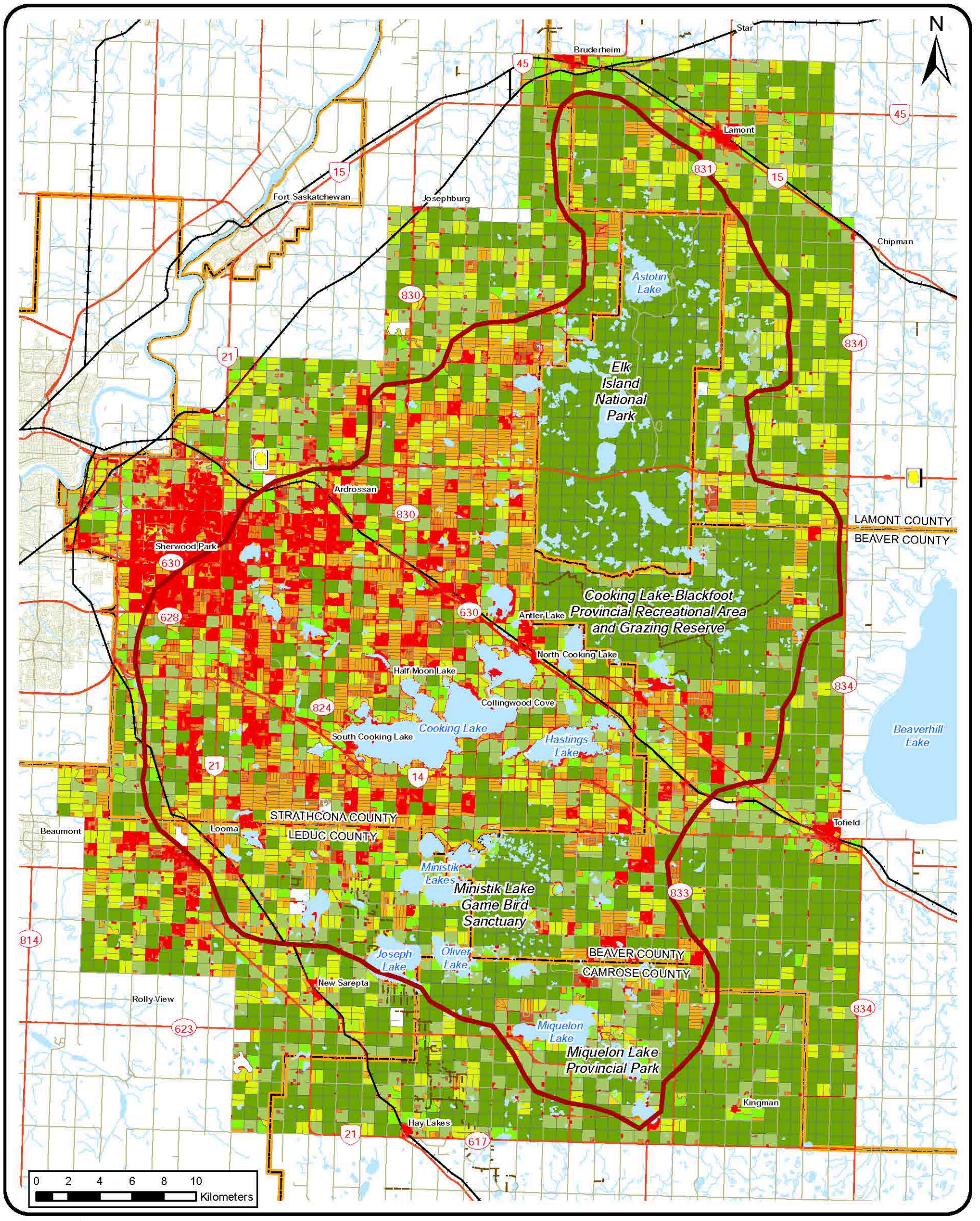
Landscape pattern is a fundamental principle of both landscape ecology and land use planning. These patterns help define biophysical movements and flows within the land base, as well as human use and movement. Measuring intact quarter sections and the density of linear disturbance is an indicator of fragmentation on the land base, caused by human development and the subdivision of land. In particular, measuring the changes of intact quarter sections could indirectly reflect country residential (e.g. rural residential) development, as this type of residential development typically involves the subdivision of quarter sections into smaller parcels. Country or rural residential development has seen increasing growth over the past forty years, and is an important parameter to track. This type of land use and land cover change can have impacts on the biophysical parameters of the landscape as parcels become more fragmented, increased transportation routes mean increased linear disturbances and the amount of impervious surface from residential developments increases. It also typically means a conversion of agricultural land to non-agricultural uses, indicating a change in the socioeconomic nature of the area and potential reduction in the provision of ecosystem services as a result of the loss of agricultural lands.

Intact Quarter Sections

Intact quarter sections, or parcelization, was evaluated using the 2011 title mapping (AltaLIS 2011). Prior to analysis, a topology inspection was completed and identified errors in the data set were corrected (e.g., gaps between polygons were corrected or infilled, duplicate polygons were removed). Once topology errors were addressed, parcel areas were categorized into 11 area based classes, in acres, consistent with previous analysis completed by the Beaver Hills Initiative. Protected areas were not included in the analysis.

The spatial distribution of parcel sizes within the Beaver Hills is presented in Figure 4. Within the Beaver Hills, 504 parcels have areas of 155 acres to 165 acres, indicating that they are intact or nearly intact quarter sections (an intact quarter section is 160 acres). Parcels within this range occur throughout the Beaver Hills, although a concentration of these parcels occur in the eastern and southern portions of the Beaver Hills. Parcel size tends to decrease in proximity to transportation corridors and urban or residential areas. Portions of the Beaver Hills nearest to Sherwood Park support the highest frequencies of parcels within the smallest size range (0-6 acres) occurring near Sherwood Park.

Figure 4: Parcel Sizes



Legend

- Waterbody
- Beaver Hills Initiative Area
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation

Parcel Areas (Acres)

- 0 - 6
- 7 - 11
- 12 - 22
- 23 - 42
- 43 - 62
- 63 - 82
- 83 - 102
- 103 - 125
- 126 - 154
- 155 - 165
- Protected Areas

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Density of Linear Development

Data on existing linear developments was compiled from AltaLIS's Base Features Access datasets (AltaLIS 2015), and included roads, railways, transmission lines, pipelines, and cutlines, as well as the BHI's mapping of trail systems within the Beaver Hills. Prior to merging, the BHI's recreational trail mapping was compared to the AltaLIS Base Features Access dataset to ensure that the data sets did not include duplicate features. No duplicate features were identified based on visual inspection of the data. The linear development data sets were merged into a single data set and total lengths for each type of linear development calculated.

Over 4,000 km of linear developments exist within the Beaver Hills, and combined, the overall density of linear development within the Beaver Hills is 256 km/km^2 (Table 4). Roads, ranging from multi-lane highways to truck trails, are the most common linear development type, accounting for 43% of the total length of linear developments within the Beaver Hills and have the highest individual density within the Beaver Hills (109 km/km^2). Cutline trails, which includes cutlines (linear clearings with light usages, which may include minor pipelines and seismic lines) and all-terrain vehicle trails, are the second most common type of linear development within the Beaver Hills. Pipelines and recreational trails are relatively less common, accounting for only 15% and 13%, respectively, of the total linear development length within the Beaver Hills.

Table 4: Linear Developments within the Beaver Hills

Linear Development Type	Linear Development Length (km)	Percentage of Total Linear Development in Beaver Hills	Density of Linear Development (km/km^2)
Road	1,742	43	109
Cutline Trail	1,127	28	71
Pipeline	599	15	38
Powerline	43	1	3
Railway	50	1	3
Recreational Trail	521	13	33
Total	***4,082***	***100***	256

4.1.5 Wetland Distribution

Wetlands, a common type of water feature that occurs in the landscapes of Alberta, are defined as lands that are saturated long enough to promote aquatic processes as indicated by the formation of water-altered soils, establishment of water tolerant plants, and biological activity that is adapted to wet environments (ESRD 2014b). Both organic wetlands, which have more than 40 cm of peat accumulation, or mineral wetlands, a mineral wetlands, shallow water bodies (<2 m) which occur on mineral soils (CWCS 1997). Mineral wetlands can vary in permanence from temporary or seasonal water bodies where water is present for only short periods of the year, to permanent water bodies that support open water areas year-round. Wetlands provide a host of ecological functions, including supporting biodiversity, providing flood mitigation and

water storage functions, water quality filtration and purification, as well as supporting a variety of human activities, particularly recreational pursuits (hunting and fishing) and ecotourism (ESRD 2014b).

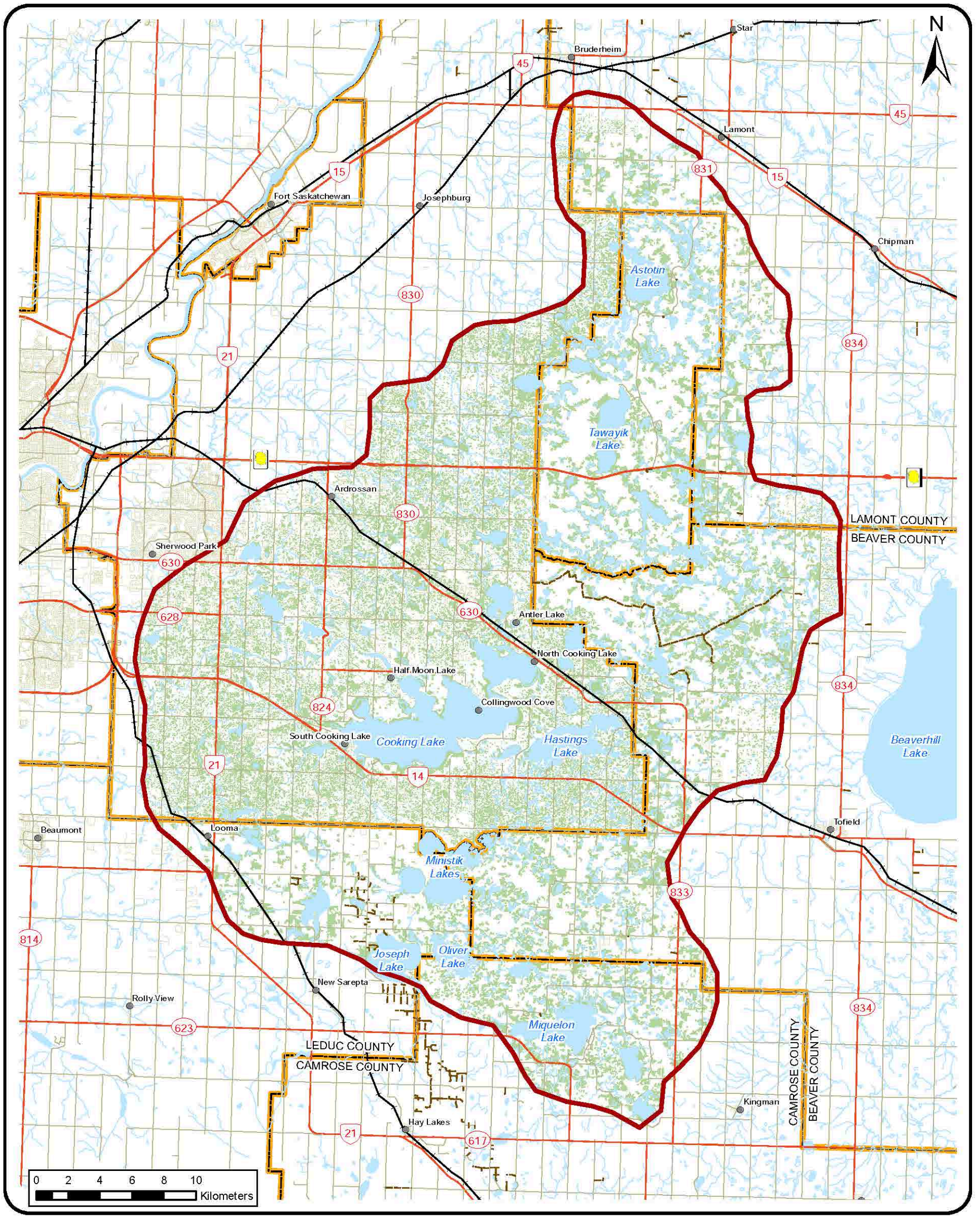
The *Alberta Wetland Policy* aims to conserve, protect, and manage Alberta's wetlands to sustain the benefits they provide to the environment, society and the economy (ESRD 2013). In recognition of the local and provincial significance of wetlands, understanding the existing distribution of wetlands within the Beaver Hills has been included as an indicator in this State of the Beaver Hills reporting. Evaluating the spatial extent of wetlands can aid in prioritizing land use and land management practices to conserve wetlands within the Beaver Hills. Furthermore, measuring changes in wetlands can assist in evaluating the effectiveness of land management practices in relation to changing climate and development pressures over time

In support of the *Alberta Wetland Policy*, Alberta Environment and Sustainable Development (ESRD) has compiled previously completed wetland mapping data sets into a single merged data set, the *Canadian Wetland Classification System (CWCS) Merged Wetland Inventory* (ESRD 2014a). Thirty individual wetland inventories, completed between 1998 and 2009 which utilized four different classification systems with differing base imagery and resolutions to map wetlands, were merged to create the data set (ESRD 2014a). Component wetlands within each of the thirty inventories were re-classified to the five major classes in the CWCS (NWWG 1997): marsh, bog, fen, swamp and open water. Although this data set is a valuable tool for wetland management in the province, and represents the best-available wetland data for the province, there are a number of limitations with this data set. The CWCS classes include 'shallow open water' as a major class of wetlands, however, the *CWCS Merged Wetland Inventory* has captured this class under the broader category of 'open water' and does not distinguish between open water wetlands and lakes. Furthermore, the *CWCS Merged Wetland Inventory* has not been field verified, and is not considered to provide definitive wetland boundaries.

Wetlands, as mapped by the *CWCS Merged Wetland Inventory*, account for 52,073 ha or 33% of the total area of the Beaver Hills. Spatial distribution of wetlands within the Beaver Hills is shown in Figure 6.

Analysis of the *CWCS Merged Wetland Inventory* provides a high level overview of the distribution of wetlands within the Beaver Hills. However, this data set is considered static; future updating is uncertain. Further updates would be anticipated to result in refinement of wetland delineations, improved methodologies and classifications. As such, future State of the Beaver Hills reporting will require evaluation of wetlands using an alternative data set or assessment methodology. It is recommended that using a rapid wetland function and benefit methodology to assess a set of pre-determined reference wetlands should be considered, in lieu of wetland class. Such methodologies are currently under development by ESRD, such as the Alberta Wetland Rapid Evaluation Tool and should be available in June of 2015 (ESRD 2015b).

Figure 5: Wetlands



Legend

- Populated Place
- Beaver Hills Initiative Area
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Open Water
- Wetland

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4.1.6 Habitat Extent and Connectivity

This indicator describes the areal extent, individual size, and connectivity of different habitats, waterbodies, and anthropogenic land developments. Tracking this specific indicator shows changes in the size of individual habitats and anthropogenic developments, in addition to the connectivity between the two. Connectivity is important for many landscape ecology principles, including the movement between and within different land cover types (Forman 1995).

Habitat Extent

For evaluating the extent and individual size of existing habitats within the Beaver Hills, habitats areas were interpreted from the 2013 AAFC Annual Crop Inventory land cover data set. Land cover classes within the Beaver Hills were re-categorized based on relative levels of human alteration as natural habitat, semi-natural habitat, and anthropogenic areas as follows:

- **Natural habitats:** Habitats with little to no human alteration; anticipated to have highest value as habitat and highest biodiversity. Land cover classes in this category include: grassland, coniferous trees, deciduous trees, mixed trees, shrubland, wetland and water.
- **Semi-natural habitats:** Habitats with some human alteration, but may provide some value as wildlife habitat, particularly for species more tolerant of human activity. Land cover classes in this category include: annual cropland and forages.
- **Anthropogenic areas:** Areas which have undergone significant human alteration and are expected to provide little to no value as habitat. Land cover classes in this category includes: exposed land and developed.

Distribution of habitat types in the Beaver Hills is summarized in Table 5 and depicted in Figure 6. Over half of the Beaver Hills (59%) is classified as natural habitats. Semi-natural habitats, consisting of perennial (forage) cropland, constitutes 39% of the total area of the Beaver Hills. Anthropogenic areas account for a very small portion (2%) of the total area of the Beaver Hills. Figure 6 shows a concentration of natural and semi-natural habitats within central areas of the Beaver Hills, particularly in and around Elk Island National Park and east of Ministik Lake, with anthropogenic and semi-natural influenced habitats (including cropland and urban/built-up areas) more common to the western portions of the Beaver Hills.

Of the land cover types classified as natural habitat, deciduous trees is the dominant land cover type, accounting for 36% of the total area of the Beaver Hills (Table 5). The remainder of the natural habitats is a mixture of treed (coniferous and mixed), grasslands, and wetland cover types[2]. Semi-natural habitat types are dominated by forage land cover types, accounting for 34% of the total area of the Beaver Hills, with annual crop cover types accounting for only 5% of the total area of the Beaver Hills.

[2] The aerial extent of wetlands as indicated by the AAFC (2013) Annual Crop Inventory land cover data varies from the aerial extent of wetlands as determined in Section 4.1.5 based on the *CWCS Merged Wetland Inventory* (ESRD 2014a) due to differences in how wetlands are delineated by the two data sets.

