Assessment of Environmental Sensitivity and Sustainability in Support of the Strathcona County MDP Review

Final Report

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1.0 INTRODUCTION

1.1 Background

Strathcona County's current Municipal Development Plan (MDP) was adopted in 1998. That MDP establishes the guidelines for orderly growth and development over the next 20 years and beyond. In doing so, the MDP provides a comprehensive long-term land use policy framework outlining future development. MDPs are updated at 5 year intervals, and Strathcona County is currently undertaking such a review.

The County wishes to create an environmentally sensitive MDP, consistent with the sustainability principles developed by the Beaverhills Initiative (BHI). In order to develop environmentally sustainable MDP policy areas, more information was required regarding the environmental constraints and opportunities across the County as a whole, as well as in specific locations. To that end, Strathcona County retained Spencer Environmental Management Services Ltd. (Spencer Environmental) to undertake an environmental assessment in support of the MDP review. Specifically, that review included two exercises:

- mapping of environmental sensitivity throughout the County, and
- detailed investigation of site-specific concerns.

This report presents the findings of those investigations, as well as the methods and resources used in the assessment process.

1.2 Current Municipal Development Plan Policy

One objective of the MDP review is to ensure that the updated MDP is sensitive to environmental issues, however, this is not to say that the current MDP ignores the subject of environmental sensitivity. In fact, there are several references to the environment, conservation and sustainability in Strathcona County’s current MDP. The following is a selection of the key policy statements:

General MDP Objectives
- To enhance the environmental management of the County.

Environmental Management Objectives
- To encourage land uses and developments that maintain and enhance the natural habitat.
- To acknowledge and conserve significant natural resources and features within and adjacent to the County.

Environmental Management Policy Statements
- …identify significant valleys, ravines, stream corridors, lakeshores, wetlands or other unique landscape areas and promote land uses in the vicinity of these features which recognize their value to the County.

- …to identify existing and potential problems in sensitive surface water and shoreline areas, and to mitigate or eliminate problems. In these areas, the types of land uses and developments which may be allowed will be limited to those which will not have a negative effect on the resource.
- To protect rare or sensitive native flora, fauna or habitat, Strathcona will encourage the appropriate jurisdiction to identify and protect environmentally sensitive areas. Habitat (i.e. lands and/or watercourses) that support rare or sensitive flora, fauna or habitat will be protected through environmental protection instruments and policies.
- Strathcona will encourage a revegetation/restoration program to promote shared stewardship of the County's natural resources.

Agricultural Development Policy Statements

- Incompatible land uses which lead to degradation of environmentally significant and sensitive areas … shall not be allowed.

Industrial Development Policy Statements

- Encourage and facilitate complementary industrial development which will maintain or enhance the quality of air, water and land resources; and implement sound environmental practices.

1.3 Objectives

1.3.1 Landscape Management Area Mapping

Previous work by the BHI included development of a Landscape Management Areas map that identified areas with sensitive natural features. That map classified all lands into four categories based on the summed total of natural features present. Those categories ranged from protected areas that already had some level of statutory protection to areas that had been developed such that virtually no environmental resources remained on them. Although a large part of Strathcona County was already mapped as part of the BHI work, the County wished to extend the Landscape Management Area analysis across the remainder of the County for use in the MDP review. The Strathcona County Landscape Management Area map will identify land areas of high sensitivity, highlighting areas requiring management attention.

1.3.2 Site-specific Assessments

The updated MDP may modify existing policy areas, adjusting the areas to include different land uses or changing their boundaries to include similar lands. Site-specific analyses were used to confirm whether natural areas in those MDP policy areas were sustainable in the context of the current land use, and whether they were capable of sustaining their natural values in the face of future, modified land use.

The specific issues and concerns varied for each site. The objectives for each site-specific analysis are outlined below.

- The sandhills area north of Bruderheim, recognized as the North Bruderheim (Sandhills) Natural Area, lies within a Conservation Policy Area in the current MDP. Its location immediately adjacent the Northeast Heavy Industrial Policy Area presents a potential conflict in land use objectives. Under the present MDP, the area is considered a transition zone, buffering the heavy industrial area from the adjacent agricultural area. A light/medium industrial transitional area lies immediately to the south of it. The issue to be addressed in the new MDP regarding this area is how to manage the site best, in the present development context. What are the key natural values of this site? Is it sustainable in the current and potential future developed context? What is required to effectively conserve the site in light of its current context?

- The North Bruderheim (Sandhills) Natural Area and the adjacent North Saskatchewan River Valley are considered to be part of the same Conservation Policy Area. The two natural areas are, however, quite different in terms of the significance of their constituent natural resources and ecological functions. Should these two landscapes continue to be combined under the same MDP policy area? Do their respective natural values require different management approaches?

- Within the Northeast Heavy Industrial Policy Area, there are remnant patches of natural habitat that are becoming increasingly isolated by industrial development, including several designated NAs. How valuable and sustainable are these patches now, within the current developed context? Should they continue to be retained and protected under some form of conservation policy? Is there potential and value in improving their condition through restoration?

- The southwest corner of the County (Policy Areas 1 and 2, south of Sherwood Park and Highway 14 and adjacent to the City of Edmonton), is currently considered an Agricultural Policy Area. That classification could be changed in the new MDP to accommodate different land uses, if such activity will not adversely affect other resources and values, including natural features. Are there natural features in this area that are sensitive to development? Is there potential and value in restoring natural features in this area to enhance ecological function and sustainability of other, intact natural features?

- The Lakeland Policy Area, on the southeast side of the County, was previously identified as an area that required special management because of the extensive woodlands, large lakes and small wetlands concentrated in this area. Does the Landscape Management Area mapping system support this need? Does the current Lakeland Policy Area protect the key areas of high sensitivity?

- Several intensive livestock operations are currently located in the southeast part of the County, within the Lakeland Policy Area. Given the abundant waterbodies found in this area, such land use may not be sustainable. Where in the County might environmental conditions be more suitable, based on surface and groundwater conditions and soil textures? Are there existing livestock operations within the Lakeland Policy Area that pose significant risk to environmental resources?

- The top-of-bank (TOB) of the North Saskatchewan River Valley is not currently mapped. To aid in management decisions concerning adjacent policy areas, the County wished to identify, generally, the location of the TOB.

1.4 Existing Environmental Planning Resources

Currently, the environmental planning and assessment process within the County is centered on the Prioritized Landscape Ecology Assessment (PLEA), an inventory of all existing wildlife habitat units present within Strathcona County (Saxena *et al* 1997). The County's Planning and Development Department now reviews development proposals against the PLEA to ensure that wildlife habitat, wetlands, forests, water resources and drainage are taken into account through the establishment of environmental reserves and easements. This study is now somewhat dated, and may not accurately reflect current land conditions. The BHI has more recently provided another planning tool as they have compiled several GIS datasets describing various natural features within the vicinity of the Beaver Hills/Cooking Lake Moraine (Appendix A). These data include hydrology, wetlands, groundwater recharge and discharge, native vegetation, rare plant and wildlife species, and soils information. Although these data have some inaccuracies due to scale, they offer a more up-to-date inventory of resources in this area. In combination with the PLEA, which is also available as a GIS product, these data could support the various analyses proposed for the MDP review. The application of these data in our analyses is described further in the methods section.

1.5 Report Organization

This report has been organized primarily as a resource document for Strathcona County. It comprises a total of 6 chapters. Chapter 1 provides an introduction and background information for the project and states the objectives of the assessment. Chapter 2 describes the methods used in the implementation of the work program. Chapters 3 and 4 describe in detail the results of the Landscape Management Area mapping process and the site-specific assessments, respectively. Chapter 5 provides a summary of the results and presents some overall conclusions and recommendations that refer back to the originally stated objectives. Lastly, Chapter 6 lists all sources referenced in the text. There are three appendices of supporting information: Appendix A presents a list of GIS datasets used in this assessment, Appendix B comprises a summary of riparian buffer guidelines and Appendix C includes a series of supporting natural resource maps.

2.0 METHODS

2.1 Regional Ecosystem Setting

Strathcona County covers an area of 1243 km^2 and straddles an area of the Central Parkland Natural Subregion and an isolated component of the Dry Mixedwood Natural Subregion, a subcomponent of the Boreal Forest Natural Region (Figure 1; Achuff 1994). The transition between the two Subregions occurs along an approximate southwest-northeast line that more or less bisects the County.

The west half of the County is relatively flat and characterized by vegetation of the northern Central Parkland Natural Subregion. Typically, this subregion consists of relatively closed aspen and balsam poplar forest interspersed with areas of fescue grasslands and a variety of wetlands (Achuff 1994). Today, however, few continuous tracts of deciduous forest or natural grasslands remain, as much of the region has been converted to urban and agricultural land uses (Achuff 1994). Similarly, conversion to those land uses has led to the draining and filling of many wetlands. The soils throughout the area have very few limitations for agriculture and, combined with the generally flat terrain, make ideal conditions for agricultural crops. As a result, much of the land has been cleared and, where they occur, natural areas are generally small and highly fragmented.