Table 5: Extent and Size Distribution of Habitat Types within the Beaver Hills Area

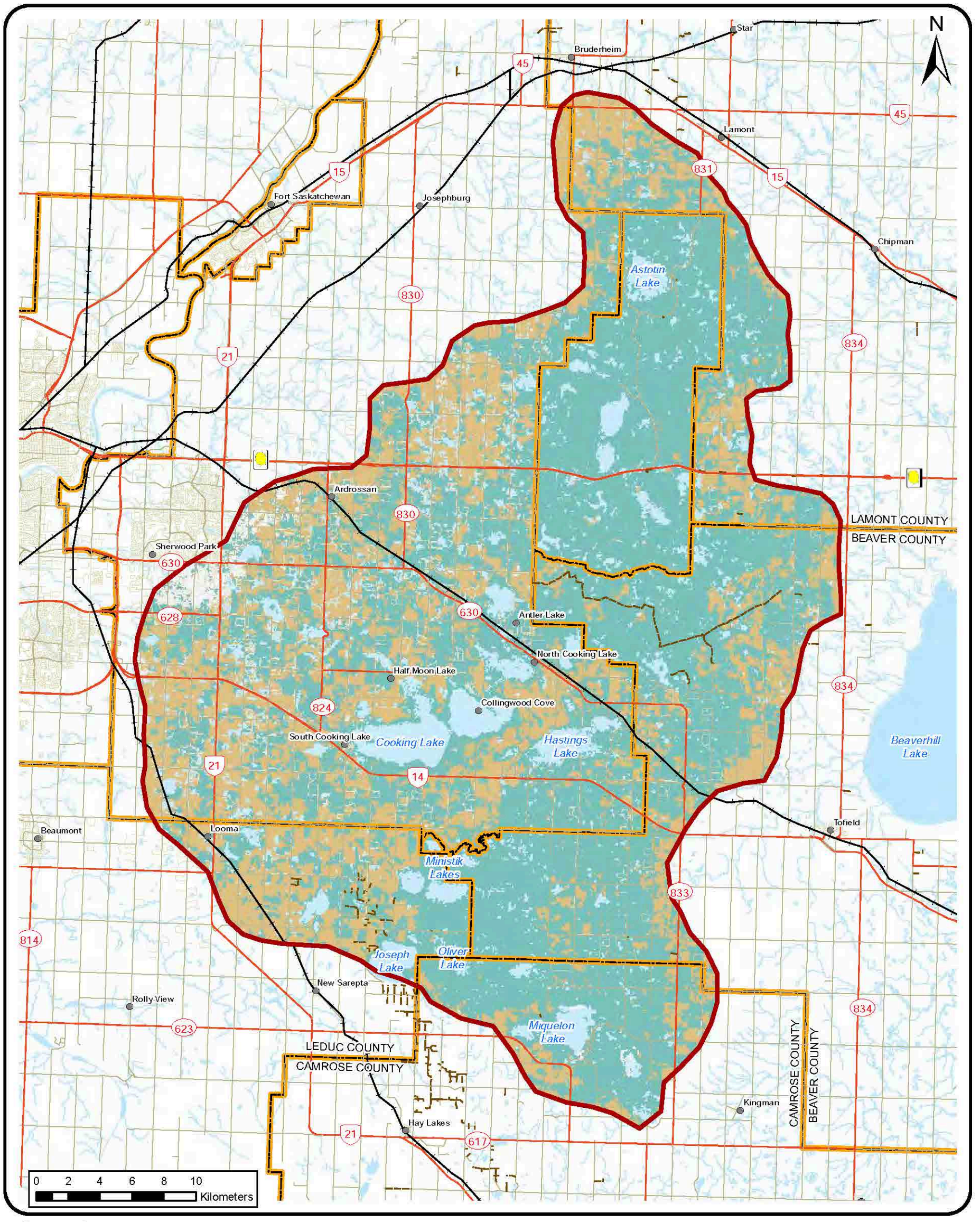
Habitat Type/ Land Cover Type	Number of Habitat Patches	Total Extent of Habitat Type (ha)	Percent of Total Beaver Hills	Average Patch Area (ha)	Smallest Patch Size (ha)	Largest Patch Size (ha)	Patch Density[1]
Natural Habitats							
Coniferous Trees	1,591	3,273	2	2	<1	45	49
Deciduous Trees	2,607	56,837	36	22	<1	10,446	5
Mixed Trees	707	4,106	3	6	<1	258	17
Shrubland	1,361	9,394	6	7	<1	430	14
Grassland	381	2,045	1	5	<1	197	19
Wetland	1,219	2,794	2	2	<1	54	44
Water	996	14,664	9	15	<1	3,714	7
Subtotal	*8,862*	*93,113*	*59*	*8*	*<1*	*10,446*	*10*
Semi-natural Habitats							
Forages	3,772	54,646	34	14	<1	5,871	7
Annual Crop	1,217	8,139	5	7	<1	486	15
Subtotal	*4,989*	*62,785*	*39*	*11*	*<1*	*5,871*	*8*
Anthropogenic Areas							
Bare Earth	97	106	<1	1	<1	6	92
Developed	1,424	3,506	2	2	<1	363	41
Subtotal	*1,521*	*3,612*	*2*	*2*	*<1*	*363*	*42*
Grand Total	***15,372***	***159,510***	***100***	-	-	-	-

Notes: 1: Patch Density = (Number of habitat patches / total area of habitat type)*100. See section 4.1.7 for further discussion on patch Density.

Habitat Connectivity

Habitat connectivity is generally defined as the degree to which landscapes facilitate movement of organisms (wildlife, fish, or even plants) or the movement of ecological processes (McGarigal et al. 2005). The connectivity of individual habitat patches that are separate in space from other habitat patches or human development cannot be measured simply as a distance between patches. Rather, measuring connectivity requires evaluating both the pattern of habitats on the landscape and the ability of processes or organisms to move through these habitats. As such, habitat connectivity is generally evaluated for a given indicator species (or suite or species) or ecological processes. It is recommended that for future state of the Beaver Hills reporting, a suite of indicator species be selected and habitat connectivity be evaluated for each.

Figure 6: Habitat



Legend

- Beaver Hills Initiative Area
- Stream
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation

Habitats

- Open Water
- Anthropogenic
- Natural
- Semi-Natural

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References:
AAFC Land Cover Crop Inventory, 2013
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4.1.7 Habitat Fragmentation

Habitat fragmentation is generally defined as the progressive sub-division of habitats into smaller, geometrically altered, and more isolated fragments, as a result of both natural and human activities (McCarigal et al. 2005). All landscapes have a degree of existing, natural habitat fragmentation. For example, natural habitats within the Beaver Hills include forested areas, shrublands, grasslands, wetlands and waterbodies. These habitats create a mosaic on the landscape; not all habitats of the same type are immediately adjacent to each other. Human induced fragmentation occurs when human activities result in habitat losses or changes that cause previously congruent habitats to be divided into isolated patches. Habitats, within the Beaver Hills have historically been fragmented by a number of human developments and activities (i.e., clearing of forested vegetation). Human-created fragmentation can have a negative effect on biodiversity and ecological processes and functions, which in turn affects the provision of ecological goods and services (de Groot et al. 2002). In some cases, fragmentation of land cover and habitat types can be beneficial. Examples of beneficial fragmentation include planting of shelterbelts, restoration of riparian corridors, and wetland restoration.

Monitoring the changes in habitat fragmentation can add depth to understanding of habitat change on the landscape and the pattern of development. Declines in the areal extent of a given habitat without an increase in fragmentation implies that habitat losses are occurring along the margins of existing habitat patches, or that losses of entire patches are occurring. Conversely, declines in total habitat area with increased fragmentation implies that habitat losses or alterations are occurring through (e.g., bisecting) habitat patches. Changes in fragmentation may also provide insight into changes on the landscape resulting from effective land management practices, habitat restoration or conservation initiatives. For example, planting or restoring habitat corridors through agricultural lands would increase the areal extent of the restored habitat or land cover types and increase fragmentation of the agricultural land.

Fragmentation is evaluated by calculating the number and habitat patch size. Statistical analysis of habitat (land cover) mapping within the Beaver Hills was completed using GIS software to calculate the number of patches of each habitat type; the average patch size, minimum and maximum patch sizes. Patch density standardizes patch number by area, using the following formula (McGarigal et al. 2005), which facilitates comparison of more than one landscape area (e.g., comparison of fragmentation within the Beaver Hills to fragmentation within overlapping municipalities). Results of the analysis are provided in Table 5 (Section 4.1.6).

$$PD = \frac{n}{a}(100)$$

PD = Patch Density (PD) per 100 ha
n = number of patches
a = total area of habitat type

The number of patches of a habitat type or patch density (the number of patches expressed by area), is a simple and direct measurement of habitat fragmentation. As the number of habitat patches increases, regardless of area, the habitat is more fragmented, although it is noted that this metric does not differentiate between natural or anthropogenic causes. Comparison of the number of patches for a habitat type from year to year will provide an indication of change in habitat fragmentation. Patch density is most useful for comparing habitats between different landscapes and landforms. This parameter was also calculated to provide for future comparisons to regional landscapes (e.g., comparison of habitat fragmentation within the Beaver Hills to habitat fragmentation within the respective municipalities). Calculated patch densities for natural and semi natural habitats are presented in Table 5 (Section 4.1.6)

Patch densities of natural and semi-natural habitats within the Beaver Hills are variable. Natural habitats have an average patch size of 8 ha and a patch density of 10 patches/100 ha. Of the land cover types classified as natural habitat, deciduous tree land cover types have the lowest patch density (5 patches/100 ha), suggesting that this land cover type is the least fragmented. This land cover type is also the most common habitat, accounting for 36% of the total Beaver Hills, and also has the highest average patch area (22 ha) and maximum patch size (10,466 ha), indicating that deciduous tree land covers exist as large, contiguous tracts within the landscape of the Beaver Hills. Coniferous trees cover types have the highest patch density (49 patches/100 ha), indicating that these habitats are the most fragmented within the landscape. Wetland cover types also have a relatively high patch density (44 patches/100 ha). Both wetlands and coniferous forest habitats are relatively uncommon in the landscape of the Beaver Hills in terms of area (each accounting for 2% or less of the total area of the Beaver Hills) and have small average patch sizes (2 ha and 7 ha respectively), indicating that these habitats generally exist as relatively small, disconnected patches within the landscape of the Beaver Hills.

Semi-natural habitats have an average patch size of 11 ha and patch density of 8 patches/100 ha. Forage land cover types have a relatively lower patch density (7 patches/100 ha) as compared to annual crop land cover types (8 patches/100 ha), indicating that forage land cover types are less fragmented in the landscape. Anthropogenic areas (bare earth and developed land cover types) have small patch sizes (2 ha) and high patch densities (42 patches/100 ha) suggesting that these areas are highly fragmented in the landscape.

As noted previously, the patch density data set does not distinguish between naturally occurring and human-created patches. However, the patch density of each habitat type can be compared from year to year in future State of the Beaver Hills monitoring using subsequent versions of the land cover data set (AAFC Annual Crop Inventory, which is updated yearly) to evaluate if fragmentation has changed and what habitats have been gained or lost.

4.1.8 Soil Cover

Bare soils, that is soils which do not have a vegetative cover, are susceptible to degradation through soil erosion (wind and water), break-down of soil structure and loss of fertility (AAFC 2010). Bare soils also increase the risk to surface water supplies through increased risk of sedimentation and nutrient transport. Soils lacking vegetative cover are also prone to invasion by non-native invasive species.

There are a number of natural processes and human related activities that may cause bare soils within a landscape. Fluctuations of water bodies, naturally and human-induced, can result in soils along the margins of the water body becoming exposed when water levels are drawn-down or naturally decrease in drier periods. Natural fires and controlled burn which remove ground cover also temporarily remove vegetative cover, exposing underlying soils. Vegetation removal and physical soil disturbance during construction activities for infrastructure also results in areas of bare soils. The duration of time that agricultural soils are left bare over a production cycle is influenced by a number of factors, including the crop type, crop productivity (amount of vegetative growth), and tillage practices (AAFC 2010).

Tracking bare soils, or its inverse, soil cover, provides and indicator of risk of soil loss or degradation. Tracking of bare soils can also be indicative of adoption of beneficial land management practices. Within agricultural landscapes, adoption of practices such as no-till or conservation tillage would decrease the period of time that soils are left exposed. Bare soils can also be reflective of the amount of direct physical disturbance that has or is occurring on a landscape. Effective re-vegetation of areas temporarily disturbed during construction also decreases the amount of bare soils that remain.

Analysis of the land cover data (Annual Crop Inventory; AAFC 2013) was used to quantify the amount of base soils within the Beaver Hills. The total area of bare soils within the Beaver Hills was estimated based on the summation of three land cover classes which reflect bare soils: exposed land, too wet to be seeded, and fallow. No areas were classified as too wet to be seeded or fallow land cover types within the Beaver Hills in the 2013 data. Only 300 ha of the Beaver Hills, representing less than 1% of the total area of the Beaver Hills, was classified as exposed land.

4.1.9 Soil Capability Related to Land Cover and Land Use

Varying types of soils are generally typically suited to accommodate different types of land use. For example, black mineral soil rich in nutrients and organic matter is typically best suited for agricultural purposes as it provides an excellent growth medium. By assessing the types of soils mapped in an area, and correlating it against current land uses, the appropriate use of soil resources can be evaluated. This type of knowledge could aid land managers and planners in future land use planning. Land cover is also an important aspect in terms of land management and planning. Land cover can be native (e.g., old growth forest), or it can be anthropogenic (e.g., manicured lawns). Soil suitability classes may be compared to land cover, based on the

land cover maps developed for previous indicators (habitat connectivity and fragmentation) in order to provide an indication of which types of land cover correspond to areas of land capability classes. This is another indicator of land management and can be used in land management or land use planning.

Analysis of this indicator used the Canada Land Inventory (CLI) soil capability related to agriculture. The classes identified in the CLI indicate the degree of limitation that the soil imposes on agriculture (Government of Canada 2013). Definitions of each class and the spatial extent of soils of each class within the Beaver hills is provided in Table 3 below. This data set dates back to the 1960's; however, was mapped based on existing soils. Soils do not change quickly without anthropogenic intervention and therefore this data set is considered relevant and is still commonly used in this type of assessment. The CLI data was analyzed in reference to the land use zone data set created for the Beaver Hills (see Section 4.1.3) and the 2013 AAFC land cover data set (AAFC 2013). Distribution of the land capability classes within the Beaver Hills is shown in Figure 7.

Table 6: Land Capability for Agriculture Class Descriptions and Extent in the Beaver Hills

Class	Description[1]	Area (ha)	Percentage of Total Area of the Beaver Hills
Class 1	Soils in this class have no significant limitations in use for crops.	672	<1
Class 2	Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.	12,411	8
Class 3	Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices.	43,415	27
Class 4	Soils in this class have severe limitations that restrict the range of crops or require special conservation practices.	39,983	25
Class 5	Soils in this class have very severe limitations that restrict their capability in producing perennial forage crops, and improvement practices are feasible.	61,149	38
Class 6	Soils in this class are capable only of producing perennial forage crops, and improvement practices are not feasible.	1,880	1
Class 7	Soils in this class have no capacity for arable culture or permanent pasture.	-	-
Class 0	Organic soils (not placed in capability classes)	-	-
Total		*159,510*	*100*

Notes: [1]Taken from the Overview of Classification Methodology for Determining Land Capability for Agriculture (Government of Canada 2013).

The majority (92%) of soils within the Beaver Hills are considered to have moderately severe to very severe limitations for agricultural capability (Class 3 to 5), or capable only of producing

perennial forage crops (Class 6). Only 8% of the soils are considered to have no significant limitations or only moderate limitations for agricultural capability (Class 1 or 2).

The proportion of each soil suitability class occupied by each type of land use zone is summarized in Table 7. As agriculture is the most dominant land use zone within the Beaver Hills, agriculture accounts for the majority (greater than 50%) of the extent of most capability classes (Class 1 through 5). The proportion of other land use zones, particularly Country Residential, Conservation, increases as soil capability decreases for capability classes 1 through 5.

The proportion of each soil suitability class occupied by each type of land cover is summarized in Table 8. Natural habitats (which include forested areas, wetland, shrublands, and water bodies) are the most common habitat types, and more commonly occur on soils that have lower capability classes. As land capability class increases, the proportion of the land cover class that is occupied by semi-natural habitats (annual crops and forages) decreases. Anthropogenic areas (developed, exposed lands) are most common on lands with soil capability of Class 3 and 4.

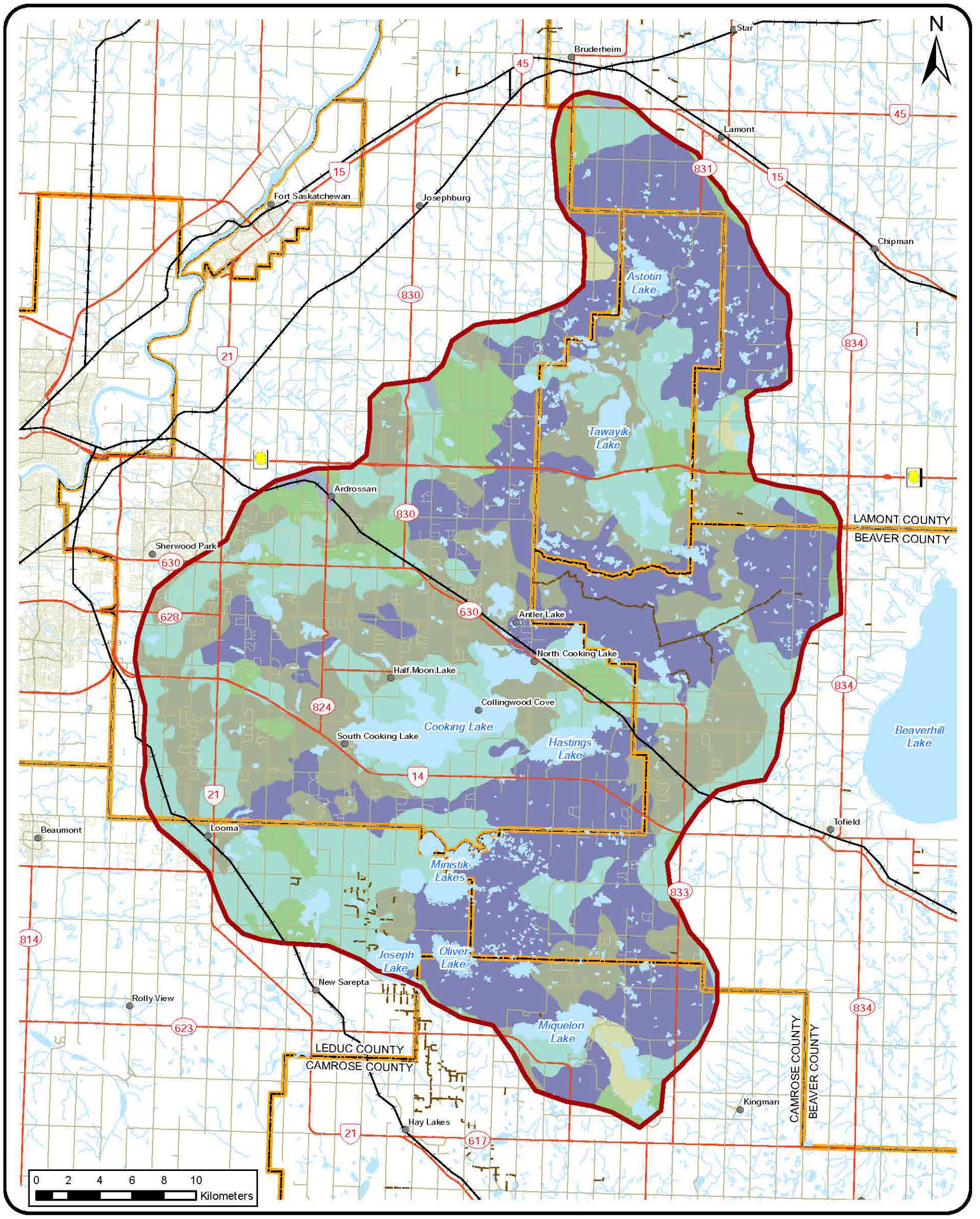
Table 7: Extent of Soil Capability Class by Land Use Sector

Land Use Sector	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Agriculture	510	8,653	24,373	18,436	28,836	707
Commercial	8	70	164	346	211	0
Conservation	2	1,274	7,167	10,079	22,466	741
Country Residential	65	1,358	5,201	7,661	5,201	46
Industrial	33	26	0	0	0	0
Recreation	7	39	128	133	179	23
Residential	4	8	86	20	7	0
Transportation	43	509	1,650	1,568	1,363	0
Water Body	0	474	4,645	1,740	2,886	362
Total	*672*	*12,411*	*43,414*	*39,983*	*61,149*	*1,879*

Table 8: Extent of Soil Capability Class by Land Cover Type

Land Cover	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Natural Habitat	39	3,894	20,421	21,915	45,417	1,427
Semi-natural Habitat	603	8,177	21,754	16,812	15,005	434
Anthropogenic Areas	30	340	1,240	1,256	727	19
Total	*672*	*12,411*	*43,415*	*39,983*	*61,149*	*1,880*

Figure 7: Soil Capability Classes for Agriculture



Legend

- Populated Place
- Beaver Hills Initiative Area
- Waterbody
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation

Land Capability for Agriculture

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6

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4.2 AIR

The guiding principle behind the air indicators is “industrial growth in the region will maintain air quality standards” and “air quality in Beaver Hills requires monitoring to ensure recommendations can be made to maintain or improve air quality” (BHI 2015). Air quality is important for both ecological and human health. Due to the proximity to heavy industrialized areas (the Alberta Industrial Heartland), the air quality monitoring in the Beaver Hills is a consideration. One of the goals of the BHI is to maintain the clean air and current air quality, while still encouraging responsible industrial development.

Four indicators were originally identified to include in this initial State of the Beaver Hills reporting. Two of these indictors, 1) Ambient air quality and 2) Drought index, were selected for inclusion in this initial State of the Beaver Hills report, as sufficient data were available to allow evaluation, and future tracking. Two indicators, 1) Greenhouse gas emissions and 2) Brightness scale, are not included in this report based on limitations relating to available data for these indicators identified in the *Beaver Hills Initiative State of the Beaver Hills Report Indicator Cost Benefit Analysis* (AMEC 2014). No information is currently available for the Beaver Hills to assess brightness scale and the data to determine greenhouse gas emissions are only partial and would require significant efforts to compile. The following presents the status of the two indicators chosen for inclusion in this report.

4.2.1 Ambient Air Quality

Air quality indicators aims to evaluate fine particulate levels (particles less than 2.5 microns in diameter, $PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) in the Beaver Hills. These are important indicators of air pollutants or potential health impacts, and can be analyzed for the Air Quality Health Index (AQHI). This indicator will enable the monitoring of air pollution in the Beaver Hills over time.

The most recent 12-months of air quality data for SO_2, NO_2, O_3 and $PM_{2.5}$ were analyzed to demonstrate the current status of ambient air quality in the Beaver Hills. Data from five air monitoring stations were included in the analysis, as shown in Table 9. Air quality data were obtained from the CASA Data Warehouse for the 12-months period from December 1, 2013 to November 30, 2014.

The Alberta Ambient Air Quality Objectives (AAAQO) serves as the benchmark to evaluate the status of air quality (ESRD 2013). The annual average concentration presents the average air quality in the Beaver Hills. The maximum 1-hour and 24-hour concentrations demonstrate the worst case air quality scenario. The number of exceedances of concentrations (as compared to the AAAQO) can indicate the frequency of incidences of poor air quality within a 12 month period.

Table 9: Ambient Air Quality Monitoring Stations (AQHI Eligible) in the Beaver Hills

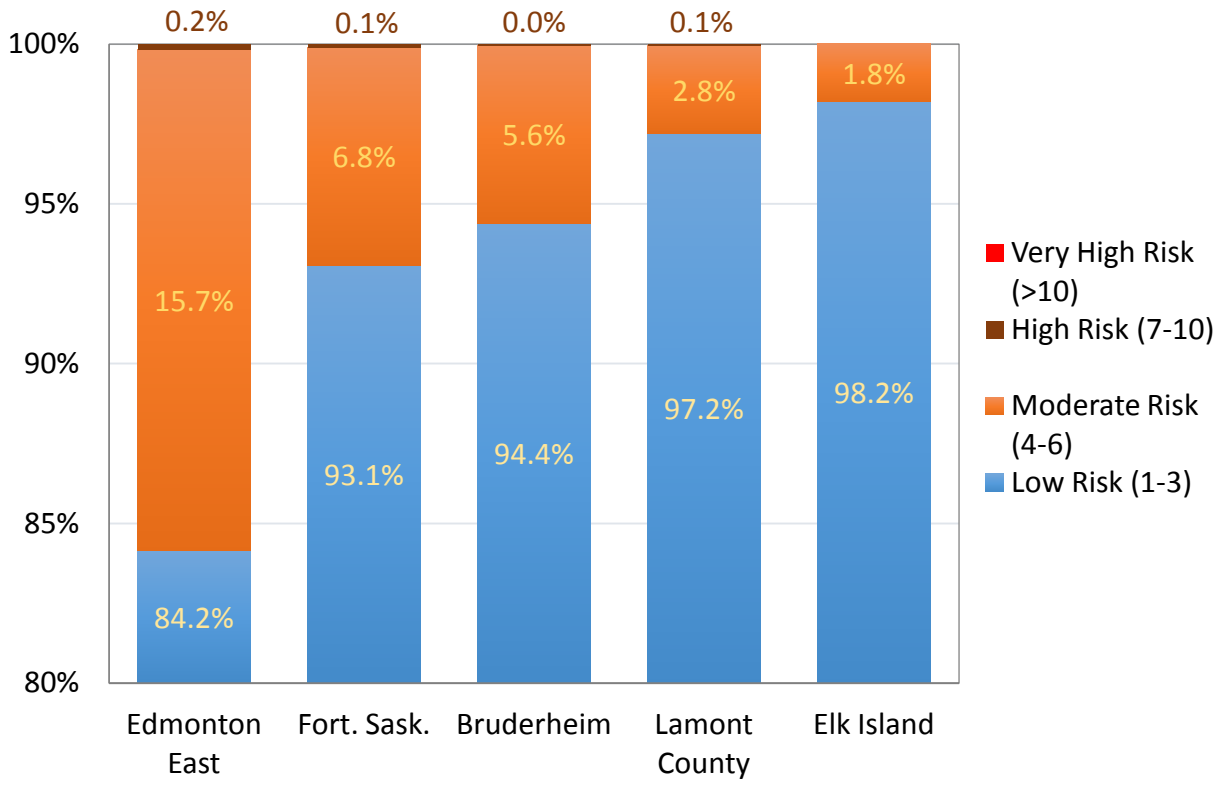
Station Name	Coordinates		Parameters Analyzed				
	Longitude	Latitude	SO_2	NO_2	O_3	$PM_{2.5}$	AQHI
Edmonton East	-113.368086°	53.548211°	✓	✓	✓	✓	✓
Lamont County	-112.880200°	53.760400°	✓	✓	✓	✓	✓
Fort Saskatchewan	-113.222831°	53.698756°	✓	✓	✓	✓	✓
Bruderheim	-112.922622°	53.799042°	✓	✓	✓	✓	✓
Elk Island	-112.868100°	53.682400°	✓	✓	✓	✓	✓

Table B1, Appendix B provides a summary of key air quality statistics for the five monitoring stations used in this analysis. There were no AAAQO exceedances, with the exception of 24-hour average $PM_{2.5}$. The exceedances were primarily due to wildfire smoke in the Beaver Hills, according to the NOAA Smoke Forecasting System modelling results (National Oceanic and Atmosphere Administration 2014).

Figure 8 presents a chart showing percentage of time for AQHI risk categories. For the majority of the time air quality health risk is in the Low Risk (AQHI 1–3) or Moderate Risk (AQHI 4–6) categories.

Monitoring stations which become AQHI compatible in the future in the Beaver Hills region should be included in subsequent State of the Beaver Hills reports.

Figure 8: Air Quality Health Risk for Five Stations in the Beaver Hills



4.2.2 Drought Index

The drought index indicator provides insight into weather cycles in an area. The tracking of weather cycles not only provides an evaluation of seasonal variance, but given enough time can provide an indication of climate conditions. To track weather cycles in the Beaver Hills, the drought index, compiled and reported on by Alberta Agriculture and Rural Development, can be used as an indicator of weather cycles. Prolonged drought, or sustained rainfall, can have effects on water resources, agricultural yields, forage supplies for wildlife and livestock, and others. This indicator can, therefore, help with risk management and preparedness for climate changes, or weather events.

While several different indexes have been developed to assess drought, based on various methods and models, the Palmer Drought Index is used to evaluate this indicator for this State of Beaver Hills report. The Palmer Drought Index is a meteorological index that responds to weather conditions that are abnormally dry or abnormally wet (National Climatic Data Center 2013). The index is calculated based on precipitation and temperature data, in addition to the available water holding capacity of soil and is considered a measure of long term drought or moisture surplus. To track this indicator, the Palmer Drought Index developed by the Government of Canada (Agriculture and Agri-Food Canada 2015) is reported.

Table 5 presents monthly reports of the Palmer Drought Index category for the Beaver Hills for the past five years, 2009 to 2014. The results of Palmer Drought Index analysis range from severe drought to slightly wet conditions. Although conditions varied from year to year, there appears to be a general trend of conditions becoming increasingly wet from 2009 to 2014.

Table 10: Monthly Drought Index for the Beaver Hills, 2009 to 2014

Month	Year					
	2009	2010	2011	2012	2013	2014
January	Mild Drought	Moderate Drought	Mild Drought	Normal	Normal	Mild Drought
February	Moderate Drought	Moderate Drought	Mild Drought	Moderate Drought	Mild Drought	Mild Drought
March	Moderate Drought	Severe Drought	Slightly Wet	Moderate Drought	Normal	Normal
April	Mild Drought	Severe Drought	Mild Drought	Moderate Drought	Normal	Normal
May	Moderate Drought	Moderate Drought	Moderate Drought	Moderate Drought	Normal	Normal
June	Severe Drought	Moderate Drought	Mild Drought	Normal	Mild Drought	Normal
July	Severe Drought	Mild Drought	Mild Drought	Slightly Wet	Not Available	Normal
August	Severe Drought	Mild Drought	Moderate Drought	Mild Drought	Not Available	Mild Drought
September	Severe Drought	Mild Drought	Moderate Drought	Mild Drought	Moderate Drought	Mild Drought

Source: Agriculture and Agri-Food Canada 2015

4.3 WATER

The guiding principle behind water management is “maintaining function of local watersheds to sustain regional surface and groundwater systems; and sustaining local watersheds to maintain the water quality of surface and groundwater systems” (BHI 2015). Maintaining the function of local watersheds to sustain regional surface and groundwater systems and maintaining the water quality of surface and groundwater systems are core goals of the BHI. By tracking indicators relating to surface and groundwater, the BHI can evaluate changes in the conditions of water resources within the Beaver Hills and evaluate whether the desired objectives with respect to management of these resources are being met.

Five indicators were identified by the BHI to be included in State of the Beaver Hills reporting and all five were evaluated initially in the *Beaver Hills Initiative State of the Beaver Hills Report Indicator Cost Benefit Analysis* (AMEC 2014). Of these five indicators, two (i.e., trends in lake levels and oil and gas well site density) were determined to be highly applicable, and sufficient data are available, making them feasible for inclusion in the State of the Beaver Hills report. The three indicators not presented in this report include: 1) nitrogen and phosphorous levels, contaminants, sediment load; 2) stormwater management systems – natural or man-made; and 3) supply and demand (water footprint analysis). Although all three indicators are highly applicable to the water guiding principle, existing data limitations preclude them from this initial State of the Beaver Hills report. For more information regarding the details of these limitations, refer to the *Beaver Hills Initiative State of the Beaver Hills Report Indicator Cost Benefit Analysis* report mentioned above.

4.3.1 Trend in Lake Levels

Lakes provide a variety of environmental, recreational, social and economic benefits (ESRD 2014c). The simplest way to track this indicator is by referencing results from ESRD’s Historic Lake Level Index, although only 27 lakes are tracked in this manner in the province of Alberta. Lakes selected for tracking by ESRD are chosen based on the availability of long-term data and includes those lakes that are not subject to reservoirs or major diversions or withdrawals (ESRD 2014c). As such, changes in lake levels in these lakes are expected to mostly reflect a response to natural fluctuation in climate. Of the 27 lakes tracked by the province, only two occur within the Beaver Hills: Cooking Lake and Miquelon Lake. The status of lake levels is available for the period from 2004 to 2012, and those of the two lakes located in the Beaver Hills are shown in Table 6.

Lake levels within the two lakes were consistently rated as ‘Below Normal’ or ‘Much Below Normal” (Table 6) for years where data was available between 2004 and 2012. Since 2008, lake levels for all three lakes have consistently been rated as “Much Below Normal” (for years where data were available).

Table 11: Lake Level Status of Tracked Lakes in the Beaver Hills

Lake	Year								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cooking Lake	BN	BN	BN	BN	MBN	MBN	MBN	MBN	MBN
Miquelon Lake	BN	BN	MBN	MBN	MBN	MBN	n/a	MBN	MBN

Notes: BN = below normal, MBN = much below normal, N = normal, AN = Above Normal, MAN = much above normal, n/a = not enough data, blank = data has not been collected

4.3.2 Well Siting, Well Abandonment, and Well Density

Well siting, well abandonment and well density, for both water wells and oil and gas wells, are all reflective of the extent and location of human activities on the landscape. This indicator may reflect pressures that are not captured by other indicators, particularly indicators that track land use and land cover changes, as disturbance resulting from an individual well site is highly localized and may not be captured by these coarser resolution evaluations of human activity on the landscape.

Water well density and abandonment may reflect a higher risk to potential groundwater contamination, as there is a higher potential for unused or abandoned wells to be located in these areas (ESRD 2012a). Water well density can reflect pressure (through usage) on groundwater resources within a region. However, water well density will also be controlled by groundwater potential and suitability. As such, areas of suitable groundwater resources with comparatively higher water well density may reflect increased development demands, compared to areas with similar groundwater potential with lower well density.