The east half of the County lies within the Beaver Hills/Cooking Lake moraine, considered a disjunct unit of the Dry Mixedwood Natural Subregion. The moraine, a large geomorphological feature covering 1572 km^2, is characterized by hummocky 'knob and kettle' terrain. More generally, the moraine rises above the surrounding plain as a hilly landscape feature pocketed with numerous depressions. Surface water collects in those depressions and, as a result, lakes and wetlands are abundant; streams, however, are few. Further, because of its increased height, the moraine experiences a climate that is distinctly cooler and wetter relative to the surrounding areas. Because of these factors, the vegetation community in the east half of the County is most characteristic of the Dry Mixedwood Natural Subregion. Aspen is the dominant upland species, balsam poplar frequently occurs in moist sites and white spruce is the common successional species of mature forests (Achuff 1994). The rolling, hilly terrain of the moraine is also inherently poor for agricultural crops and, as a result, much of the area remains naturally vegetated. Some areas have, however, experienced development pressures similar to those experienced in the west side of the County. In areas with suitable land, natural vegetation has been converted to agriculture and, increasingly, rural residential neighborhoods.

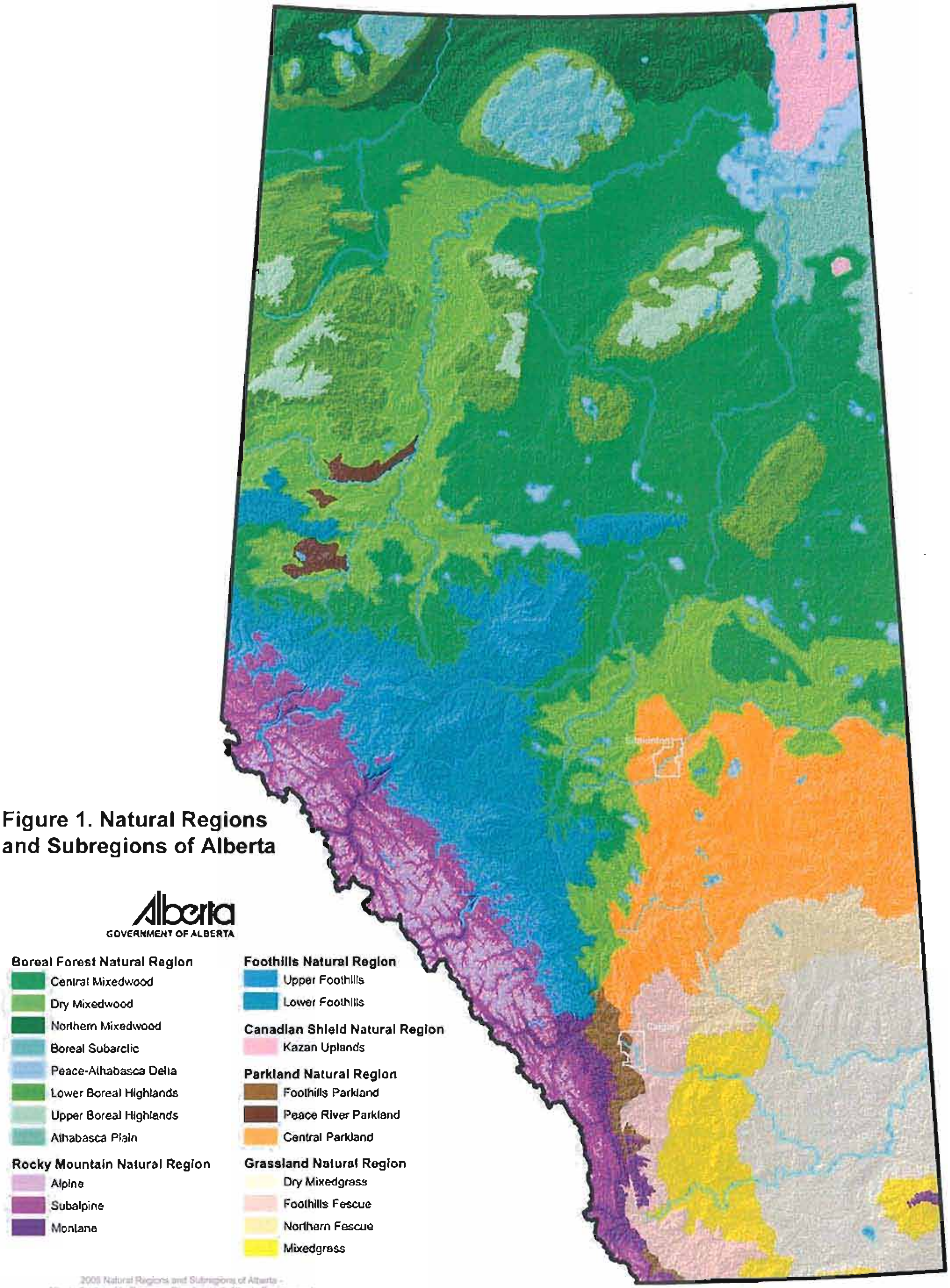


Figure 1. Natural Regions and Subregions of Alberta

2.2 Landscape Management Area Mapping

The MDP Environmental mapping, or Landscape Management Area mapping, was conducted using a multi-stage process of data validation, manipulation, modeling, and mapping.

2.2.1 Data Validation

First, appropriate datasets were selected from the BHI database, which is a collection of spatial data intended for use by the participating municipal partners to aid in land use planning activities. All selected spatial datasets were then validated through a comparison of accuracy, geographic projection, and feature attributes. Datasets were also set to the same geographic coordinate system (GCS80 UTM (Zone12N) NAD83). Because federal and provincial natural areas have already been set aside as protected areas and cannot be developed, we automatically designated them as such in the Landscape Management Area analysis. Municipal natural areas and other natural areas without formal protection were, however, included in the analysis and mapping process.

2.2.2 Data Manipulation

Once the validation process was complete, all pertinent spatial datasets were prepared for the Landscape Management Area analysis. This involved manipulating the tabular structure of the spatial datasets to arrive at a final set of spatial datasets consistent in internal structure and format. The next step involved buffering certain natural features by a pre-determined distance, as outlined in the BHI model. Each buffer reflects the zone that is generally accepted as providing protection to a given resource, and which, ideally, would be provided in land management (see Appendix B). The features and buffer distances used in this stage of the process were as follows:

Natural Feature	Buffer Distance	Comments
Wetlands	200 m	
Hydrology	200 m	(included all natural and manmade hydrologic features with the exception of islands and reservoirs)
Rare Species	500 m	(ANHIC and FWMIS[1] rare species data used, however, only ANHIC data were buffered because FWMIS data had been previously buffered)
Groundwater	None	(PFRA[2] groundwater discharge, recharge and transition data)

[1] ANHIC = Alberta Natural Heritage Information Center and FWMIS = Fish and Wildlife Information Management System, provincial tracking databases of rare plant and wildlife species.
[2] PFRA = Prairie Farm Rehabilitation Administration

Native Vegetation	None	(Alberta Sustainable Resource Development dataset, classified to deciduous, coniferous, and grassland features)
Soils	None	(Canadian Land Inventory (CLI) Agriculture Soil Capability data)

Although there were some inaccuracies in the groundwater, wetland and native vegetation data layers due to their broad scale, those datasets remain the most comprehensive information available at present. Also, because the Landscape Management Area mapping was conducted at a broad, regional scale, the impact of those errors will not significantly impact the conclusions of the analysis.

2.2.3 Modeling

Following the buffering exercise, the model then required merging the above natural features into a single dataset and classifying all data as per the previously developed BHI Landscape Management Area (LMA) model. Each natural feature was assigned a score, based on their relative sensitivity, as follows:

Dataset	**LMA Score**	**Dataset**	**LMA Score**
Wetlands	2	Groundwater Transition Zone	0
Hydrology	2	Native Vegetation	1
Rare Species	1	Ag. Soil CLI Classes 1-3	0
Groundwater Discharge	1	Ag. Soil CLI Classes 4-6	1
Groundwater Recharge	1	Ag. Soil CLI (Unclassified and Organic)	0

2.2.4 Mapping

The Landscape Management Area (LMA) model is additive and, therefore, the scores representing natural resource sensitivity present at any given location were summed to indicate the total and relative abundance of natural resource sensitivities at a given site. The entire landscape was reclassified into the four Landscape Management Area groups according to the summed final Landscape Management Area environmental sensitivity values (see below). For mapping purposes, those final values were then also translated into color coding using the following formula:

LMA Summed Value	**Sensitivity Value**	**Map Color Code**
0	Low	White
1 – 2	Moderate	Yellow
≥ 3	High	Blue
Formal protected status	Protected Areas	Green

2.3 Site Specific Assessments

2.3.1 Natural Area Assessments

The main objective of the site-specific analyses was to determine whether existing Natural Areas (NAs) and other natural features were sustainable under the current MDP policy. In order to address those concerns, we needed first to describe the type and condition (quality) of existing features in each area, the ecological context in terms of adjacent land use and management, and their relationship to other natural features in the surrounding lands. These conditions formed the basis for assessment of the sustainability of those features in the current land use context. Assessments used two primary sources of information: 'desktop' analysis and field data collection.

2.3.1.1 'Desktop' Analysis

Many of the site-specific assessment questions were addressed first through 'desktop' analysis using GIS analysis, aerial photography interpretation and review of previous assessment reports relevant to the area of concern (e.g., the PLEA study). Data included, but was not limited to, site size, soil texture, groundwater, surrounding land use and ecological connectivity. Using those data it was possible to identify the resources that contribute to the significance of the natural areas within the various policy areas. Those values were then confirmed and refined through field reconnaissance, paying particular attention to those areas where the inaccuracies and age of the data might have caused misinterpretation. At sites where there were questions regarding natural area quality and sustainability, field verification of current natural site values was particularly important.