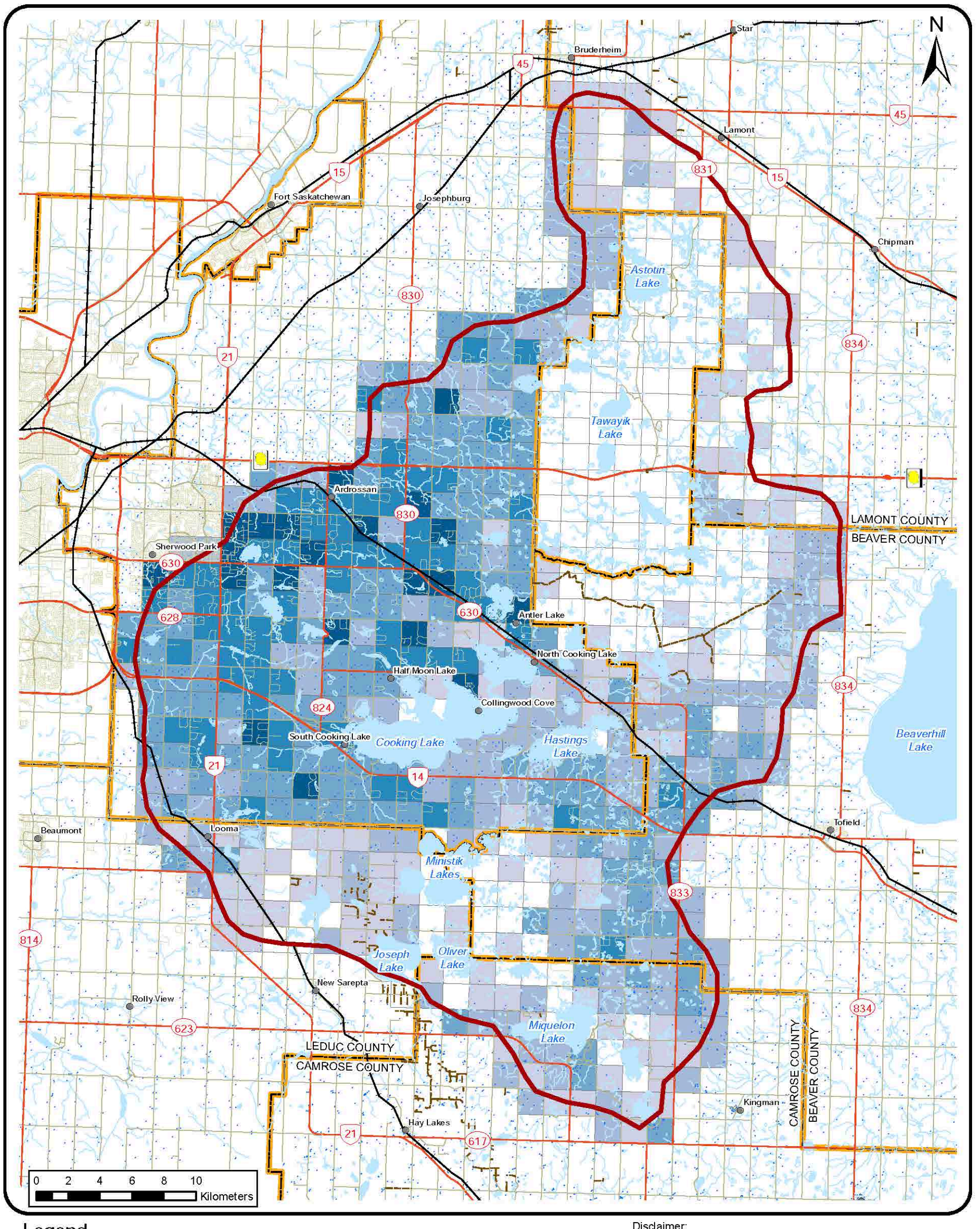
Regional groundwater assessment (RGWA) reports were completed for all municipalities in the Beaver Hills from 1999 to 2005 and were supplied to the BHI. Water well data were collected as part of these assessments and this data set was used to determine water well density within the Beaver Hills. Oil and gas well density utilized Energy and Utilities Board's (EUB) well license data (updated to 2009). Density was calculated by summing the total number of wells occurring within each section that overlaps with the Beaver Hills. The density assessment was extended past the edges of the Beaver Hills in cases where only partial sections fall within the Beaver Hills, to provide for consistent density results.

Figure 9 depicts water well density within the Beaver Hills. Water well density ranges from 0 wells per section to 122 wells per section within the Beaver Hills. A total of 184 sections (27% of the total number of sections) do not presently contain an installed water well. Seventy-seven percent of the sections have fewer than 12 water wells. Water well density is highest in the western portion of the Beaver Hills, and higher water well densities are somewhat correlated with residential and country residential land uses zones.

Figure 10 depicts the oil and gas well density for each quarter section within the Beaver Hills. Well site density by section ranges from 0 to 28 wells per section. Within the Beaver Hills, 54% of the sections have no oil or gas wells and 96% of the sections have four or fewer wells. Less than 4% of the sections within the Beaver Hills have greater than four wells.

The BHI has collected data relating to groundwater risk from each of the overlapping municipalities. However, the groundwater risk mapping does not use consistent classification of groundwater risk, and a fair amount of interpretation of the data is required to produce a merged data set that covers the entire Beaver Hills. Nonetheless, creating a merged data set that utilizes a consistent groundwater risk classification would support future State of the Beaver Hills reporting.

Figure 9: Water Well Density



Legend

- Populated Place
- Beaver Hills Initiative Area
- Stream
- Waterbody
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Water Well

Water Wells per Section

- 0
- 1 - 3
- 4 - 12
- 13 - 32
- 33 - 64
- 65 - 122

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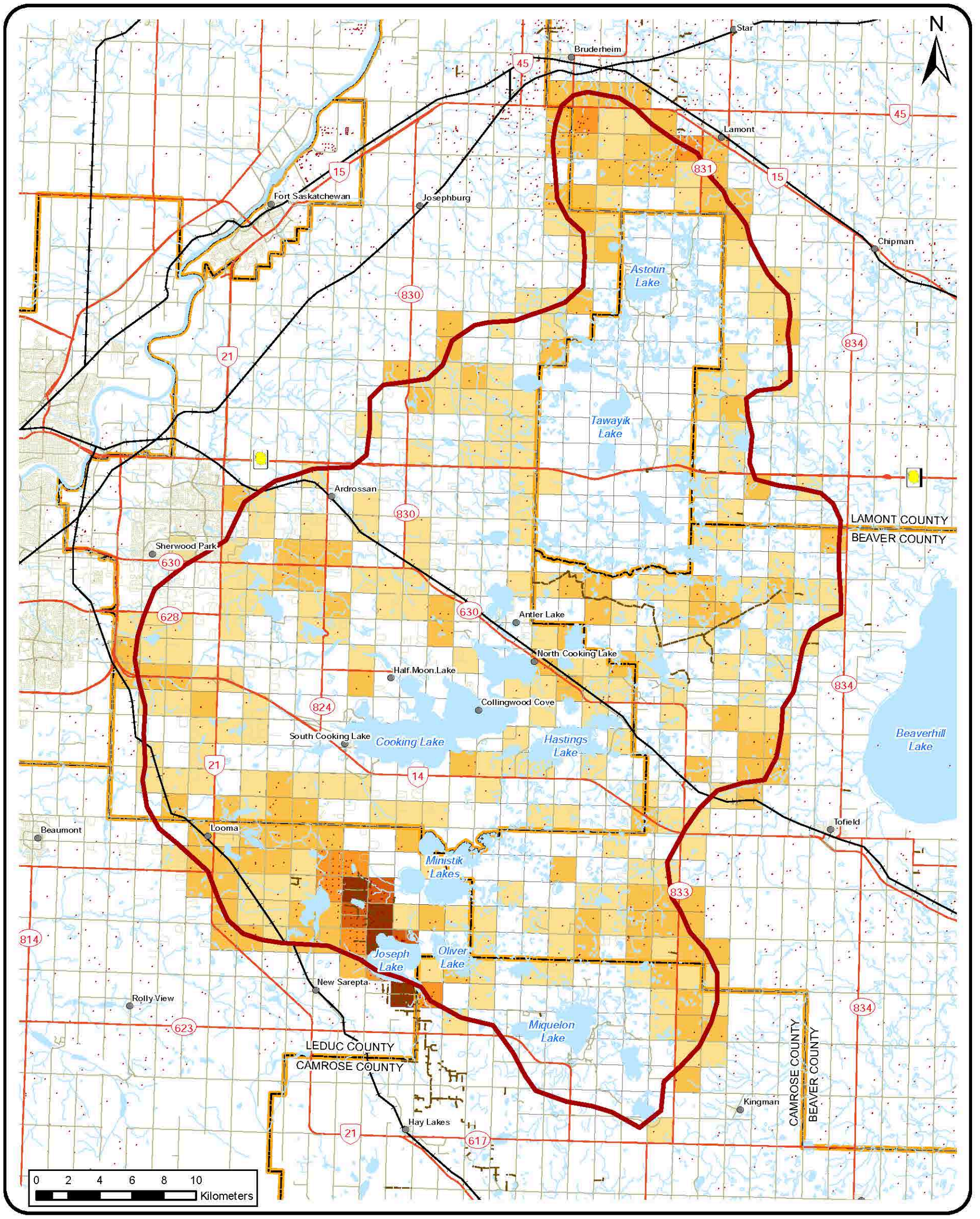
Figure 10: Oil and Gas Well Density



Legend

- Populated Place
- Beaver Hills Initiative Area
- Stream
- Waterbody
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation

Oil and Gas Wells per Section

- 0
- 1
- 2 - 6
- 7 - 11
- 12 - 18
- 19 - 28

- Well Licence

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4.4 BIODIVERSITY

The guiding principle behind biodiversity in the Beaver Hills is "existing natural wetlands and associated riparian upland margins will be conserved, both in regards to their biodiversity and their ecological functioning habitats; development will retain native upland habitats prominently featured within the Beaver Hills to maintain the majority of the existing green space and its associated biodiversity (BHI 2015). Connectivity of habitats will also be retained such that contiguous corridors remain within the Beaver Hills and between the Beaver Hills and the surrounding region. The principle also ensures that land use and land management activities will not compromise the ability of rare and sensitive species as well as species important for human use to persist in the Beaver Hills.

Six indicators were selected by the BHI to track changes in biodiversity within the Beaver Hills. Of the six identified indicators from the cost-benefit analysis (AMEC 2014), the following four are included in this State of the Beaver Hills report:

- Protected habitats
- Natural and human created edges
- Invasive species
- Species of conservation concern

Those excluded include: 1) volume of dead wood in forests, is not included in this report, due to data limitations and the determination that the results would not be highly applicable; 2) the indicator relating to tracking of specific species, although considered applicable, was not included due to cost limitations driven by species selection and requirements for multiple analyses that would need to be undertaken. The other four indicators related to biodiversity are presented and discussed herein.

4.4.1 Protected Habitats

The protected habitats indicator assesses the percentage of habitats protected, based on both habitat type and the level of protection. This indicator, therefore, measures both habitat protection and habitat diversity, as integral components of biodiversity. Assessing the proportion of each habitat identified in the Beaver Hills that is protected provides an important measure of protection for a suite of different ecological requirements of different species. In addition, conserving a range of habitats helps to ensure provision of various types of ecological goods and services. Protected areas identified within the BHI represent areas of varying ecological significance. These areas also vary in terms of intended use and permitted activities.

Protected areas identified within the Beaver Hills represent areas of varying ecological significance. These areas also vary in terms of intended use and permitted activities. Protected areas present within the Beaver Hills are summarized in Table 7.

The BHI categorizes the protected areas within the Beaver Hills as Core and Buffer Areas after the UNESCO Biosphere Reserve Program definitions, where Core Areas are lands which are managed primarily to conserve biological and ecological function and 'Buffer Areas' are lands which surround or adjoin Core Areas and lands which are managed primarily for conservation similar to Core Areas, but sustainable land uses, including recreational activities and some grazing leases are permitted (BHI 2012). The corresponding Biosphere Reserve category for each of the protected areas in the Beaver Hills are shown in Table 12.

Table 12: Description of Protected Areas in the Beaver Hills

Protected Area Type	Biosphere Reserve Zone	Description
National Park	Core	Established to protect and present outstanding representative examples of natural landscapes and natural phenomena and to provide recreational opportunities.
Provincial Park	Core	Established under *Provincial Parks Act* or *Provincial Parks (Section7 Declaration) Regulation.* Protect natural and cultural landscapes and features and support outdoor recreation, heritage tourism, and natural heritage appreciation activities that depend upon or are compatible with the natural environment.
Provincial Recreation Area	Buffer	Designated under *Provincial Parks Act*, these areas are intended to support outdoor recreation and tourism.
Alberta Parks Crown Reservations	Buffer	Notation placed on lands under the *Public Lands Act.* Represents a registered interest in the land by Alberta Parks. These areas are not currently designated under provincial Parks legislation, but indicate a potential interest by Alberta Parks for future designation. If designated, restrictions to industrial activity may apply.
Natural Area	Buffer	Designated under the *Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act*. Preserve and protect areas of local significance while providing opportunities for low-impact recreation. Permitted activities, such as grazing and oil and gas development, are considered on a case-by-case basis.
Bird Sanctuaries	Buffer	Includes the Ministik Lake Bird Sanctuary and Miquelon Lake Bird Sanctuary which are established by reservations/notations under the *Public Lands Act*.
Strathcona Wilderness Center	Buffer	A Strathcona County recreational facility managed for conservation, recreation and educational uses.
Conservation Areas and Easements	Buffer	Parcels managed or owned by various non-government conservation agencies, government agencies and/or land trusts (or combinations thereof) managed primarily for conservation and educational uses. Includes Golden ranches.

Notes: Adapted from Parks Canada (2012), Alberta Parks (2014), and BHI (2012).

The data set previously developed by the BHI depicting Biosphere Zones within the Beaver Hills was used as the primary data source for spatial mapping for this indicator. Protected area polygons were extracted from the data set and merged with the following more recent data sets available publically or obtained by the BHI, including:

- National Park boundary data (e.g., for Elk Island National Park) from (AltaLIS 2014);
- Provincial Parks, Natural Areas, and Provincial Recreation Areas from (AltaLIS 2014);
- Alberta Parks Crown Reservations (ATRP 2014);
- Miquelon Lake Bird Sanctuary and Ministik Lake Game Bird Sanctuary; and
- Updated Miquelon Lake Provincial Park boundary data.

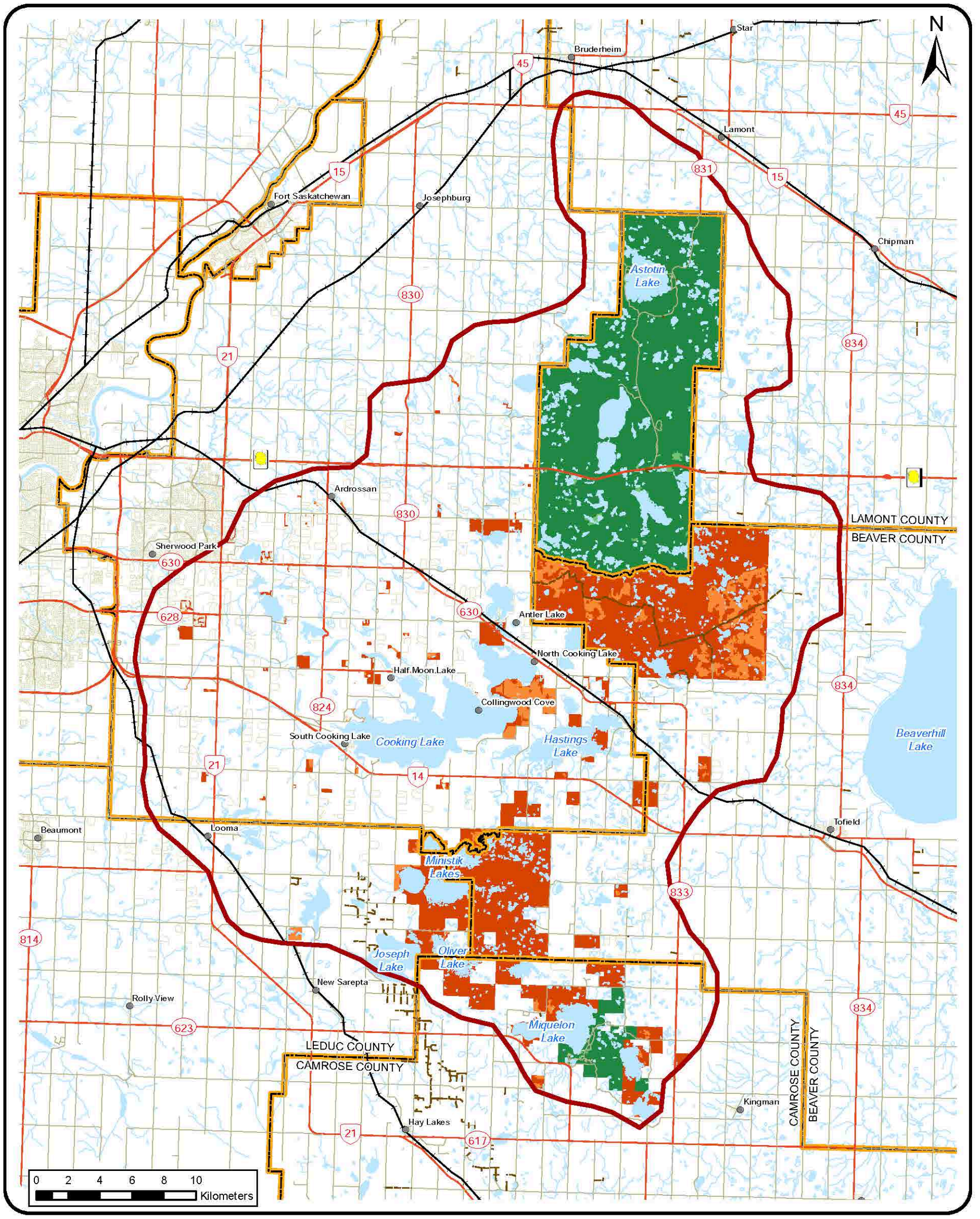
The merged protected areas data set was analyzed in reference to the AAFC 2013 land cover data set to determine the spatial extent habitats present within each protected area. For this analysis, land cover types were classified as natural habitat, semi-natural or anthropogenic areas as defined in Section 4.1.6. Table 13 presents a summary of habitat types within Core and Buffer Areas and spatial distribution of the habitats and protected areas is shown in Figure 11.

In total, protected areas occupy approximately 27% (43,736 ha) of the total area of the Beaver Hills. Core areas comprise 14% of the Beaver Hills and Buffer Areas comprise 13 % of the total area of the Beaver Hills. The areas contained within the protected areas largely consists of natural habitats; 90 % of the Core Areas and 99 % of the Buffer Areas.