2.3.1.2 Field Data Collection

Determining current natural site values and assessing the sustainability of those sites required the collection of additional field data at three areas: the North Bruderheim (Sandhills) Natural Area, the northeast Heavy Industrial Policy Area and the southwest Agricultural Policy Area.

In general, field data collection verified and assessed:

- site existence (for sites not formally designated as NAs),
- habitat type,
- site sensitivities,
- current land management,
- ecological condition,
- ecological connectivity, and
- wildlife use of the area.

More specifically, field data also included dominant plant species, topography, environmental sensitivities, current land uses and presence of infrastructure. All site-specific information was recorded on a standardized data sheet to ensure consistency across all sites and photos were taken at all sites to supplement field data.

2.3.2 Confined Feeding Operation (CFO) Sensitivity Analysis

The CFO sensitivity analysis was conducted using a series of methods similar in fashion to the methodology employed for the Landscape Management Area analysis. In fact, in many ways, the CFO analysis represented a subset of the more detailed Landscape Management Area analysis. The key difference was the use of different buffer widths in the data manipulation stage and a more select, modified suite of environmental features in the modeling. The following sections outline those differences and explain the GIS analysis.

2.3.2.1 Data Manipulation

The primary environmental concern with CFOs is the potential for contamination of either surface or groundwater. As such, the natural features included in the analysis were limited to those features that are associated with hydrological and hydrogeological functions. The features and buffer distances (see Appendix B) used in this stage of the process were as follows:

Natural Feature	**Buffer Distance**	**Comments**
Wetlands	50 m	
Hydrology	50 m	(included all natural and manmade hydrologic features with the exception of islands and reservoirs)
Groundwater	None	(PFRA groundwater discharge, recharge and transition data)
Soil Texture	None	(reclassified AGRASID parent material texture data)

Relative to the Landscape Management Area analysis, the buffer distance used for the CFO analysis was reduced from 200 m to 50 m to reflect the more specific focus on water quality. A naturally-vegetated buffer of between 30 m and 50 m is considered effective in maintaining good water quality in surface hydrological features (i.e., creeks, wetlands; Appendix B). To maintain a conservative approach, and to achieve a buffer that was capable of being mapped at a large scale, 50 m was selected as the buffer distance.

Generalized soil texture classes (i.e., fine, moderately fine, medium, moderately coarse, coarse and organic) were obtained through a reclassification of AGRASID parent material texture data.

2.3.2.2 Modeling

Following the buffering exercise, the data were classified using the following scoring model:

Dataset	CFO Score	Dataset	CFO Score
Wetlands	2	Moderately fine soils	0
Hydrology	2	Medium soils	0
Groundwater Discharge	1	Moderately coarse soils	1
Groundwater Recharge	1	Coarse soils	1
Groundwater Transition	0	Organic soils	1
Fine soils	0		

Surface water features were weighted more heavily than other features because of their greater vulnerability to surface contaminants. Although less so than surface water, areas of groundwater flow, particularly through coarse and moderately coarse soils, also have a certain vulnerability to contamination. Areas without groundwater flow (i.e. transition zones) and areas with fine soils were not considered at high risk.

2.3.2.3 Mapping

As with the Landscape Management Area model, the CFO model was additive. The scores of natural features representing sensitivity to CFO development at any given location were summed to indicate the total relative sensitivity at a given site. The entire landscape was then reclassified into three CFO sensitivity rating classes according to the summed final CFO score (see below). For mapping purposes, those final scores were then also translated into color coding using the following formula:

CFO Summed Score	Sensitivity Value	Map Color Code
0	Low	White
1 – 2	Medium	Purple
≥ 3	High	Red

2.3.3 Top-of-Bank (TOB) Analysis

The TOB for the section of the North Saskatchewan River Valley within Strathcona County was estimated as the break of slope (i.e., where the terrain changed from steep valley slope to generally level ground) using a digital elevation model (DEM) raster dataset, with 5 m contour intervals, provided by Natural Resources Canada (NRCAN) and Parks Canada. Aerial photography confirmed the TOB derived from the contour data. The confirmed TOB was then manually digitized in a GIS.

3.0 LANDSCAPE MANAGEMENT AREA MAPPING – RESULTS AND INTERPRETATION

3.1 Overview

In general, the Landscape Management Area map (Figure 2) identifies the relative abundance of natural features and, thus, the environmental sensitivity, of lands within Strathcona County. The abundance of resources at any given location is represented by inclusion in any one of four categories:

- Protected Areas (federal or provincial designation),
- High Sensitivity (≥ 3 natural resources),
- Medium Sensitivity (1 – 2 natural resources), and
- Low Sensitivity (0 natural resources).

Protected areas already have some level of statutory protection because they represent particularly good sites with abundant environmental resources. The low sensitivity areas, of which there are relatively few, have been developed such that virtually no environmental resources remain on them. The moderate and high sensitivity areas, comprising the majority of the County, represent the fine differentiation point to identify areas where special management might be required. In a general sense, where the relative abundance of natural resource values was high (high sensitivity), development might require specific management due to environmental sensitivity. Where natural resources were fewer (medium sensitivity), management requirements might be less restrictive and development opportunities broader. Specific management requirements would, however, depend on the type of resources present at a given location.

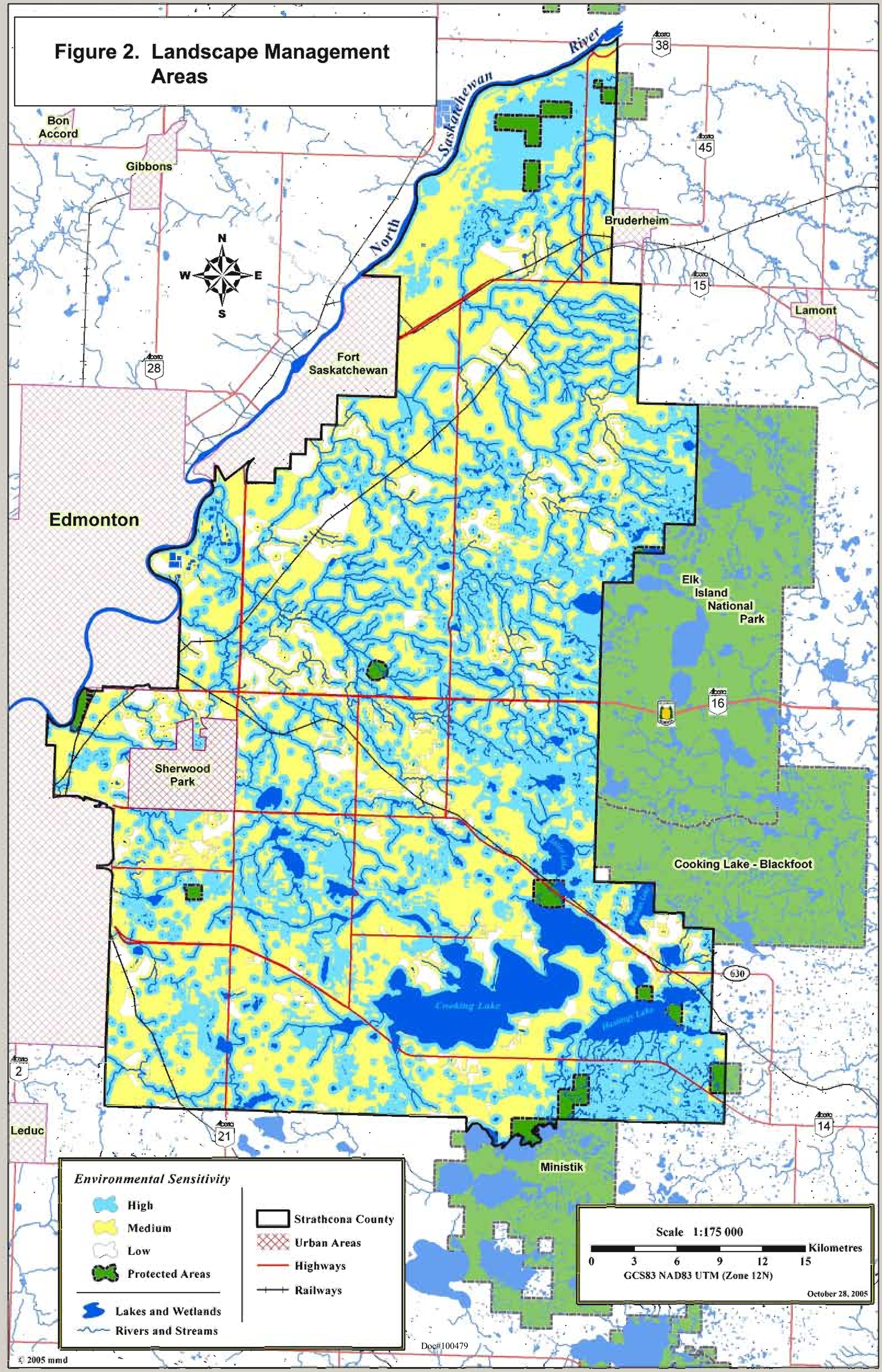


Figure 2. Landscape Management Areas
North Saskatchewan River
Bon Accord
Gibbons
Bruderheim
Lamont
Fort Saskatchewan
Edmonton
Elk Island National Park
Sherwood Park
Cooking Lake - Blackfoot
Cooking Lake
Hastings Lake
Ministik
Leduc
38
45
15
28
16
630
2
21
14
N
S
E
W
Environmental Sensitivity
High
Medium
Low
Protected Areas
Lakes and Wetlands
Rivers and Streams
Strathcona County
Urban Areas
Highways
Railways
Scale 1:175 000
0
3
6
9
12
15
Kilometres
GCS83 NAD83 UTM (Zone 12N)
October 28, 2005
Doc#100479
© 2005 mmd

3.2 Highlighted Specific Areas

The following sections highlight certain geographical areas within the County, noteworthy because of their Landscape Management Area rating and constituent environmental features, or lack thereof. The discussion also illustrates the management principles that could be applied to those areas, tailored to the types of resources present.

3.2.1 Southeast Corner

The extreme southeast corner of the County is characterized by a large concentration of natural resource values and, as such, carries a high sensitivity rating (Figure 3). More specifically, a low agricultural soil capability, extensive cover of native vegetation, abundant wetlands, concentration of rare species records, large groundwater recharge areas and all their associated benefits contribute to the environmental sensitivity of this area.

Soils in this area have poor agricultural capability, with moderate to very severe limitations for crop production (i.e., CLI Class 3 to 5; Appendix C). Contributing to this poor rating is the hummocky 'knob and kettle' terrain that is common in the southeast corner of the County; terrain which is difficult to cultivate. As a result, this part of the County has experienced relatively limited clearing and still supports broad areas of native vegetation, primarily deciduous-dominated upland. This expanse of native vegetation provides a valuable link between Elk Island National Park and the Cooking Lake/Blackfoot Reserve in the north and the Ministik Bird Sanctuary and Miquelon Lake Provincial Park to the south.

Not only does the abundance of native vegetation function as a valuable ecological linkage, but, in its own right, it provides high quality habitat that supports a high level of biodiversity. The mosaic of wetland and upland habitat in this area of the County is suitable for a large number of species that can be expected to include up to 48 mammal, 152 bird, and 8 herptile (i.e., amphibian and reptile) species (Saxena *et al* 1997). Vegetation species have not been formally inventoried, but there area a number of rare plant records in this area (Appendix C). The combination of extensive vegetation and abundant water features (i.e., wetlands, creeks) also provides important surface water quality and groundwater recharge functions.

Maintaining the southeast corner of the County in its current condition is, therefore, crucial for the long-term sustainability of wildlife habitat, the adjacent protected areas and water quality (both surface and groundwater). Specifically, retaining the existing network of wetlands and woodlands is critical to that sustainability as it will, in turn, ensure the maintenance of the regional ecological connectivity. Maintaining this connectivity will allow for the dispersal of wildlife and vegetation species across the landscape, providing source populations to habitat patches, thereby reducing the potential for the loss of species at a local level. Land management in this area should, therefore, carefully consider the potential impacts to wildlife, surface water resources and groundwater when considering the locations and conditions of proposed developments.

3.2.2 Cooking Lake Area

Despite containing the largest waterbody in all of Strathcona County, much of the area surrounding Cooking Lake received only a moderate sensitivity rating (Figure 4). Several factors contribute to this area's rating; most notably the high agricultural crop capacity rating of the soils, the relative lack of extensive native vegetation, the low occurrence of streams and wetland, a patchy distribution of rare species records, and the fact that this area supports little in the way of groundwater recharge or discharge areas (Appendix C).

As a result of favorable soil conditions, much of this area has been cleared to accommodate agricultural crops. Native vegetation is particularly lacking between Cooking Lake and Hastings Lake. This reduces the effectiveness of the ecological linkage between those two waterbodies and, at a larger regional scale, between Elk Island National Park, the Cooking Lake-Blackfoot Reserve, the Ministik Bird Sanctuary and Miquelon Lake Provincial Park.

Despite the relative lack of natural features in the area, Cooking Lake is, in its own right, a highly sensitive and functional environmental feature. For the most part, native vegetation borders the shoreline, providing the lake with a buffer against surrounding agricultural land use. The lake and adjacent upland areas provide suitable habitat for a number of special status species including recent records of piping plover, Caspian tern, great blue heron and barred owl. The presence of these species has positively influenced the environmental sensitivity rating for some areas adjacent to the lake.

The entire Cooking Lake area, and particularly the area between Cooking Lake and Hastings Lake, would benefit from habitat restoration and enhancement, perhaps through landowner awareness programs designed to restore connectivity. Such measures would help to maintain viable connections between the adjacent protected areas incorporating the naturally vegetated areas surrounding both Cooking and Hastings Lake. That, in turn, would help sustain local and regional plant and wildlife populations, including rare and economically important species. In order to maintain Cooking Lake as a healthy and productive waterbody, land use planning must acknowledge the important water purification and wildlife habitat functions provided by the naturally vegetated buffer that currently surrounds much of the lake. Buffer widths vary with the intended management objective, from 30 or 50 m to protect water quality to up to 200 m to facilitate wildlife movement (see Appendix B). Considering this, development should be set back as much as possible from the shoreline, but a minimum of 30 m. The MDP may not be an appropriate means to enforce such buffers: County administration should consider other more suitable avenues of policy or awareness programs.

3.2.3 Lake Network between Sherwood Park and Cooking Lake

Another area of high environmental sensitivity occurs between Sherwood Park and Cooking Lake (Figure 5). This area is characterized by an abundance of woodland areas, associated with a low agricultural soil capability, a network of small lakes connected via a series of creeks and a large groundwater recharge area (Appendix C). The surface hydrology of this area is a direct result of the topography of the Beaver Hill/Cooking

Lake moraine. Towards the outer edge of the moraine, the terrain slopes down, shedding water and creating watercourses that flow towards Beaverhill Lake in the east, various drainages to the south and across the western plain towards the North Saskatchewan River. In this area, these lakes and creeks comprise the headwaters of Oldman Creek, which flows northwest before its confluence with the North Saskatchewan River. As such, this area provides an integral and functional link for surface water flow between the Lakeland Policy Area in the southeast, including Cooking and Hastings Lake, and, ultimately, the North Saskatchewan River.

The woodlands of this area are interspersed with cattle pastures and agricultural croplands. This extensive fragmentation results in a high ratio of forest edge to forest interior. Detrimental to some interior-loving wildlife species (e.g., ovenbird, Swainson's thrush), an abundance of forest edge is productive habitat for many other species (i.e., edge species such as deer, red-tailed hawk, great horned owl, cedar waxwing). This, in association with the concentration of streams and lakes, suggests that this area is capable of supporting a great diversity of plant and wildlife species, despite the level of fragmentation. This biodiversity is also a function of the area's connectivity to other woodland areas, including Elk Island National Park and the Cooking Lake-Blackfoot Reserve, within the moraine. Because of this connectivity, dispersing wildlife and vegetation can reach the smaller woodlands in this area, providing a source for continued replacement of individuals. This process reduces the potential for species loss at a local level and, in doing so, maintains biodiversity.

Considering that the sensitivities in this area are closely linked to hydrology and biodiversity, land use policy in this area should incorporate management strategies to protect surface and groundwater resources, as well as woodland areas. In some places this could simply consist of retaining the existing native vegetation along watercourses to protect surface water quality. In areas identified for country residential development, maintenance of existing values could be realized through cluster development, with priority given to sites away from watercourses and woodlands. In other areas, maintaining a healthy riparian zone may require more active management such as revegetation of upland areas adjacent to creeks or controlled access of cattle to shoreline areas. Again, the MDP may not be the appropriate mechanism to implement such measures and the County should investigate other suitable means to protect sensitive resources, including landowner awareness programs. The Beaverhills Initiative, with its environmental non-government organization (ENGO) partners may be able to assist in developing such awareness programs, or perhaps, develop incentive programs to encourage retention of vegetative buffers.

3.2.4 East and Central Strathcona County

A large portion of the east and central areas of the County are rated as having a high environmental sensitivity, primarily as a result of a high concentration of headwaters (Figure 6). Lower capability agricultural soils, remnant forested areas and groundwater recharge and discharge areas also contribute to the high rating (Appendix C).

The east and central parts of the County are located along the periphery of the Beaver Hill/Cooking Lake moraine where the terrain begins to slope down towards the North Saskatchewan River. As a result of this topography, surface water collects in a network of drainages and small creeks, not the wetlands typical of the hummocky, central areas of the moraine. Those drainages and creeks converge into either Point-aux-Pins Creek or Ross Creek and, ultimately the North Saskatchewan River. For the most part, the watercourses overlap with, or are bordered by additional natural resources (e.g., low capability agricultural soils, forested areas, groundwater recharge/discharge areas), resulting in the high environmental sensitivity rating.

There are, however, a few areas where creeks occur in isolation of all other natural resources and are buffered by areas of only moderate environmental sensitivity. For example, the area north of Highway 16 and east of Highway 21 has very little native vegetation. It has no groundwater recharge or discharge areas and has soils with high agricultural capability. In such cases, riparian areas are often cultivated to the stream edge and, due to that disturbance, highly degraded (Plate 1). However, this may not be the case in all areas of moderate sensitivity. Because of the inconsistent coverage of the native vegetation dataset, some narrower areas of riparian vegetation are not accurately represented in the Landscape Management Area analysis. These deficiencies highlight the need for further and more detailed site-specific field investigations when assessing development proposals and determining areas of restoration potential.

Plate 1. Two examples of severely degraded riparian areas.