Table 13: Distribution of Habitat Types occurring in Protected Areas in the Beaver Hills

Habitat Type	Core Areas		Buffer Areas		Core and Buffer Areas		Proportion of Total Habitat Type in Beaver Hills (%)
	Area (ha)	Proportion of Total Core Area (%)	Area (ha)	Proportion of Total Core Area (%)	Total Area (ha)	Proportion of Total Protected Areas (%)	
Natural Habitat	20,874	90	20,319	99	41,193	94	37
Semi-natural Habitat	2,134	9	163	1	2,297	5	5
Anthropogenic Areas	127	1	118	1	246	1	0
Total	***23,135***	***100***	***20,601***	***100***	***43,736***	***100***	***27***

Figure 11: Protected Habitats



Legend

- Populated Place
- Beaver Hills Initiative Area
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Stream
- Waterbody

Zone / Landcover Classification

- Core - Anthropogenic
- Core - Semi-Natural
- Core - Natural
- Buffer - Anthropogenic
- Buffer - Semi-Natural
- Buffer - Natural

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4.4.2 Natural and Human-Created Edges

In ecology, the term “edge effects” is used to describe changes in communities or populations that occur at the boundary of two different habitats (Ries and Sisk 2004). Evaluating natural and human created edges enables tracking of edge effects that are occurring in the Beaver Hills. This indicator evaluates both natural and human-created edges.

Natural and human created edges were evaluated using the 2013 AAFC Agriculture Inventory land cover data set. To identify edges, the land cover data were re-classified and merged into five broad categories, based largely on existing vegetation type: forested, shrubland, grassland and waterbodies (which included both wetlands and water) and anthropogenic (annual crop, forages, developed, and bare ground). Using this re-classification, the edges of the land cover areas were categorized based on the adjacent habitat types and total lengths for each type of edge calculated. Table 14 presents the length of different natural to natural edges, and human to natural edges. Figure 12 presents this indicator visually.

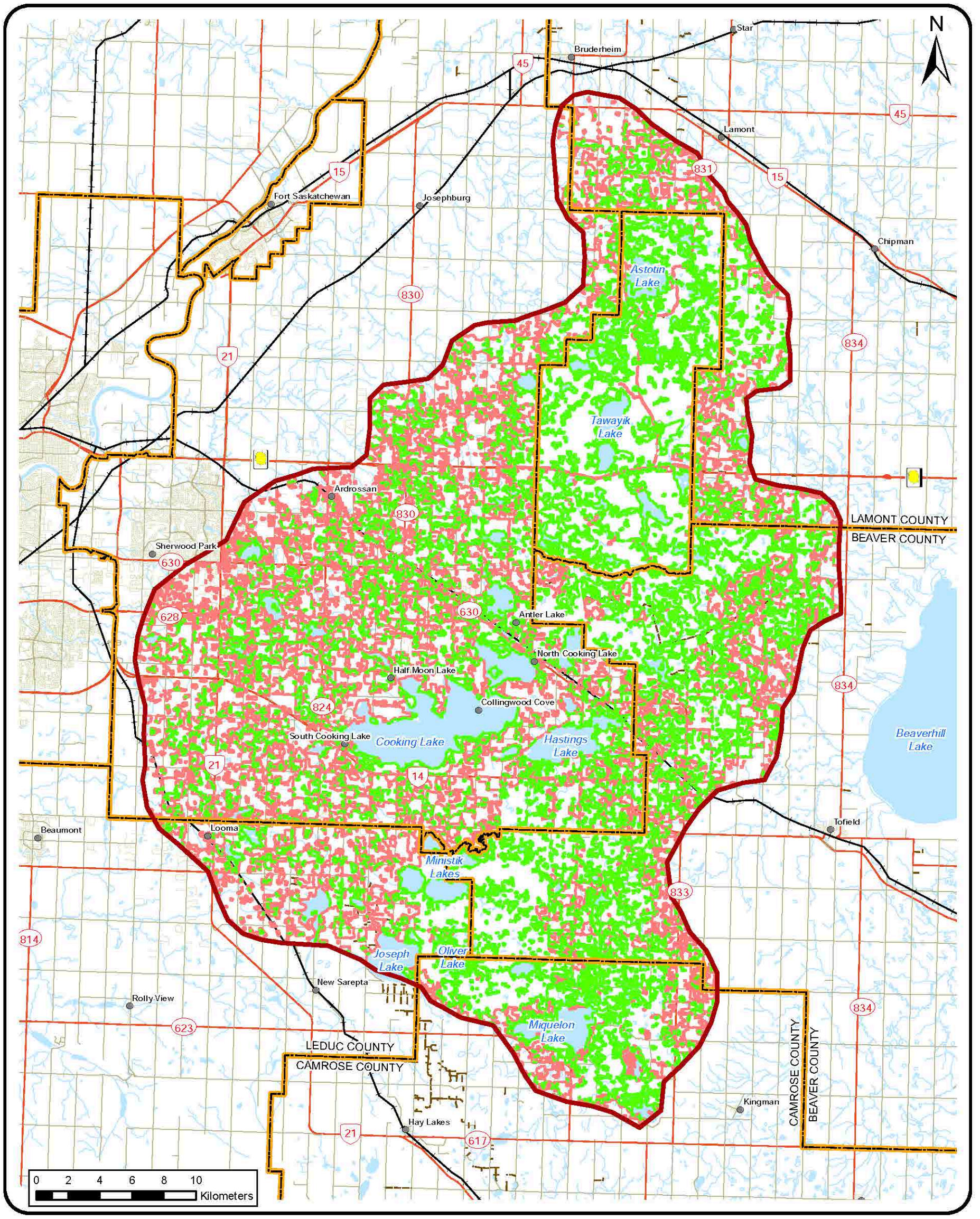
Human-created edges are more common than natural edges in the Beaver Hills, where human-created edges account for 56% of the total length of edges and natural edges account for 44% of the total length. The most common human-created edges were between anthropogenic and forested habitats (accounting for 56% of the total human-created edges) and the least common were between anthropogenic areas and grasslands (accounting for only 1% of human created edges). The most common natural edge types are shrubland to forest and shrubland to waterbodies, which, combined, account for 96% of the total natural edges.

As shown on Figure 12, natural edges are more dominant in central portions of the Beaver Hills, particularly Elk Island National Park and the area east of Ministik Lake. Human-created edges are more common around the perimeter of the Beaver Hills and in the western portion of the Beaver Hills.

Table 14: Summary of Edge Effects

Type of Edge	Specific Habitats	Length (km)	Proportion of Total Edge Length (%)
Natural Edges	Grassland to Forested	100	1
	Shrubland to Forested	2,261	22
	Shrubland to Grassland	32	<1
	Waterbodies to Forested	2,015	20
	Waterbodies to Grassland	25	<1
	Subtotal	*4,433*	*44*
Human Created Edges	Forested to Anthropogenic	3,160	31
	Shrubland to Anthropogenic	1,274	13
	Grassland to Anthropogenic	73	1
	Waterbodies to Anthropogenic	1,244	12
	Subtotal	*5,751*	*56*
	Grand Total	*10,183*	*100*

Figure 12: Natural and Human-Created Edges



Legend

- Beaver Hills Initiative Area
- Populated Place
- Stream
- Waterbody
- Human-Natural
- Natural-Natural

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4.4.3 Invasive Species

Invasive species are defined as species of plant or animals which were introduced by human activities to areas which are outside of the species' past or present distribution and pose a threat to the environment, economy, or society (Invasive Alien Species Working Group 2010). There are a variety of human activities that can transfer and facilitate the introduction of invasive species. Commonly noted examples include vehicles, particularly construction or agricultural equipment, which can transfer species from one parcel of land to another when soil and plant residues remain on the equipment when it is moved. Recreational vehicles (all-terrain vehicles) can also facilitate introduction of invasive species in a similar manner. In some cases, invasive species are directly released into Alberta habitats by individuals unintentionally and, in some cases, intentionally. Invasive species are generally strong colonizers often lack natural predators or population controls, which further enables them to spread and out-compete native species. Once introduced, invasive species can be very difficult and expensive to remove from an area. Tracking invasive species shows the distribution and severity of infestation of various species. Invasive species can replace native species in an area, thereby decreasing biodiversity. Tracking invasive species can also help land managers decided on integrated pest management and control, if applicable.

There are a variety of invasive species which were introduced or are considered to have a high potential for introduction to Alberta. Plant species defined as invasive are those listed under the *Alberta Weed Control Act* (Alberta Government 2010) as Prohibited Noxious, or Noxious weed species. Under the Alberta *Weed Control Act* (Government of Alberta 2010), weeds identified as noxious are required to be controlled, and weeds identified as prohibited noxious are required to be destroyed. At the time of writing, the *Weed Control Act* lists 75 species of plants as either prohibited Noxious or Noxious. A number of other plant species may also be considered invasive under the *Weed Control Act*. For these species, individual municipalities have the authority to designate weeds to either Prohibited Noxious or Noxious status within their municipality.

Within Alberta, there are fewer animal and aquatic invasive species currently identified as concerns (as compared to vegetation species). Aquatic invasive species (aside from aquatic plants) of concern for Alberta include Prussian Carp (*Carassius gibelio*), quagga mussels (*Dreissena polymorpha*) and zebra mussels (*Driessena rostriformis bugenis*). Although quagga and zebra mussels have spread rapidly across western United States and Eastern Canada, they have yet to be documented in Alberta (Alberta Parks 2015). Prussian carp have been documented in drainages in southern and central Alberta (e.g., Red Deer River watershed; ESRD 2015b), but were not documented to occur as far north as the Beaver Hills. The Norway rat (*Rattus norvegicus)*, considered highly destructive, has historically been documented to occur along the eastern border of southern and central Alberta, and was the focus of extensive control programs (AAFRD no date). The Norway rat was not previously documented within the Beaver Hills.

Based on available resources, aquatic invasive species and animal invasive species are not expected to occur in the Beaver Hills. As such, tracking of invasive species within the Beaver Hills for the purpose of this initial State of the Beaver Hills report focuses on invasive plant species. In future State of the Beaver Hills reporting, confirmation that non-plant invasive species introduction should be undertaken.

There is no single data set that tracks the occurrence of invasive weed species within Alberta. Municipalities are responsible for enforcing the *Weed Control Act* and undertaking weed inspections every year; however, levels of enforcement are not equal from one municipality to the next. Further, weed inventory methods employed by individual municipalities varies, ranging from voluntary landowner reporting to targeted or more comprehensive detailed presence/absence surveying. Alberta Agriculture and Rural Development's "Weed Survey Map" web mapping (AARD 2015) summarizes weed occurrence and infestation level by municipality, but does not provide information relating to weed occurrence at a more refined scale.

A list of weeds that have been identified as commonly occurring within the municipalities overlapping the Beaver Hills provided in Table 15. Fifteen noxious weed species and four prohibited noxious weed species have been noted within the counties overlapping the Beaver Hills.

For future State of the Beaver Hills reporting, weed survey data may be available, by request, from overlapping municipalities and other land managers (e.g., Elk Island National Park and the province of Alberta). If made available, this data may be able to identify additional, location specific, weed and weed control data which may be valuable in evaluating this indicator.

Table 15: Weed Species Previously identified in Counties Overlapping the Beaver Hills

Weed Species		Weed Control Act Status
Common Name	**Latin Name**	
Black Henbane	*Hyoscyamus niger*	Noxious
Canada Thistle	*Cirsium arvense*	Noxious
Common Tansy	*Tanacetum vulgare*	Noxious
Yellow (Common) Toadflax	*Linaria vulgaris*	Noxious
Creeping Bellflower	*Campanula rapunculoides*	Noxious
Dame's Rocket	*Hesperis matronalis*	Noxious
Field Scabious	*Knautia arvensis*	Noxious
Himalayan Balsam	*Impatiens glandulifera*	Prohibited Noxious
Leafy Spurge	*Euphorbia esula*	Noxious
Orange Hawkweed	*Hieracium pilosella*	Prohibited Noxious
Oxeye Daisy	*Leucanthemum vulgare*	Noxious
Perennial Sow-Thistle	*Sonchus arvensis*	Noxious
Purple Loosestrife	*Lythrum salicaria*	Prohibited Noxious
Saltcedar	*Tamarix ramosissima*	Prohibited Noxious
Scentless Chamomile	*Tripleurospermum inodorum*	Noxious
Spotted Knapweed	*Centaurea macrocephala*	Prohibited Noxious
Tall Buttercup	*Ranunculus acris*	Noxious
White Cockle	*Silene latifolia*	Noxious
Yellow Clematis	*Clematis tangutica*	Noxious

4.4.4 Species of Conservation Concern

The conservation status of a species is an indication of how likely the species is to become extinct in the near future. Identifying those species with conservation status followed by monitoring future occurrences, provides an indication of change to the distribution of species of conservation concern. Tracking species of conservation status within the Beaver Hills can inform land management decisions, such as identification of key habitats for species of conservation concern for restoration or conservation.

A list of the species of conservation status, observed in the Beaver Hills to date, was compiled through a desktop review. This included a search of the Alberta Conservation Information Management System (ACIMS; Alberta Parks 2014a) in conjunction with the Fish and Wildlife Information Management System (FWIMS; ESRD 2015a). These databases are frequently updated, but data collection is on an ad-hoc basis, driven by individual research and environmental assessments requirements. As such, it is recognized that there may be some limitations in reflectivity and spatial coverage of using these data sets.

The current conservation status for each species of plant, wildlife, or fish under the *General Status of Alberta Wild Species,* the provincial *Wildlife Act*, the Committee on the Status of Wildlife in Canada (COSEWIC), and the federal *Species at Risk Act* (SARA) was determined by searching in the respective online databases (Government of Canada 2015, COSEWIC 2015,

and ESRD 2010). Species identified in the area as reported by these databases and their respective conservation status' are listed in Tables C1 through C3, Appendix C.

The database searches identified a total of 65 species which are listed by one or more of the federal or provincial lists of species of conservation concern. A total of 37 bird species, six mammals, three amphibians and three reptiles were reported as occurring within the Beaver Hills by FWMIS (Table 16). A total of 38 plants that are tracked by ACIMS have previously been reported within the Beaver Hills. Of these, only 16 are listed under the *General Status of Alberta Wild Species*. None of the plant species are listed under the *Wildlife Act*, COSEWIC, or SARA. No listed fish species were reported to occur within the Beaver Hills.

Table 16: Number of Listed Species of Conservation Concern

	ESRD General Status of Alberta Wild Species	Wildlife Act	COSEWIC	SARA	Total
Birds	37	2	11	4	37
Mammals	6	0	3	0	6
Amphibians	3	1	3	2	3
Reptiles	3	2	7	4	3
Plants	16	0	0	0	16

Notes: Species listed as 'Secure', 'undetermined' or not listed under the *General Status of Alberta Wild Species* were not included in total species counts. For COSEWIC counts, species listed as 'not at risk' or not listed by COSEWIC were not included; species listed on priority assessment lists were included.

4.5 QUALITY OF LIFE

The BHI guiding principle behind quality of life is the "unique essential character of the Beaver Hills will be conserved in its natural beauty" (BHI 2015). The BHI provides information to decision-makers to improve the quality of life in the Beaver Hills and supports activities to balance the conservation of the landscape that supports quality of life with responsible use of the ecosystem services that sustain livelihoods.

Eight indicators were evaluated in the *Beaver Hills Initiative State of the Beaver Hills Report Indicator Cost Benefit Analysis* (AMEC 2014). Six indicators were chosen for inclusion in the State of the Beaver Hills report, including:

- Community/Stewardship Groups
- Population
- Employment
- Access to Natural Areas and Recreational Facilities
- Tourism
- Regional Planning

The two indicators not included in this report include: 1) land values, potential values, and current land market prices in the area; and 2) the percent land owned, leased, etc. These two

indicators had high costs associated with their data, without strong evidence of precedent use of these indicators.

4.5.1 Community/Stewardship Groups

The presence of active community/stewardship groups in the Beaver Hills provides opportunities for community members to interact with one another, become involved in community initiatives and learn about the area they live in. In particular, the presence of environmental stewardship groups enables community members to become involved in initiatives that focus on sustainability. Additionally, the presence of heritage and cultural community groups can indicate cultural diversity in a community and can facilitate community members' understanding of and respect for other cultures. In general, the presence of such groups can indicate that residents have a vested interest in the community. Additionally, cultural diversity can reflect welcoming and tolerant communities.

To understand community/stewardship initiatives, the BHI identifies groups through professional and personal knowledge, networks and internet research. The BHI identifies the focus of each group to understand potential changes in and trends in the community (i.e., increasing environmental stewardship, cultural diversity). The number of groups indicates opportunities for community members to participate. In the future, the BHI will look to identify the success of these groups in achieving their missions to understand potential contributions to BHI priorities and to identify the number of volunteers/volunteer hours for each group and overall to understand actual participation.

To date, the BHI has identified 40 various community/stewardship groups located or operating in the Beaver Hills (Wispinski 2015). All of these groups have a mandate that relates to land stewardship. Appendix D identifies the groups, their area of focus and the area of the Beaver Hills represented.

4.5.2 Population

Population statistics are important indicators for quality of life. A higher population density (number of people per unit area) represents a centralized resource demand, which can facilitate efficient provision and use of infrastructure and services and thus minimize impact on the environment and local governments. A lower population density can represent sprawled development, increased vehicle use and increased impact on the environment. However, a lower population density in rural or agricultural areas can be efficient and provide ecosystem services, such as food, water, crop pollination, and recreational opportunities. Population size and growth are important factors in a community's economy. Population size directly impacts the tax base and a dynamic population changes the tax base. Rapid changes in population can present issues for government agencies in providing services and infrastructure. However, a growing population can indicate a strong economy. Important considerations with population size and growth are the impacts on the environment. Finally, an ethnically diverse population can indicate tolerant communities.

To understand population density, the BHI calculated and mapped the number of people per square kilometre based on the Statistics Canada 2011 Census of the Canadian Population at the municipal level, which is the smallest standard geographic area for which all Census data are disseminated. While the BHI focuses on density within the Beaver Hills, Statistics Canada's 2011 National Household Survey also reports on population density, population change and visible minority, First Nations and Metis populations at the county level and for other geographic areas. The BHI looks at these statistics for the five counties that overlap the Beaver Hills and for comparison purposes, the City of Edmonton and the Province of Alberta.