Considering that the sensitivity of this area is largely dependent on water resources, the protection of water quality and, more generally, the aquatic and riparian environment is of primary importance in this area. Further, because any impacts to surface water quality in this region are ultimately spread to all downstream areas, including the North Saskatchewan River, management of issues in the east and central parts of the County have widespread, regional implications.

Among the methods to protect and enhance water quality, proper management of streamside, or riparian vegetation, is particularly important. Buffer strips of natural vegetation along watercourses perform several water purification functions: they filter out sediment, stabilize stream banks, reduce erosion and retain pollutants (Connecticut River

Joint Commissions 2000, Fischer and Fischenich 2000). Linked to the management of riparian vegetation is the management of adjacent land uses. In an agricultural context, cattle grazing is a particular concern. Where cattle have direct access to streams, they can trample streamside vegetation (Plate 2), exposing soils and cause sediment release. As a result, they can reduce the effectiveness of riparian buffer function with regard to water quality, as well as introducing a point disturbance. In areas where streamside conditions have already been disturbed, active management (e.g., installation of controlled-access fencing for cattle) and restoration of vegetation can often greatly improve the effectiveness of ecological functions. Again, outlining of such measures is not appropriate within the MDP, but could be implemented through complementary policy and awareness programs through the County or through the Beaverhills Initiative and its various partners. The Cows and Fish program would be an excellent means of raising landowner awareness and encouraging better riparian buffer management for water quality protection.


Plate 2. Left: undisturbed native vegetation extends to a creek's edge on ungrazed land; Right: extensive vegetation trampling and shoreline disturbance is evident on the opposite bank with active cattle grazing.

3.2.5 West Boundary of Elk Island National Park and the Cooking Lake/Blackfoot Reserve

Most of Strathcona County's eastern boundary is shared with Elk Island National Park and the Cooking Lake-Blackfoot Reserve. The lands adjacent to these protected areas were predominantly of high environmental sensitivity, with very few areas of low or moderate sensitivity (Figure 7). Among the key factors behind this area's sensitivity are the abundance of native vegetation, the occurrence of groundwater recharge areas and the poor agricultural capability of the soils (CLI Agricultural Capability Classes 5 and 6; Appendix C).

Perhaps the most important factor for the relationship between the County and the protected areas is the presence of native vegetation. Not only does the abundance of native vegetation buffer the protected areas from the surrounding agricultural and country residential land uses, but it provides additional habitat for many of the 250 or more wildlife species that inhabit the protected areas (Saxena *et al* 1997). For many of those species, this extensive coverage of native vegetation also provides an effective connection to other areas of suitable habitat outside the boundaries of the largely fenced protected areas. This buffer of native vegetation continues around the south end of the Cooking Lake-Blackfoot Reserve and into the current Lakeland Policy Area. As a result, it also provides a vital link in the regional connection between Elk Island National Park and Cooking Lake-Blackfoot Reserve and the areas of Cooking Lake, Hastings Lake, the Ministik Bird Sanctuary and Miquelon Lake Provincial Park to the south.

Maintenance of the existing native vegetation in the area adjacent to Elk Island National Park and the Cooking Lake-Blackfoot Reserve is integral to sustaining the ecological functions that that area, and the protected areas themselves. Together, these lands currently provide regional ecological linkages, habitat for biodiversity, and source populations to recolonize habitat with reduced populations. As in the preceding sections, the means to implement such management would require a combination of MDP level policy statements, land use policy and landowner programs offered by other agencies.

Among the most direct and easily implemented management strategies to retain this wooded buffer would be to maintain large agricultural holdings. Alternatives might include limiting country residential development and restricting further clearing of native vegetation. Landowner programs might encourage active revegetation of previously cleared areas immediately adjacent to the Elk Island National Park fenceline, or perhaps more realistically, convince landowners to allow such areas to succeed to more natural vegetation communities. For areas where continued agricultural use is desirable, landowner programs could recommend the use of rotational crops to accommodate bird nesting periods, particularly around wetlands. Ducks Unlimited and the Alberta Fish and Game Association, partner agencies of the Beaverhills Initiative, have a variety of awareness programs that could help in this regard.

3.2.6 North Strathcona County

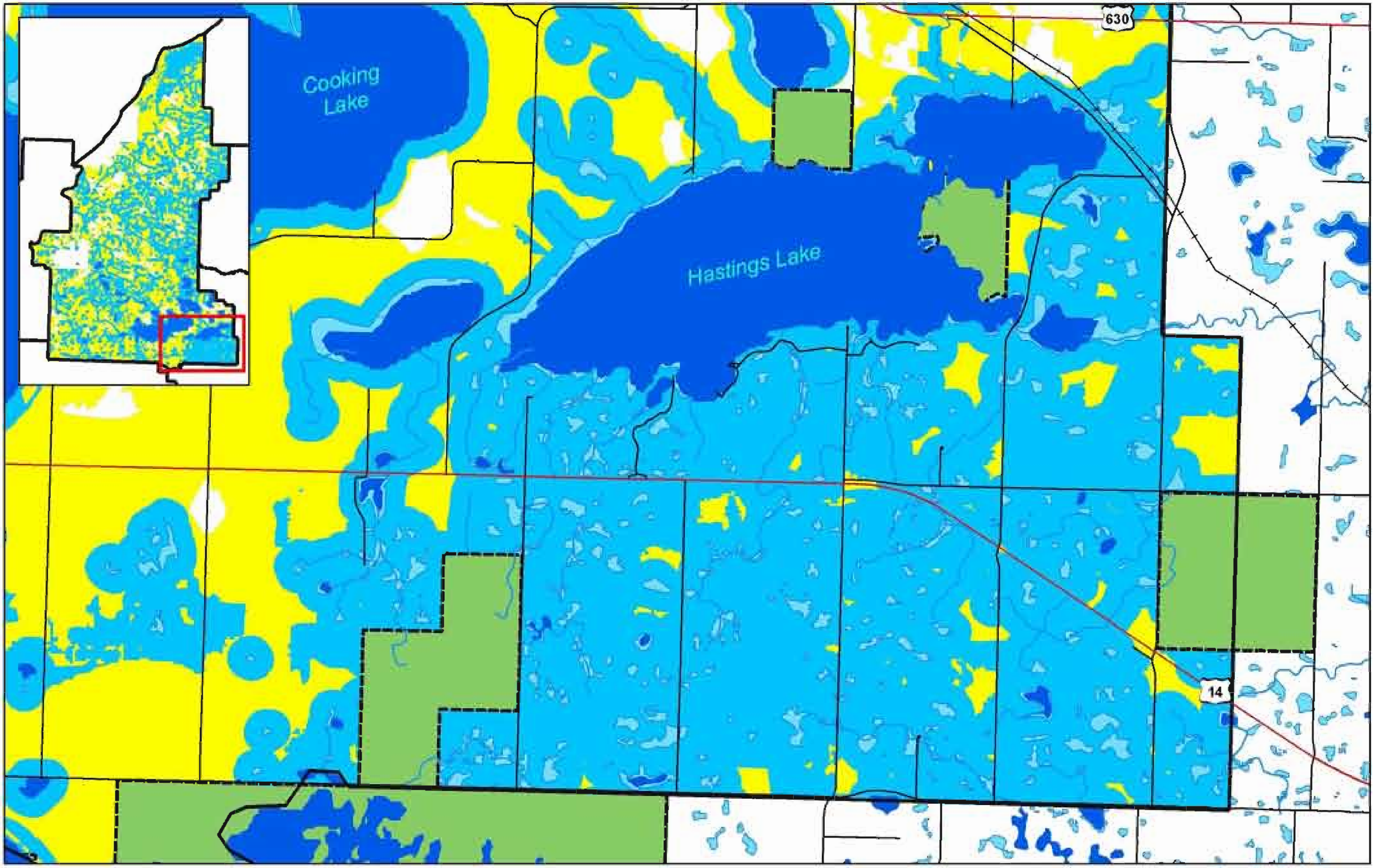
At the very north end of the County, between Highway 15 and the North Saskatchewan River, the Landscape Management Area map displays a large area of highly sensitive lands (Figure 8). This area is characterized by relatively few surface water features (i.e., creeks, wetlands). Its sensitivity is due to extensive native vegetation cover and a broad groundwater water recharge area. In addition, it is dominated by soils that have very severe limitations for the growth of agricultural crops (CLI Agricultural Capability Class 6; Appendix C).

The natural characteristics of this area can almost entirely be related to the high sand content of the soils in the area. Sandy soils are inherently poor for crop production, therefore, limited clearing has taken place to accommodate agriculture, leaving large areas of native vegetation relatively intact. Secondly, sandy soils are highly permeable, which allows precipitation and other sources of surface water to percolate rapidly through the soils to recharge groundwater aquifers. Further, as a result of this permeability, permanent wetlands are scarce on this landscape.

The native vegetation in this area is represented by a vegetation community that is unique within the County. The dominant tree species is jack pine; a species that thrives in well-drained sandy and gravelly areas (Johnson et. al 1995). Although patches of jack pine are scattered throughout central Alberta, this area represents the only example of such a community in the County. Due to the unique, sandy features of the landscape and vegetation in this area three separate provincial Natural Areas have been created by the province to protect it: the North Bruderheim (Sandhills), Northwest of Bruderheim and Astotin Natural Areas. At a regional scale, this large and relatively continuous area of native vegetation also provides an important link for the movement of wildlife and dispersal of individuals between the North Saskatchewan River Valley and Elk Island National Park. In addition, the dense forest of this area provides suitable habitat (Semenchuk 1992) for at least two species provincially ranked as Sensitive: the broad-winged hawk and northern goshawk.