The population density map shows that for almost all of the Beaver Hills, population density is between zero and 1,000 people per square kilometre. A small area that overlaps with Sherwood Park has population density ranges between 1,000 and 4,000 people per square kilometre (Figure 28). In general, the counties that overlap the Beaver Hills have a low population density relative to the City of Edmonton. Four of the five counties that overlap the Beaver Hills have population densities of less than ten people per square kilometre (Table 17). However, overall, the low population density in the Beaver Hills aligns with that of the Province of Alberta. In most of the Beaver Hills, the low population density likely reflects rural or agricultural areas as opposed to sprawled development. The areas with higher population density, Sherwood Park (Figure 28) and Strathcona County (Table 17), likely reflect a centralized resource demand.

Strathcona County has the largest population of the five counties that overlap the Beaver Hills, largely because it is a specialized municipality and likely due to its relatively industrial and urbanized setting. Strathcona County and Camrose County both experienced significant population growth in recent years (Table 17). Overall, the ethnic diversity (the visible minority, First Nations and Metis populations) within the five counties is significantly lower than in the City of Edmonton and lower than in the Province of Alberta (Table 18).

Table 17: Population Density, Population and Population Change, 2011

	Beaver County (1,150 km^2)	**Camrose County (3,321 km^2)**	**Lamont County (2,386 km^2)**	**Leduc County (2,608 km^2)**	**Strathcona County (1,181 km^2)**	**Edmonton (684.4 km^2)**	**Alberta (661,848 km^2)**
Population density (number of people per square kilometer)	1.7	2.3	1.6	5.2	78.3	1,186.8	5.7
Population	5,689	7,721	3,872	13,541	92,490	812,201	3,645,257
Population change (2006 to 2011)	0.2%	8%	-0.8%	3.1%	12.1%	11.2%	10.8%

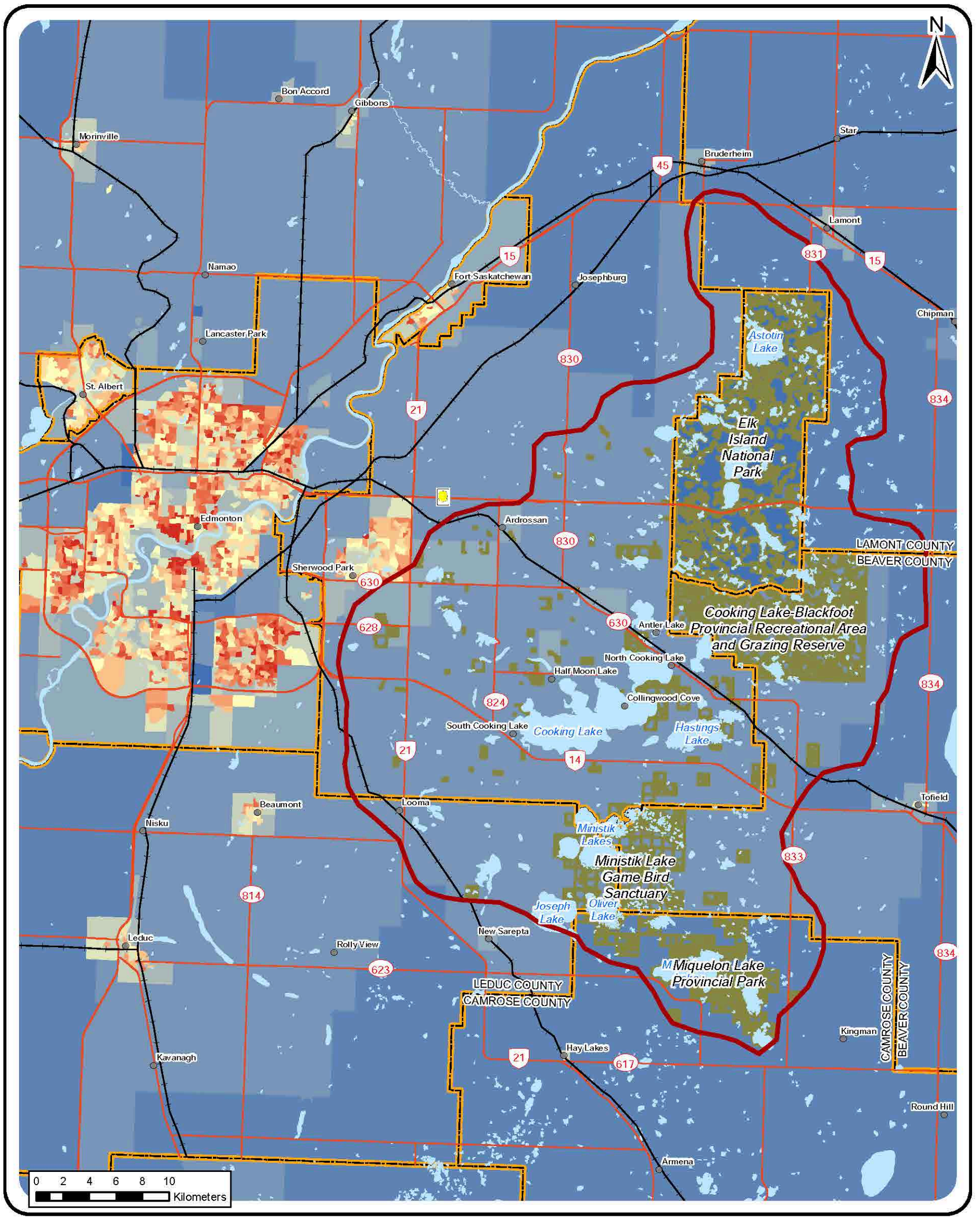
Source: Statistics Canada NHS 2013a-n

Table 18: Population Composition, 2011 (%)

	Beaver County	Camrose County	Lamont County	Leduc County	Strathcona County	Edmonton	Alberta
Visible minority	1.2	1.3	-	1.4	5.5	30.0	18.4
First Nations	1.8	2.2	1.7	2.3	2.6	4.0	5.0
Métis	1.5	1.5	1.7	1.2	2.3	2.5	2.7

Notes: Some data categories will not sum to the total census population due to Statistics Canada survey error. '-' indicates data was unavailable or suppressed by Statistics Canada due to small survey counts. Source: Statistics Canada NHS 2013a-n.

Figure 13: Population Density



Legend

- Beaver Hills Initiative Area
- Populated Place
- Rail
- Highway
- Protected Areas
- Indian Reserve

Population Density
People / km² by Dissemination Area 2006

- 0 - 1
- 1 - 5
- 5 - 65
- 66 - 275
- 275 - 649
- 651 - 1313
- 1314 - 1858
- 1859 - 2242
- 2242 - 2616
- 2616 - 2961
- 2962 - 3328
- 3329 - 3788
- 3791 - 4448
- 4448 - 5764
- > 5764

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4.5.3 Employment

Employment by industry is an important measure of economic diversification in a community. A diverse economy will help ensure economic stability and resiliency, relative to an economy that is dependent on a single industry. Additionally, a stable economy contributes to a strong tax base. As tracking employment provides insight into changes in the economy of an area, tracking of employment in the Beaver Hills can support Biosphere Reserve periodic reporting relating to economic changes in the Beaver Hills.

To understand employment, the BHI obtained data from the Statistics Canada 2011 National Household Survey counts for employment by sector by county and calculated the percent of the population employed in each sector to compare across sectors and to the Province of Alberta. Table 19 shows that the five counties that overlap the Beaver Hills have representation in all employment sectors; however, there are some sectors that are over or under-represented relative to employment by sector for the Province of Alberta.

The manufacturing sector and the administrative and support; waste management and remediation services sector are slightly over-represented in Camrose County and slightly under-represented in the other four counties. The agriculture; forestry; fishing and hunting sectors are significantly over-represented in four of the five counties, while slightly under-represented in Strathcona County. The professional; scientific and technical services sector and public administration sector are slightly over-represented in Strathcona County, while slightly under-represented in the other four counties. These trends may be due to the relatively industrial and urbanized setting of Strathcona County. The construction sector is slightly under-represented in Lamont County and slightly over-represented in the other four counties. Finally, the accommodation and food services sector is under-represented compared to the Province of Alberta in all of the five counties that overlap the Beaver Hills. Also, it is interesting to note that four of the five counties that overlap the Beaver Hills have unemployment rates that are lower than the unemployment rate for the Province of Alberta.

Table 19: Employment by Industry, 2011 (%)

	Beaver County	Camrose County	Lamont County	Leduc County	Strathcona County	Alberta
Unemployment	2.1	6.1	2.9	2.2	4.2	5.8
Agriculture; forestry; fishing and hunting	19.4	27.9	24.5	14.8	1.5	2.9
Mining; quarrying; and oil and gas extraction	6.7	3.4	4.6	7.3	3.3	6.5
Utilities	0.6	1.1	0.6	1.4	1.2	1.0
Construction	12.2	10.2	8.2	11.1	11.6	9.3
Manufacturing	8.4	3.3	7.5	7.6	7.1	5.8
Wholesale trade	2.9	3.4	2.5	5.2	5.8	4.2
Retail trade	5.4	8.0	8.0	6.4	10.1	10.8
Transportation and warehousing	5.6	4.2	7.5	5.4	4.6	5.0
Information and cultural industries	1.1	0.4	-	0.7	1.4	1.7
Finance and insurance	1.6	2.6	1.5	1.7	3.6	3.3
Real estate and rental and leasing	0.8	1.7	-	2.6	1.7	1.9
Professional; scientific and technical services	3.2	4.2	3.1	4.4	7.8	7.7
Management of companies and enterprises	-	-	-	-	0.2	0.1
Administrative and support; waste management and remediation services	2.1	3.8	1.3	2.7	2.8	3.4
Educational services	3.8	5.4	4.2	5.4	7.9	6.7
Health care and social assistance	12.7	8.5	11.7	7.5	9.8	9.8
Arts; entertainment and recreation	0.6	1.4	2.5	1.9	1.5	1.9
Accommodation and food services	1.1	2.2	-	2.8	3.8	5.9
Other services (except public administration)	7.3	4.0	5.2	7.0	5.0	4.8
Public administration	3.3	3.6	4.8	4.0	8.4	6.1

Notes: Some data categories will not sum to the total census population due to Statistics Canada survey error. '-' indicates data was unavailable or suppressed by Statistics Canada due to small survey counts. Source: Statistics Canada NHS 2013a-n.

4.5.4 Access to Natural Areas and Recreational Facilities

Access to natural areas and recreation facilities is important for providing opportunities for community members to recreate and enjoy natural areas. Human health, both physical and mental, can benefit from physical activity and time spent in natural areas. However, it is important to consider that an increase in natural areas and recreation facilities may represent a decrease in forest cover (negative impact) or brownfield redevelopment (positive impact). A decrease in natural areas and recreation facilities may represent an increase in urbanization.

To understand access to natural areas and recreation facilities, the BHI identified the number, type and area (square kilometres) of provincially-identified natural areas and recreation facilities, quantified the percent of the Beaver Hills covered by provincially-identified natural areas and recreation facilities and calculated the distance between areas within the Beaver Hills zoned as residential and the provincially-identified natural areas and recreational facilities. Use of these areas and facilities is addressed through the tourism indicator.

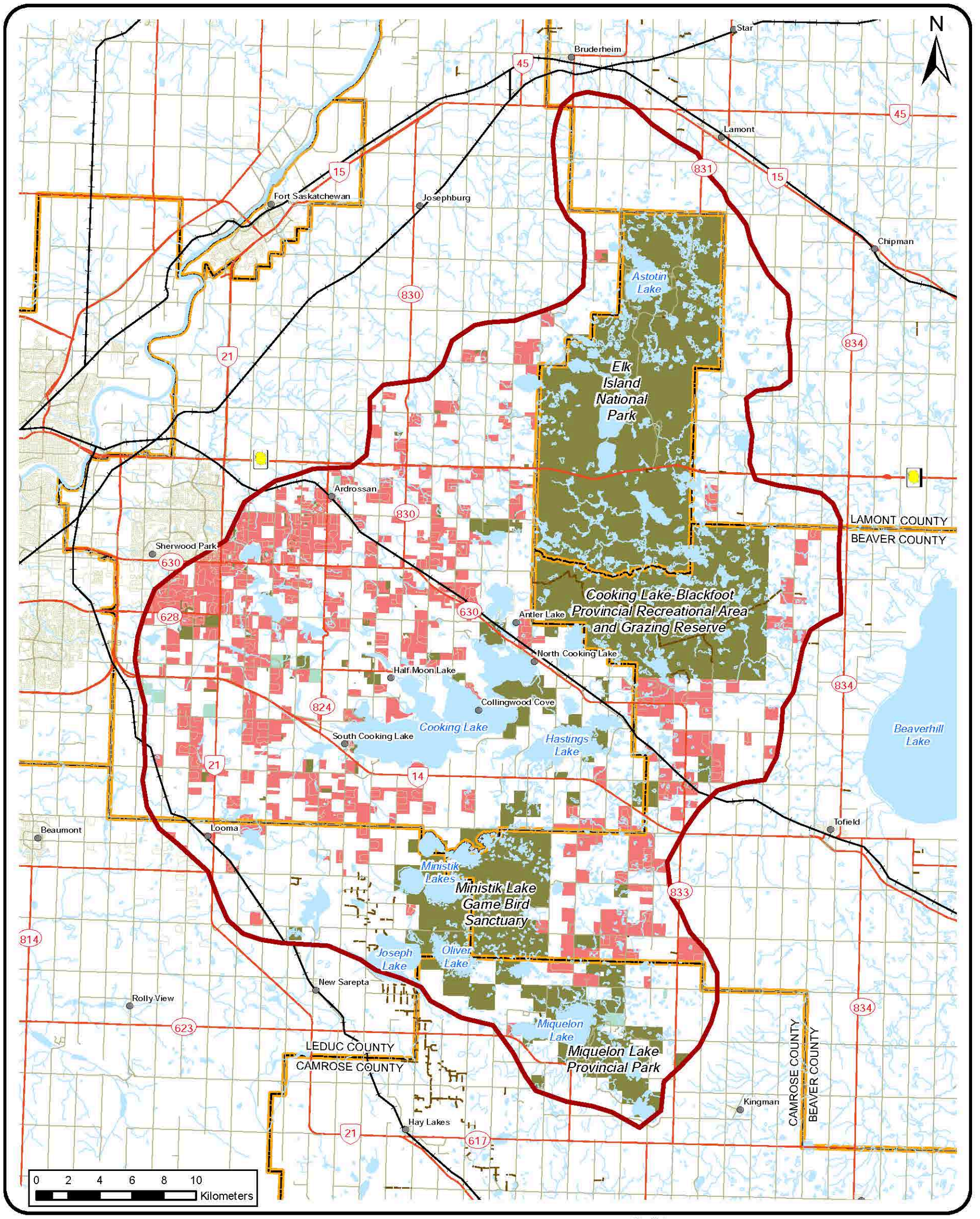
Within the Beaver Hills there is one national park; eleven provincially-identified recreational areas, natural areas or bird sanctuary; one municipal wilderness recreational facility as well as a variety of smaller conservation areas and crowns reservations (Table 20). Almost 27% of the Beaver Hills overlaps with a provincially-identified natural area and recreational facility (Table 20). All residentially-zoned areas are within at least 10 kilometres of at least one natural area and recreational facility (see Figure 14).

Table 20: Percent of Beaver Hills taken up by Natural Areas and Recreational Facilities

Natural Area/Recreation Facility Type[1]	Name	Area
National Park	Elk Island Park	19,296
Provincial Park	Miquelon Lake	1,305
Provincial Recreation Area	Cooking Lake-Blackfoot	9,889
Natural Area	Antler Lake Island Edgar T. Jones Hastings Lake North Cooking Lake Parkland Sherwood Park Wanisian Lake	
Bird Sanctuaries	Ministik Lake Miquelon Lake	714
Municipal Wilderness Recreation Facility	Strathcona Wilderness Center	9,854
Conservation Easements, Alberta Parks Crown Reservations	Golden Ranches Various unnamed	2,473

Notes: [1] See Table 12, Section 4.4.1 for descriptions of natural areas/recreational facility types identified herein.

Figure 14: Natural Areas, Recreation Facilities and Residential Areas



Legend

- Beaver Hills Initiative Area
- Rail
- Local Streets & Lanes
- Highway
- Grid
- Recreation
- Stream
- Waterbody
- Residential Area
- Natural Areas

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4.5.5 Tourism

Tourism can indicate human use of natural areas and recreation facilities and increase society's value of and support for conservation of the land and natural areas. However, tourism may have an environmental impact and it is important to consider potential negative effects such as over use, littering and vandalism.

BHI is working to understand tourism, land use and the natural environment in the area to develop ideas for appropriate use of/visitation to the area. The BHI *Tourism Development Opportunity Assessment* identifies tourism opportunities in the Beaver Hills. These opportunities include heritage/cultural trails, facilities and attractions; nature-based tourism attractions, sites and accommodations; and agritourism attractions, facilities and accommodations.

To understand tourism usage, the BHI evaluates tourist statistics but these data are generally not publically available for individual destinations. To obtain relevant data for the purpose of evaluating this indicator, the Beaver Hills Initiative requested tourism statistics) from organizations which manage or operate tourism destinations within the Beaver Hills . Tourist statistics were only available for Elk Island National Park, Miquelon Provincial Park, Strathcona Wilderness Centre and the Ukranian Village. Tourist visitation statistics provided to the BHI are summarized in Table 21.

Tourist visits data for Elk Island National Park, Miquelon Provincial Park, Strathcona Wilderness Centre and the Ukrainian Village indicate that these facilities are well visited. Tourist visits to the Edmonton and Area Tourism Region, which includes the Beaver Hills are numerous but would also include business tourism as well as recreational visits (Table 21).

To support future state of the Beaver Hills reporting, it is recommended that statistics continue to be collected from tourist destinations on an annual basis, or as frequently as available. Additional details relating to the type of visit could also be requested and where this data is available, include in future State of the Beaver Hills reporting.