Sustaining the natural values of this area is largely dependent on the retention of the extensive forested area so that the three Natural Areas remain connected to each other and to the adjacent river valley. The issue is further complicated by the overlap of provincial and municipal jurisdiction affecting land management in this area. Alberta Community Development manages the Natural Areas, but the municipality administers development on the surrounding lands. In addition, the Alberta Energy and Utilities Board (EUB) regulates and issues permits for the petrochemical developments that are the main form of industry in this policy area. In light of this area’s designation as a Heavy Industrial Policy Area in the MDP, the challenge will be to retain native vegetation and avoid isolation the Natural Areas in the face of future potential industrial development. Specifically, management should focus on two objectives: maintaining the large patches of pine-dominated mixedwood forest and protecting the area’s groundwater recharge function.

Given the development limitations of the sandy soils underlying the area, suitability for some forms of industry may be limited. Environmental Impact Assessments (EIAs) for all future development proposals should ensure that these concerns are addressed. This would need to be communicated to the EUB, as the County does not directly regulate the EIA process. Another consideration is for future developments to conserve and buffer the existing NAs. One approach may be to consider locating new industrial plants and facilities near the existing plants where possible, giving priority to development in previously disturbed areas instead of creating new areas of disturbance. This may be suitable for inclusion in the MDP, or in other supporting policy (e.g., the Land Use Bylaw). In effect, this approach is already practiced in this area, as most facilities are concentrated along the west side of the Policy Area where access to water and opportunities for the sharing of resources are available. This particular issue is addressed in further detail in Sections 4.1 and 4.2, regarding the North Bruderheim (Sandhills) Natural Area and Heavy Industrial Policy Areas site-specific analyses.



Legend

High
Medium
Low
Protected Areas
Lakes
Wetlands
Rivers and Streams
County Boundary
Highways
Roads
Railways

Figure 3. Landscape Management Area Analysis
Southeast Corner

Doc#100479

1:52,500

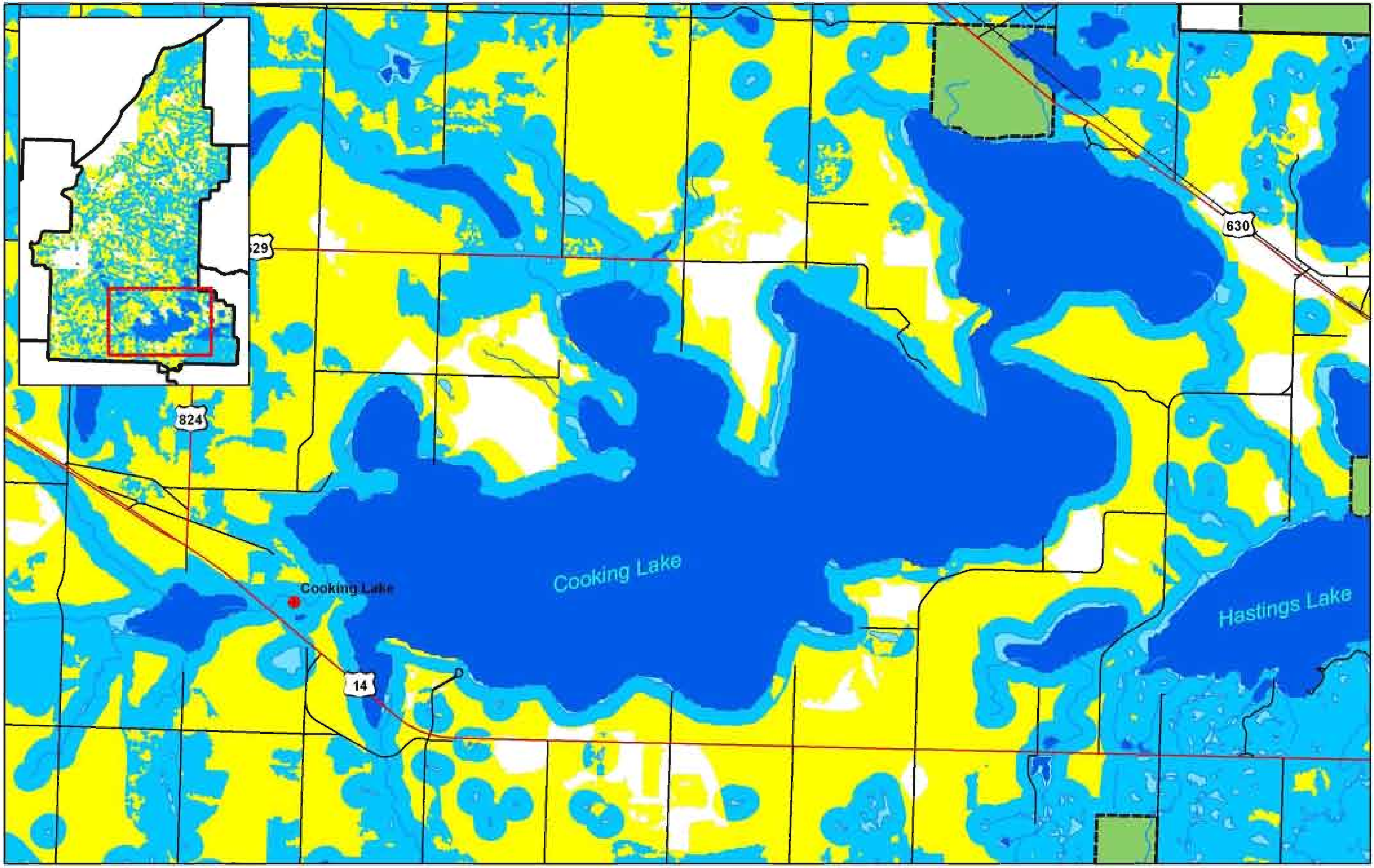


Figure 4. Landscape Management Areas Analysis

Cooking Lake Area

1:68,000

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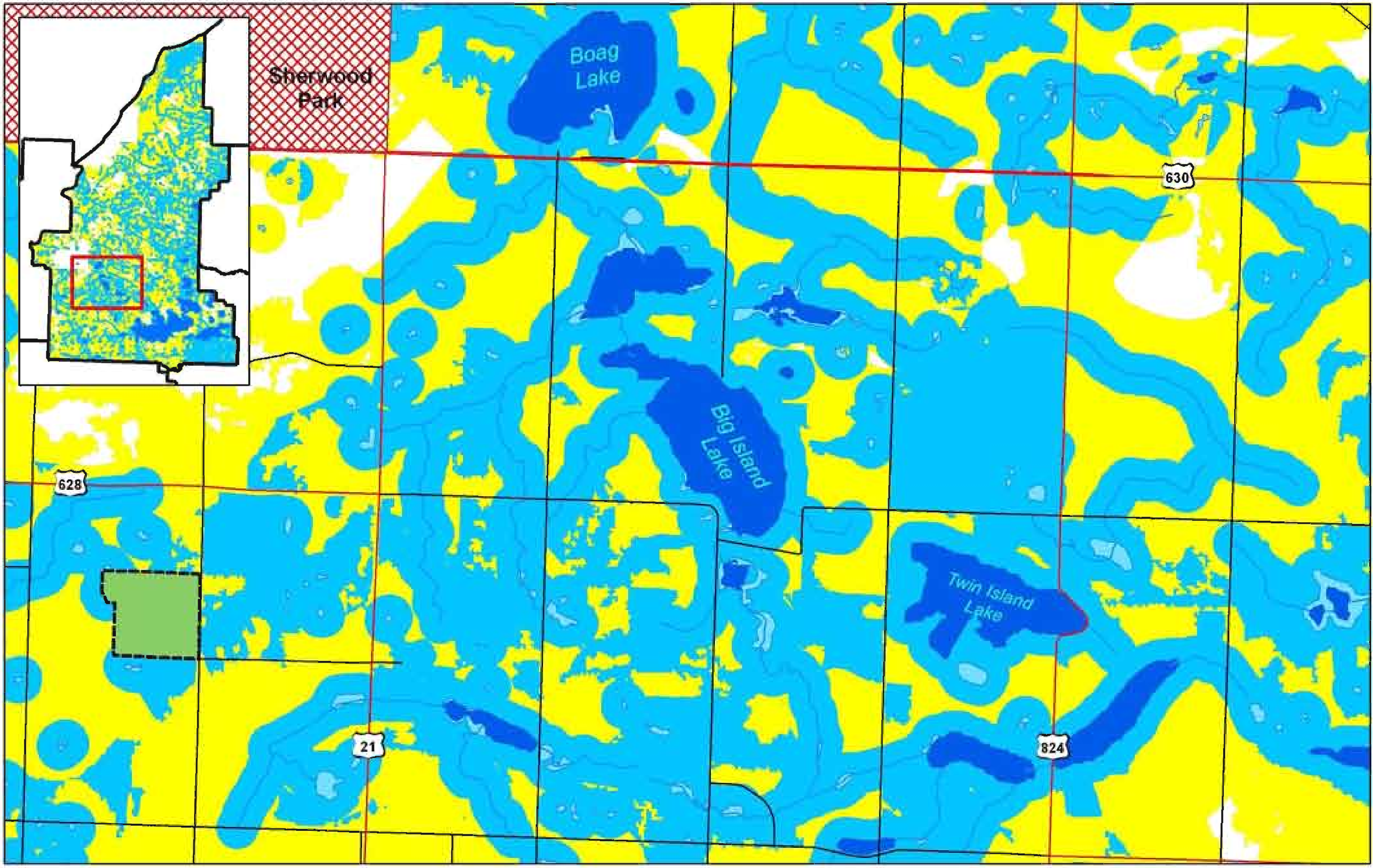

Figure 5. LMA Analysis - Lake Network between Sherwood Park and Cooking Lake

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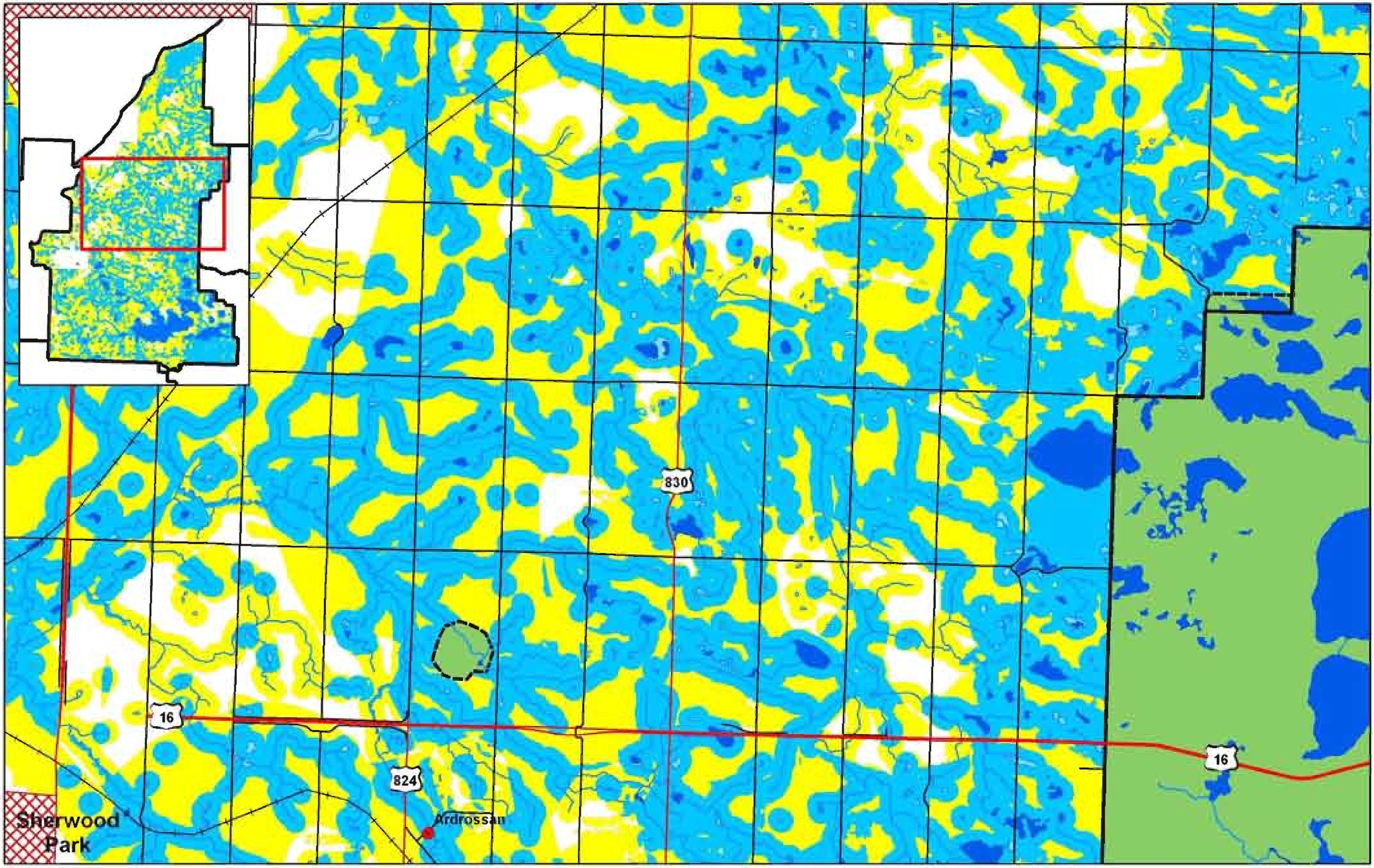
1:48,500



Legend

High
Medium
Low
Protected Areas
Lakes
wetlands
Rivers and Streams
County Boundary
Highways
Roads
Railways
Urban Lands

Figure 6. Landscape Management Areas Analysis - East and Cental Strathcona County

1:95,000

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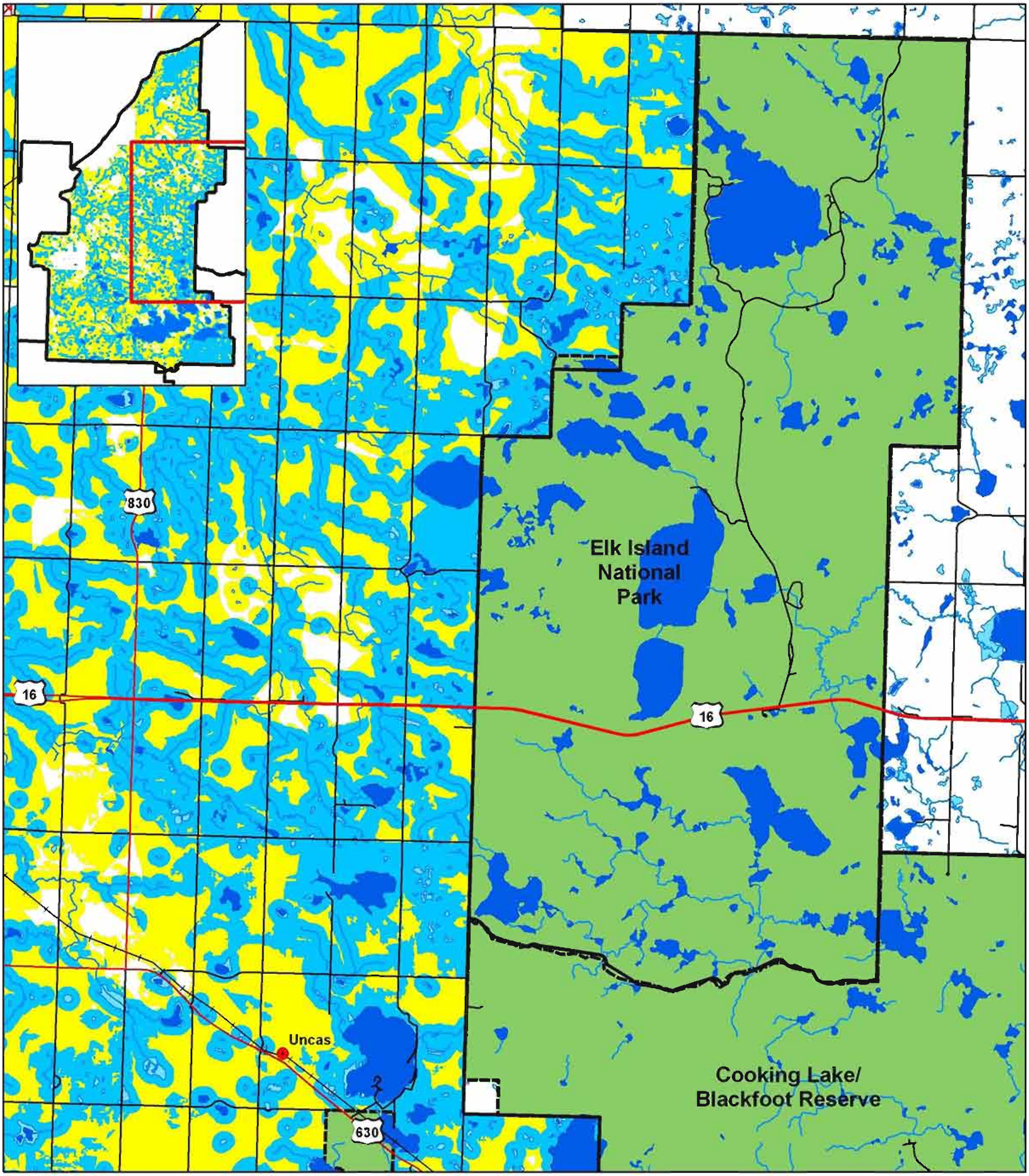

Figure 7. Landscape Management Areas Analysis - West Boundary of Elk Island National Park and the Cooking Lake-Blackfoot Reserve