Table 21: Tourist Visits by Destination

Destination	Tourist Visits (year)	Overnight Visits (year)
Elk Island National Park	220,000 (2013)	No data
Miquelon Provincial Park	24,000 (2013)	No data
Strathcona Wilderness Centre	75,882 (2014)	No data
Ukrainian Cultural Heritage Village	45,316 (2013/2014)	Not applicable
Edmonton and Area Tourism Region	6.49 million (2012)	2.89 million (2012)
Alberta	33.09 million (2012)	13.49 million (2012)

Source: Knowles 2014, Cole 2014, Funk 2014, Makowsky 2014, Alberta Government 2014

4.5.6 Regional Planning

Regional planning is a valuable tool for managing land use in the Beaver Hills. The number of planning mechanisms (i.e., Municipal Development Plan or Land Use Bylaw) can indicate opportunities for management, while the type, quality and success of those planning mechanisms can indicate their value and effectiveness.

There are at least 27 regional planning mechanisms to manage land use overlapping the Beaver Hills. These mechanisms range from Land Use Bylaws to Municipal Development Plans, Park Management Plans (MPs) and Parks Interim Management Directives (IMDs) to Integrated Resource Plans. The North Saskatchewan Integrated Watershed Plan was completed in 2012. Additionally, the provincial Land Use Framework allows for development of regional plans. The North Saskatchewan Regional Plan, which overlaps the Beaver Hills, is currently being developed.

Land use zoning in the Beaver Hills reflects development priorities which may align with or support the priorities of the Beaver Hills Initiative. For example, areas zoned for conservation should support other conservation initiatives in that location and areas zoned for agriculture and country residential may support the provision of ecosystem goods and services in the region. The majority of the Beaver Hills is zoned for agriculture, with country residential being the second largest zoned area and conservation being the third (see Table 3 and Figure 3, section 4.1.3).

Tracking the number of regional planning mechanisms that spatially overlap the Beaver Hills does provide some indication of the potential for planning policies that align with the Beaver Hills Initiative goals. However, the number of planning tools does not necessarily indicate the quality of those tools or their effective application. The type and quality of the programs may be more indicative than the number. Future State of the Beaver Hills reporting should consider more refined evaluation of the regional planning mechanisms which are applicable to the Beaver Hills. It is recognized that evaluating the type and quality of regional planning mechanisms may be involved and, to some degree subjective. At a minimum, the future State of the Beaver Hills reporting should include documenting where and how regional plans consider the Beaver Hills as a Biosphere Reserve (once designated), as this is a reporting requirement for biosphere reserve periodic review requirements (UNESCO 2013).

5.0 RECOMMENDATIONS

The scope and overall intent of this study was to provide an initial State of the Beaver Hills Report, which was focused on identifying and utilizing readily available data sets, particularly geo-spatial data, which could be used to evaluate indicators for the initial state of the Beaver Hills report. These data would also facilitate future comparison to indicator assessments conducted during future State of the Beaver Hills reporting.

The process of undertaking the indicator cost-benefit evaluation (AMEC 2014) and the subsequent indicator evaluation presented herein highlights gaps in data sets presently available. In addition, it became evident that a number of key data sets which are readily available, and in some cases free, can provide valuable foundation for analysis of multiple indicators. Finally, the analysis also identified a number of data sets required which are, by nature, specific to the Beaver Hills, and would need to be managed and updated for each State of the Beaver Hills reporting cycle by the BHI.

As such, Amec Foster Wheeler has provided a summary of recommendations relating to data set acquisition intended to assist the BHI in prioritizing data set acquisition in Table 22.

Table 22: Recommended Data Acquisitions and Timelines

Target Data	Availability	Supported Indicators[1]	Frequency of Acquisition	Notes
Key Required Data (Data sets which were utilized for current State of Beaver Hills Report, often required for more than one indicator).				
Land Cover	Available (AAFC)	**Lake shoreline and Streambank development; Shoreline/ Streambank with Permanent Vegetation; Habitat and Connectivity; Habitat Fragmentation; Bare Soils; Access to Natural Areas**	5 years	No charge for data; publically available. Obtaining data on annual basis can be considered where storage space is not a consideration.
Title map	Available (AltaLIS)	**Intact Quarter Sections, Land Use**	5 years	Cost for acquisition. Data will likely require refinement (e.g., topology).
Access	Available (AltaLIS)	**Linear Disturbance**	5 years	
Hydrology	Available (AltaLIS)	**Lake shoreline and Streambank development; Shoreline/ Streambank with Permanent Vegetation;**	5 years	
Land Use Bylaws	On request (directly from Counties)	**Land Use Sectors, Soil Capability**	5 years (as amended by Municipalities)	
Parks and Protected Areas	Available (Alberta Parks)	**Protected Habitats, Access to Natural Areas and Recreation Facilities**		
Air Quality	Available (CASA data Warehouse)	**Air Quality Index**	5 years	
Lake Levels	Available	**Lake Levels**	5 years	
Drought Indexes	Available (AAFC)	**Drought Index**		
Fish and Wildlife Occurrence	Available (FWMIS)	**Species of Conservation Concern**	5 years	Additional detailed data may be available on request from ESRD.
Tracked Plant Occurrences	Available (ACIMS)	**Species of Conservation Concern**	5 years	
Population Statistics	Available (Statistics Canada)	**Population**	5 years	
Employment Statistics	Available (Statistics Canada)	**Employment**	5 years	
Tourist Statistics	On request (from facilities)	**Tourism**	Annual	
Water Well Locations	On Request (ESRD)	**Well Siting, Well Abandonment, and Well Density**; Footprint Analysis	5 years	Data would require some analysis/interpretation.
Oil and Gas Wells	On request (AER)	**Well Siting, Well Abandonment, and Well Density**	5 years	
Strongly Recommended (Data sets which were not available for the initial State of the Beaver Hills report or an alternative data set recommended for use in future indicator evaluations).				
Groundwater Risk	On request (directly from Counties)	**Well Siting, Well Abandonment, and Well Density**; Footprint Analysis	Once	Data has been acquired; data requires specialist input to merge data sets which vary in terms of groundwater risk ratings. Footprint Analysis would require additional data, expertise and analysis.
Weed Occurrence	On request (directly from Counties)	**Invasive Species**	5 years	Weed distribution and occurrence data will need to be requested from the individual counties. Data may also become more available via web mapping interfaces which are just emerging (e.g, ARD Weed Survey Map)
Regional Plans	Available	**Regional Planning**	5 years, as available	Collecting and maintaining a 'library' of plans as they become available would assist in comparing changes in plans over time as superseded plans may not be available at the time of writing the next State of the Beaver Hills report.
Optional (These data sets generally consist of data that would have to be acquired through direct collection, require substantial effort in compiling, or for which costs may be prohibitive).				
Riparian Health Assessments	Uncertain; may require direct data collection	Riparian Health	As available	Data would have to be directly requested from collecting organization (e.g., Cows and Fish).
Municipal Conservation Areas (Easements, Reserves)	On request (directly from Counties, conservation organizations)	**Protected Habitats, Access to Natural Areas and Recreation Facilities**	5 years, as available	Likely will already be captured in data updates undertake for Biosphere Reserve Core, Buffer and Transition areas delineation.
Wetland Health/Function	Uncertain; may require direct data collection	**Wetlands**	5 years, or as available	Anticipated to require direct collection using rapid assessment methodology. Alberta Wetland Policy implementation tools may provide alternative wetlands value and function data sets that may be utilized in the future.
Brightness	Requires direct data collection	Brightness	5 years, or as available	Statistics should continue to be collected from tourist destinations on an annual basis, or as frequently as available. Additional details relating to the type of visit could also be requested, and, where this data is available.
Land Values/Market Prices	Available for cost	Land Values, Potential Available for cost values, and Current Market Prices	5 years	Cost may be prohibitive; would require significant effort to compile.

Notes: [1] Indicators evaluated in the State of the Beaver Hills reporting herein indicated by **Bold** text.

6.0 CONCLUSION

Through the evaluation of the selected indicators, this initial State of the Beaver Hills Report highlights the unique environmental, social and economic conditions that exist within the Beaver Hills. As is evident through the land and biodiversity indicators, the landscape of the Beaver Hills retains areas of little to no human development, within a substantial portion of the Beaver Hills currently designated by a variety of conservation areas (27%). The mix of natural, semi-natural and anthropogenic habitats offers a unique mosaic of habitats and landcover types within a predominantly working landscape. The status of the quality of life indicators reflect the agricultural nature of the majority of the Beaver Hills, in terms of population density, employment, and land use zoning of the overlapping counties. The Beaver Hills provides for a number of cultural, ecotourism and recreational opportunities which are well attended, as reflected by the tourism visitor statistics.

The indicators presented within this initial State of the Beaver Hills report provide a brief and focused overview of the current state of the selected indicators. Understanding the state of these indicators will inform the BHI in future planning of shared initiatives and monitoring as well as support evaluation of implemented initiatives and land management practices. The results of the analysis can be expanded upon, in future monitoring periods, by tracking the indicators through time, in comparison to other areas, or by incorporating additional analysis of indicators where other information can be obtained.

7.0 CLOSURE

This report is based on and limited by the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. Amec Foster Wheeler Environment & Infrastructure has performed its services in a manner consistent with the standard of care and skill ordinarily exercised by members of the profession practicing under similar conditions in the geographic vicinity and at the time the services were performed. Amec Foster Wheeler Environment & Infrastructure believes that this information is accurate but cannot guarantee or warrant its accuracy or completeness including information provided by third parties.

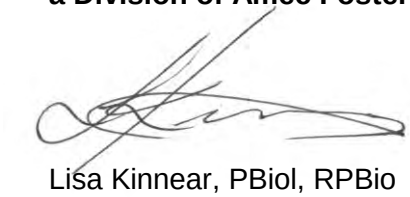
This report has been prepared for the exclusive use of the Beaver Hills Initiative and their agents for specific application to this project site. The work was conducted in accordance with the scope of work prepared for this project, and generally accepted professional work practices. No other warranty, expressed or implied, is made.

Amec Foster Wheeler Environment & Infrastructure does not accept any responsibility for the use of this report, in whole or in part, for any purpose other than that intended or to any third party for any use whatsoever. Amec Foster Wheeler requires that third parties wishing to rely on this report agree to the terms, conditions and limitations stipulated in Amec Foster Wheeler's Standard Contract and in the report.

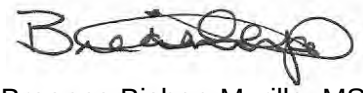
We trust that the information contained within this report satisfies your requirements. Should you have any questions, please contact the undersigned at your earliest convenience.

Respectfully submitted,

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited



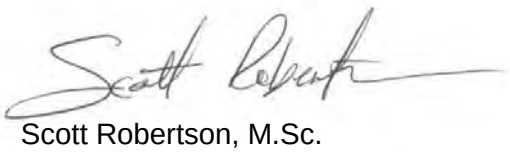
Lisa Kinnear, PBiol, RPBio
Environmental Biologist



Breanna Bishop-Murillo, MSc, BSc, RPP, MCIP
Human Environment Specialist

Reviewed by:

Nancy Griffiths, MCIP
Senior Environmental Planner



Scott Robertson, M.Sc.
Associate Geoscientist

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APPENDIX A

Land Use Zone Classifications

Table A1: Land Use Zone Classification

Assigned Land Use Sector	County Land Use Zones[1]				
	Strathcona County	**Lamont County**	**Leduc County**	**Camrose County**	**Beaver**
Agriculture	Agriculture: Future Development Agriculture: General	Agriculture Heartland Agriculture	AG (Agriculture) AG-CR (Agriculture-Country Residential Transition) Lake Watershed	AG (General Agricultural) WP (Water Protection)	Rural Residential / Agriculture
Residential	Low Density Multiple Residential Single Detached Residential A Single Detached Residential B Single Detached Residential C Semi-detached Residential Hamlet		RCM (Rural Center Mixed)		
Commercial	Local Commercial Service Commercial Highway Commercial Service Commercial Service Utilities				
Country Residential	Country Residential Estate Residential Rural Residential/Agriculture Direct Control	Country Residential	RC (Country Residential)	CR-1 (Small Lot Country Residential) CR-2 (Large Lot Country Residential)	County Residential
Recreational	Golf Course Recreation Recreation Commercial			GREC (General Recreation)	
Industrial		Heartland Industrial			
Conservation	Conservation			Prv Regs	

Notes: 1: County Land Use bylaws incorporated: *Strathcona County Land Use Bylaw 8-2001¸ Leduc County Bylaw 07-08 (Land Use Bylaw), Lamont County Land Use Bylaw 675/01, Beaver County Land Use Bylaw (Bylaw No. 98-8001), Camrose County Bylaw 1142.*

APPENDIX B

Key Air Quality Statistics

Table B1: Summary Table of Key Air Quality Statistics

Station	Pollutants		Annual Records		24-Hour Records				1-Hour Records			
	Name	Unit	Avg. Conc.	Uptime	Maximum		AAAQO	Exceed Days	Maximum		AAAQO	Exceed Hours
					Conc.	Time			Conc.	Time		
Edmonton East	SO_2	ppb	2	99.9%	7	Jul-12	48	0	32	Apr-27 16:00	172	0
	NO_2	ppb	12.7	96.7%	43.6	Mar-5	-	-	94.5	Mar-05 12:00	159	0
	O_3	ppb	21	99.9%	40	Apr-9	-	-	57	Aug-06 16:00	82	0
	$PM_{2.5}$	$\mu g/m^3$	10.8	95.0%	37.8	Nov-13	30	7	77.0	Nov-13 17:00	-	-
Lamont County	SO_2	ppb	1	99.6%	8	Dec-19	48	0	28	Mar-08 15:00	172	0
	NO_2	ppb	3.4	99.9%	22.1	Dec-19	-	-	40.1	Dec-19 22:00	159	0
	O_3	ppb	30	99.9%	50	Apr-30	-	-	67	Jul-11 16:00	82	0
	$PM_{2.5}$	$\mu g/m^3$	7.4	99.8%	41.0	Jul-11	30	2	120.0	Nov-14 00:00	-	-
Fort Saskatchewan	SO_2	ppb	1	91.4%	4	Feb-25	48	0	21	Jul-18 13:00	172	0
	NO_2	ppb	7.6	91.3%	36.5	Feb-25	-	-	61.0	Feb-26 09:00	159	0
	O_3	ppb	25	91.4%	44	Apr-9	-	-	71	Aug-06 18:00	82	0
	$PM_{2.5}$	$\mu g/m^3$	7.4	91.4%	38.5	Nov-13	30	3	139.0	Nov-13 18:00	-	-
Bruderheim	SO_2	ppb	1	91.1%	6	Dec-7	48	0	31	Jul-19 20:00	172	0
	NO_2	ppb	6.2	91.1%	27.5	Feb-6	-	-	46.5	Feb-26 01:00	159	0
	O_3	ppb	28.0	91.1%	45	Jan-19	-	-	69	Jul-04 17:00	82	0
	$PM_{2.5}$	$\mu g/m^3$	8.6	91.3%	46.0	Jul-11	30	4	82.0	Nov-13 23:00	-	-
Elk Island	SO_2	ppb	1	98.8%	6	Dec-19	48	0	25	Dec-19 14:00	172	0
	NO_2	ppb	3.5	98.8%	20.7	Feb-6	-	-	41.1	Jan-06 17:00	159	0
	O_3	ppb	27	98.8%	48	Apr-22	-	-	68	Aug-06 16:00	82	0
	$PM_{2.5}$	$\mu g/m^3$	5.5	98.9%	32.5	Jul-11	30	1	73.0	Jul-16 17:00	-	-

APPENDIX C

Species of Conservation Status

Table C1: Tracked Vascular and Non-Vascular Plant Species Previously Identified within the Beaver Hills

Species		Provincial Status			Federal Status	
Scientific Name	**Common Name**	**ESRD Status[1]**	**ACIMS[2]**	**Wildlife Act**	**COSEWIC Status**	**SARA Schedule**
Ascending grape fern	*Botrychium ascendens*	May be at Risk	S2			
Bellmouth Rams-horn	*Planorbella campanulata*		SNR			
Blunt-leaved pondweed	*Potamogeton obtusifolius*	Sensitive	S2			
Bronze copper	*Lycaena hyllus*	Secure	S2			
Brown moss	*Drepanocladus crassicostatus*	Undetermined	S2			
Campylium moss	*Campylium radicale*	Undetermined	S2			
Carolina wild germanium	*Geranium carolinianum*	Sensitive	S1			
City dot lichen	*Scoliciosporum chlorococcum*		SU			
Clinton's bulrush	*Trichophorum clintonii*	May be at Risk	S1			
Cranberry blue	*Plebejus optilete*	Undetermined	S2S3			
Crested shield fern	*Dryopteris cristata*	May be at Risk	S1			
Cupsidate earth moss	*Phascum cuspidatum*		S2			
Cyperus-like sedge - water arum	*Carex pseudocyperus - Calla palustris*	Secure	S2			
Dot-tailed whiteface	*Leucorrhinia intacta*	Secure	S2S3			
Dwarf grape fern	*Botrychium simplex*	May be at Risk	S2			
Flat topped white aster	*Doellingeria umbellata var. pubens*		S2			
Fox sedge	*Carex vulpinoidea*	May be at Risk	S2			
Golden saxifrage	*Chrysosplenium iowense*	Sensitive	S3			
Green-cushioned weissia moss	*Weissia controversa*	Undetermined	S2			
Hybrid dwarf raspberry	*Rubus paracaulis*	Not Listed	S1			
Lakeshore sedge	*Carex lacustris*	May be at Risk	S2			
Lance-leaved grape fern	*Botrychium lanceolatum*	Sensitive	S2			
Leafy pondweed	*Potamogeton foliosus*	Secure	S2			
Lichen	*Mycocalicium calicioides*		S1			
Liverwort	*Ricciocarpos natans*		S2			

Species		Provincial Status			Federal Status	
Scientific Name	**Common Name**	**ESRD Status[1]**	**ACIMS[2]**	**Wildlife Act**	**COSEWIC Status**	**SARA Schedule**
Long-stalking beardless moss	*Desmatodon heimii*		S2			
Macloskey's violet	*Viola pallens*		S2S3			
Michigan grapefern	*Botrychium michiganense*		SU			
Moss	*Conardia compacta*	Undetermined	S2			
Northwestern grapefern	*Botrychium pinnatum*	Sensitive	S3			
Pale blue-eyed grass	*Sisyrinchium septentrionale*	Sensitive	S3			
Pale moonwort	*Botrychium pallidum*	May be at risk	S1			
Round-leaved bryum	*Bryum cyclophyllum*	Sensitive	S2			
Slender naiad	*Najas flexilis*	May be at Risk	S2			
Urn moss	*Physcomitrium pyriforme*	Undetermined	S1			
Watermeal	*Wolffia columbiana*	Sensitive	S2			
Widgeon-grass	*Ruppia cirrhosa*	Sensitive	S1			

Notes: [1] ESRD Status (ESRD 2010): May be at Risk = any species that "May be at Risk" of extinction or extirpation, and is therefore a candidate for detailed risk assessment; Sensitive = any species that is not at risk of extinction or extirpation, but may require special attention or protection to prevent it from becoming "At Risk"; 'Blank cell = not listed. 2 AIMS Ranks: Standard subnational conservation status. SX = taxon believed to be extirpated from province; virtually no likelihood of rediscovery; SH = known only from historical records, but still some hope of rediscovery. S1 = known from five or fewer occurrences or especially vulnerable to extirpation because of other factors; S2 = Known from twenty or fewer occurrence or vulnerable to extirpation because of other factors; S3 = known from 100 or fewer occurrences or somewhat vulnerable to extirpation from other factors; S4 = apparently secure; S5 = Secure, common, widespread and abundant.

Table C2: Fish Species Previously Identified within the Beaver Hills

Species		Provincial Status		Federal Status	
Common Name	**Scientific Name**	**ESRD Status**	**Wildlife Act**	**COSEWIC Status**	**SARA Schedule**
Sport Fish					
Rainbow trout (introduced)	*Oncorhynchus mykiss*				
Yellow perch	*Perca flavescens*	Secure			
Minnows					
Brook stickleback	*Culaea inconstans*	Secure			
Fathead minnow	*Pimephales promelas*	Secure			
Lake chub	*Couesius plumbeus*	Secure			

Notes: [1] ESRD Status (ESRD 2010): Secure' = A species that is not At Risk, May Be At Risk or Sensitive; Blank cell = not listed.

Table C3: Wildlife Species of Conservation Concern Previously Identified within the Beaver Hills

Species		Provincial Status		Federal Status	
Common Name	**Scientific Name**	**ESRD Status**	**Wildlife Act**	**COSEWIC Status**	**SARA Schedule**
Birds					
American bittern	*Botaurus lentiginosus*	Sensitive			
Green-winged teal	*Anas crecca*	Secure			
American kestrel	*Falco sparverius*	Sensitive		Priority 3	
American white pelican	*Pelecanus erythrorhynchos*	Sensitive		Not at Risk	
Bald eagle	*Haliaeetus leucephalus*	Sensitive		Not at Risk	
Barn swallow	*Hirundo rustica*	Sensitive		Threatened	
Barred owl	*Strix varia`*	Sensitive			
Black-crowned night heron	*Nycticorax nycticorax*	Sensitive			
Black tern	*Chlidonias niger*	Sensitive		Not at Risk	
Broad-winged hawk	*Buteo platypterus*	Sensitive			
Chestnut-collared longspur	*Calcarius ornatus*	Sensitive		Threatened	Schedule 1 (Threatened)
Common nighthawk	*Chordeiles minor*	Sensitive		Threatened	Schedule 1 (Threatened)
Common yellowthroat	*Geothlypis trichas*	Sensitive		Not at Risk	
Eastern Phoebe	*Sayornis phoebe*	Sensitive			
Forster's tern	*Sterna forsteri*	Sensitive			
Grasshopper sparrow	*Ammodramus savannarum*	Sensitive			
Great blue heron	*Ardea herodias*	Sensitive		Special Concern	
Great gray owl	*Strix nebulosa*	Sensitive		Not at Risk	
Horned grebe	*Podiceps auritus*	Sensitive		Special Concern	
Least flycatcher	*Empidonax minimus*	Sensitive		Priority 3	
Lesser scaup	*Aythya affinis*	Sensitive			
Northern goshawk	*Accipiter gentilis*	Sensitive		Not at Risk	
Northern Harrier	*Circus cyaneus*	Sensitive		Not at Risk	
Northern pintail	*Anas acuta*	Sensitive			
Northern pygmy owl	*Glaucidium gnoma*	Sensitive			
Piping plover	*Charadrius melodus*	At Risk	Endangered	Endangered	Schedule 1 (Endangered)
Purple martin	*Progne subis*	Sensitive			
Pileated woodpecker	*Dryocopus pileatus*	Sensitive			
Short-eared owl	*Asio flammeus*	May be at Risk		Special Concern	Schedule 1 (Special Concern)
Sora	*Porzana carolina*	Sensitive			
Sprague's pipit	*Anthus spragueii*	Sensitive		Threatened	
Swainson's hawk	*Buteo swainsoni*	Sensitive			

Species		Provincial Status		Federal Status	
Common Name	**Scientific Name**	**ESRD Status**	**Wildlife Act**	**COSEWIC Status**	**SARA Schedule**
Trumpeter swan	*Cygnus buccinator*	At Risk		Not at Risk	
Western grebe	*Aechmophorus occidentalis*	Sensitive	Endangered	Special Concern	
Western tanager	*Piranga ludoviciana*	Sensitive			
Western wood-pewee	*Contopus Sordidulus*	Sensitive			
White-winged scoter	*Melanitta fusca*	Sensitive			
Mammals					
American badger	*Taxidea taxus*	Sensitive		Special Concern	
Fisher	*Martes pennanti*	Sensitive			
Hoary bat	*Lasiurus cinereus*	Sensitive			
Northern long-eared bat	*Myotis septentrionalis*	May Be At Risk		Endangered	
Prairie long-tailed weasel	*Mustela frenata longicauda*			May be at Risk	
Silver-haired bat	*Lasionycteris noctivagans*	Sensitive			
Amphibians					
Boreal toad	*Anaxyrus boreas*	Sensitive		Non-active	Schedule 1 (Special Concern)
Canadian toad	*Bufo hemiophrys*	May Be At Risk		Not at Risk, Priority 1	
Northern leopard frog	*Lithobates pipiens*	At Risk	Endangered	Special Concern	Schedule 1 (Special Concern)
Reptiles					
Plains garter snake	*Thamnophis radix*	Sensitive		Priority 2	
Red-sided garter snake	*Thamnophis sirtalis*	Sensitive			
Wandering garter snake	*Thamnophis elegans*	Sensitive			

Notes: [1] ESRD Status (ESRD 2010): May be at Risk = any species that "May be at Risk" of extinction or extirpation, and is therefore a candidate for detailed risk assessment; Sensitive = any species that is not at risk of extinction or extirpation, but may require special attention or protection to prevent it from becoming "At Risk"; Secure' = A species that is not At Risk, May Be At Risk or Sensitive; Blank cell = not listed. [2] Federal Status: (COSEWIC 2014; EC 2014): "Special Concern" = a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats. "Threatened" = wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction. "Not at Risk" = A wildlife species that has been evaluated and found to be not at risk of extinction given existing circumstances.

APPENDIX D

Community / Stewardship Groups

Table D1: Partner Organizations

Partner Organization	Area(s) of Focus	Areas of the Beaver Hills Represented
Beaver County	Agriculture, community development and safety, local government	Beaver County; Includes Cooking Lake/Blackfoot Provincial Recreation Area and part of the Ministik Lake Game Bird Sanctuary
Leduc County	Agriculture, community development and safety, local government	Leduc County; Includes part of the Ministik Lake Game Bird Sanctuary
Lamont County	Agriculture, community development and safety, local government	Lamont County; Includes northern and eastern boundaries of Elk Island National Park
Strathcona County	Community development and safety, local government	Strathcona County: includes western boundary of Elk Island National Park and a small section of the Ministik Lake Game Bird Sanctuary
Agriculture and Rural Development	Industrial growth, sustainability in rural areas, and managing risks in relevant businesses	~ All of the Beaver Hills falls under this Ministry's jurisdiction, excepting the protected areas of Elk Island National Park, Miquelon Lakes Provincial Park, and the Cooking Lake/Blackfoot Provincial Recreation Area
Environment and Sustainable Resource Development	Resource development, environmental regulations and stewardship	~ All of the Beaver Hills falls under this Ministry's jurisdiction as WMUs
Municipal Affairs	Municipality development and funding	~ Sherwood Park, Counties of Strathcona, Lamont, Leduc and Camrose and the Improvement District of Elk Island (Elk Island National Park)
Tourism, Parks and Recreation	Tourism marketing, park management, supporting recreation and sports facilities	~ Miquelon Lake Provincial Park and Cooking Lake/Blackfoot Provincial Recreation Area (see the Parks and Protected Areas tab for more information) ~ Rest of the Beaver Hills Moraine
Alberta Innovates Technology Futures	Bio-Solutions (Agriculture and Forestry), Health, Energy, and Environment	All areas of the Beaver Hills Moraine are applicable
Elk Island National Park (Parks Canada)	Habitat preservation and restoration; ungulate management; species-at-risk; interpretation	Elk Island National Park
Agriculture and Agri-Food Canada	Agriculture, Agricultural Food, and other Agricultural Products	All agricultural sections within the Beaver Hills Moraine
University of Alberta	All subjects, but Engineering, Science and Arts in general	Research could be conducted anywhere
Alberta Industrial Heartland Association	Promoting responsible industrial development in the region	None directly, but Strathcona and Lamont counties are both involved.
Fort Air Partnership	Air Quality	Monitoring Station in Elk Island National Park

Partner Organization	Area(s) of Focus	Areas of the Beaver Hills Represented
Northeast Capital Industrial Association	Industry impacts on air, land, noise, water and surrounding communities	None directly, but Strathcona and Lamont counties are both involved
Strathcona Industrial Association	Air Quality, Community-based health and safety, emergency response planning	Monitoring Station in Sherwood Park
Alberta Invasive Plants Council	Invasive Plants	All of the Beaver Hills Moraine
Alberta Conservation Association	Wildlife Management and monitoring; sustainable outdoor recreation; poaching awareness; habitat preservation	Robert Bateman Get to Know (Site 139); Golden Ranches (Site 137); Cameron Development (Site 141); Sherwood Park 1 (Site 52); Sherwood Park 2 (Site 56); Brown (Site 140); Tritten (Site 117); Pydde (Site 17); Muloy (Site 110); Churchill (Site 60)
Alberta Fish and Game Association	Responsible utilization of fish and wildlife; habitat protection and enhancement	Golden Ranches (Sections 1 and 2); Sherwood Park Conservation Property
Alberta Lake Management Society	Lake, reservoir, and watershed health and management	All lakes in the Beaver Hills Moraine
Alberta Land Trust Alliance	Assisting establishment of new land trusts and providing a forum for current trust organizations	Projects are represented on the Alberta Land Trust Maps (available by request)
Alberta Recreation and Sport Development	Amateur sport development and active living	All areas in the Beaver Hills Moraine
Alberta Sports Recreation, Parks and Wildlife Foundation	Quality of life through athletics, active living, and conservation of natural areas	All areas in the Beaver Hills Moraine
Beaver Hills Dark Sky Preserve	Astronomy and light-based environmental awareness	Elk Island National Park and Cooking Lake/Blackfoot Provincial Recreation Area
Ducks Unlimited Canada	Wetland retention, restoration, and monitoring	SEE ALBERTA LAND TRUST ASSOCIATION MAPS
Edmonton and Area Land Trust	Conservation easements, land purchases, and education programs	SEE ALBERTA LAND TRUST ASSOCIATION MAPS
Land Stewardship Centre of Canada	Landowner education, personal and professional stewardship development	See partner organizations for details on which areas have stewardship programs
Miistakis Institute	Conservation research and management tool development	All of the Beaver Hills Moraine

Partner Organization	Area(s) of Focus	Areas of the Beaver Hills Represented
Nature Conservancy of Canada	Land procurement, conservation easements, and land management	SEE ALBERTA LAND TRUST ASSOCIATION MAPS
North Saskatchewan Watershed Alliance	Water quality and quantity in the North Saskatchewan Watershed	All of the Beaver Hills Moraine is contained within the North Saskatchewan Watershed
Royal Astronomical Society of Canada	Astronomy education, collaboration, and light-pollution awareness	Beaver Hills Dark Sky Preserve (Elk Island National Park and Cooking Lake/Blackfoot Provincial Recreation Area

Table D2: Non-Partner Organizations

Organization	Area(s) of Focus	Areas of the Beaver Hills Represented
Camrose County	Agriculture, Community development and safety, local government	Camrose County: Includes Miquelon Lake Provincial Park and a small part of the Ministik Lakes Game Bird Sanctuary
The Town of Mundare	Community development, local government	None, but Mundare is close to Elk Island National Park and Cooking Lake/Blackfoot Provincial Recreation Area
The Town of Tofield	Community development, local government	None, but Tofield is close to the Golden Ranches, Ministik Lakes Game Bird Sanctuary and Cooking Lake/Blackfoot Provincial Recreation Area
The Village of Ryley	Community development, local government	None, but Ryley is close to the Golden Ranches, Ministik Lakes Game Bird Sanctuary and Cooking Lake/Blackfoot Provincial Recreation Area
Alberta Association of Agricultural Societies	Agriculture education and leadership, investment, sustainable and ethical agricultural development	All agricultural areas are applicable
Agriculture and Food Council of Alberta	Networking among industries, encouraging development within agriculture and agri-food sectors	All agricultural areas are applicable
Community Supported Agriculture Alberta	Community Supported Agriculture	Select farms in the Edmonton area- see website for more details
Green Hectares	Agriculture education and support, sustainable agriculture, community networking	Currently partners with Strathcona County, but all other agricultural areas are applicable
Friends of Blackfoot/Cooking Lake Society	Outdoor recreation, fundraising, maintenance of trails	Cooking Lake/Blackfoot Provincial Recreation Area
Friends of Elk Island Society	Conservation Research, Public Outreach, Special events, fundraising	Elk Island National Park
Alberta Hunter Education Instructors Association	Hunter training; promoting responsible use of wildlife and the environment	All areas that allow hunting are affected
Nature Watch	Monitoring environmental changes; educating people about the natural world	All areas of the Beaver Hills are applicable
North American Waterfowl Management Plan	Waterfowl conservation	All areas with waterfowl are affected
Strathcona Wilderness Center	Promoting outdoor recreation, trail maintenance, campsite	Strathcona Wilderness Centre and surrounding area
Ukrainian Cultural Heritage Village	Ukrainian-Canadian culture	Ukrainian Cultural Heritage Village (Near Elk Island National Park)

Organization	Area(s) of Focus	Areas of the Beaver Hills Represented
Edmonton Nature Club	Outdoor recreation, environmental awareness	Elk Island National Park, Cooking Lake/Blackfoot Provincial Recreation Area. All other areas of the Beaver Hills Moraine would also be applicable
Edmonton Outdoor Club	Outdoor recreation, environmental awareness, healthy lifestyles	Cooking Lake/Blackfoot Provincial Recreation Area; Miquelon Lake Provincial Park; Elk Island National Park
Waskahegan Trail Association	Outdoor Recreation	Elk Island National Park, Cooking Lake/ Blackfoot Provincial Recreation Area, Golden Ranches, Ministik Lake Game Bird Sanctuary, Miquelon Lake Provincial Park, and trails between these areas
U of A Chapter of the Wildlife Society	Wildlife appreciation, field trips and volunteering	Elk Island National Park (but all areas are applicable)
U of A Organization of Botany Students	Plant appreciation, field trips and volunteering	Elk Island National Park (but all areas are applicable)
Augustana Wildlife Society	Wildlife appreciation, field trips and volunteering	Elk Island National Park (but all areas are applicable)
Scouts Canada - Rover Scouts	Outdoor recreation, community service, leadership	All areas are applicable
4-H Clubs	Personal development, projects and programs, community involvement	All areas are applicable
Girl Guides Canada	Outdoor recreation, community service, personal development	All areas are applicable
Nature Explorers (Nature Canada)	Outdoor recreation, nature-based education, networking	All areas are applicable
Scouts Canada	Outdoor recreation, community service, leadership	All areas are applicable
Strathcona County Youth Volunteer Program	Community involvement, leadership skill development	Strathcona County
Young Naturalists (Nature Alberta) Program	Outdoor recreation, nature-based education, environmental stewardship	All areas are applicable

Table D3: Potential Organizations

Potential Partner Organization	Area(s) of Focus	Areas of the Beaver Hills Applicable
Canadian Parks and Wilderness Society	Protection of wilderness and wildlife in Canada	All areas are applicable
Nature Alberta	Conservation issues, natural history	All areas are applicable
Nature Canada	Bird conservation, wilderness protection, endangered species, and connecting people to nature	All areas, especially those that are important bird habitats, are applicable
Sierra Club Canada	Protection and restoration of the environment	All areas are applicable
The Alberta Chapter of the Wildlife Society	Wildlife preservation and awareness	All areas are applicable
U of A Agriculture Club	Agriculture social events; possible volunteers	All agricultural areas are applicable
U of A Forest Society	Forestry social events; professional networking; volunteering	All forested areas are applicable
U of A Naturalist's Guild	Nature-based activities	All areas are applicable
U of A Outdoors Club	Outdoor activities and equipment rental	All areas are applicable