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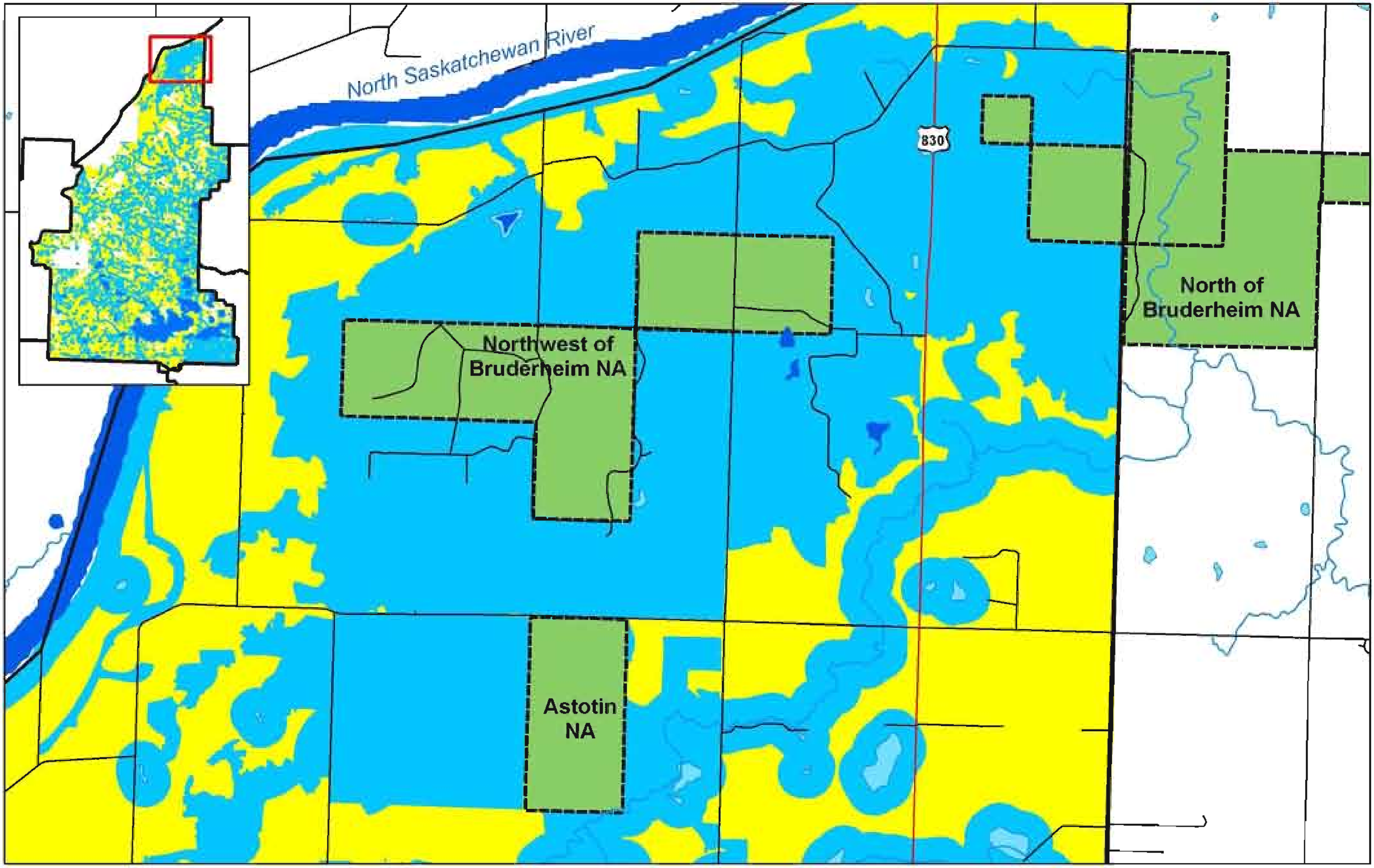

Legend

High
Medium
Low
Protected Areas
Lakes
wetlands
Rivers and Streams
County Boundary
Highways
Roads
Railways

Figure 8. **Landscape Management Areas Analysis - North Strathcona County**

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4.0 SITE SPECIFIC ASSESSMENTS – RESULTS

This section provides a discussion of each site specific assessment. For each site we present information pertaining to the existing conditions, site sustainability, management implications and other details related to site-specific concerns. In Section 1.3.2, objectives for each site specific assessment were posed as a series of questions. In this section those questions are revisited.

4.1 North Bruderheim (Sandhills) Natural Area

The North Bruderheim (Sandhills) Natural Area is located in the extreme north end of the County straddling the boundary between the Counties of Strathcona and Lamont. As a Provincial Natural Area, this site is intended to preserve and protect this locally significant site and provide opportunities for low-impact recreation and nature appreciation activities (Alberta Community Development 2005). The majority of the Natural Area lies on the Lamont side.

4.1.1 Existing Conditions

The Natural Area consists of a mosaic of habitat types ranging from jack pine-dominated mixedwood forest on upland sites, to a variety of wetland communities, including willow-sedge and black spruce, in low-lying depressions. The predominance of sandy soils throughout the area is, by far, the primary factor influencing the vegetation community. The coarse textured nature of sandy soils results in well-drained and, thus, dry conditions, suitable only for species adapted to those conditions. As a result, jack pine is the dominant tree species of the Natural Area, with aspen present in lower numbers. The growth limitations posed by the sandy soils also contribute to a Class 6 CLI agricultural soils capability rating (Appendix C), meaning the soils are very poor for agricultural crops. Beaverhill Creek, which originates from Beaverhill Lake, flows through the Lamont side of the Natural Area before meeting the North Saskatchewan River. Much, if not all, of the Natural Area lies above a large groundwater recharge area.

The North Bruderheim (Sandhills) Natural Area is part of a large and relatively continuous belt of native vegetation that serves as an important ecological linkage between the North Saskatchewan River Valley and Elk Island National Park (Appendix C). The Natural Area is directly linked to the North Saskatchewan River Valley through the heavily forested Beaverhill Creek ravine. To either side the Natural Area is linked with forested areas, including the NW of Bruderheim and Astotin NAs to the east and large areas of unprotected forest to the west. These linkages facilitate the movement of wildlife between the North Saskatchewan River Valley and adjacent uplands. At a regional scale, the North Bruderheim (Sandhills) Natural Area area, as a component of a larger vegetation belt, provides a bridge between the lands of the Dry Mixedwood Natural Subregion to the north and the Beaver Hills/Cooking Lake moraine to the south.

Despite its provincial designation as a natural area, the North Bruderheim (Sandhills) Natural Area contains extensive industrial infrastructure and associated utilities. Additionally, the primary use of the Natural Area appears to be recreational: all-terrain vehicles (ATVs) tracks were found throughout the area. Although some ATV trails were both named and signed, and so apparently sanctioned, there was abundant evidence of off-trail riding. In many areas trails crossed through wetlands, causing serious and long-lasting impacts (Plate 3). Evidence of other obvious ATV impacts included soil surface disturbance, vegetation trampling, soil erosion, and creek sedimentation (Plate 3). In addition, large amounts of litter were observed throughout the Natural Area and, in particular, at staging areas.

Although beyond the scope of our field investigations, the intensive use of ATVs is also likely to result in wildlife alienation. Research has shown that ATVs, or more generally off-road vehicles, can stress, displace and restrict movements of wildlife (Sowl and Poetter 2004). It is, therefore, likely that the human activity and noise disturbance associated with ATV use is affecting sensitive wildlife species (e.g., American mink, northern goshawk, barred owl) in the Natural Area, and, as a result, some species may altogether avoid use of the area (Gilbert 2003). However, despite this and the abundance of industrial infrastructure, the presence of deer, moose and coyote tracks suggest that the Natural Area is commonly used by those species. Those species are, however, considered to be relatively tolerant of human disturbance and their use of the area is not surprising, especially considering this area's proximity to the North Saskatchewan River Valley and its function as a wildlife corridor.

Plate 3. Left: extensive ATV soil surface damage with significant down cutting; Right: wide ATV trail through wetland.

At several areas along its length within the Natural Area, Beaverhill Creek was highly degraded as a result of ATV use (Plate 4). Trails across the creek and along the creek's shoreline were abundant, causing significant losses of riparian vegetation. Areas of exposed soil (i.e., stripped of vegetation) are extremely susceptible to erosion and could result in increased creek sedimentation, which can reduce the quality of the aquatic environment for fish, amphibians and invertebrates.


Plate 4. Left: ATV trails crossing and running along the shoreline of Beaverhill Creek; Right: extensive bank erosion caused by ATV use.

4.1.2 Site Sustainability and Management Implications

What are the key natural values of this site? Is it sustainable in the current and potential future developed context? What is required to effectively conserve the site in light of its current context?

The North Bruderheim (Sandhills) Natural Area is currently located within a Conservation Policy Area. According to the existing MDP, this area 'shall primarily be used for long-term conservation' and 'incompatible land uses which may lead to degradation of environmentally significant and sensitive areas…shall not be permitted.' Considering this, the extensive ATV use within the Natural Area appears to contradict the existing objectives stated for the Conservation Policy Area.

Based on the extensive evidence of habitat degradation within the Natural Area, the current level of ATV use is not sustainable. The sandy soils, which are not only sensitive to surface disturbance, but create dry conditions on which native vegetation re-establishes slowly, makes the Natural Area extremely vulnerable to disturbance. Without management, ATV users will likely continue to create new trails, eliminate native vegetation and disturb soils, further fragmenting the habitat and potentially alienating sensitive wildlife species. The North Bruderheim (Sandhills) Natural Area is, however, still surrounded by largely undeveloped land. As such, the Natural Area is, in effect, a subunit of a much larger ecosystem. This connectivity enhances site sustainability as it allows for movement of wildlife, provides access to source populations of plants and animals, and buffers the Natural Area from other surrounding disturbances and land uses.

In summary, the North Bruderheim (Sandhills) Natural Area has resources requiring protection offered by its current Conservation Policy Area and provincial Natural Area status. The current management of the site is, however, ineffective in achieving the goals of those designations. The main concern is the extensive ATV usage of the Natural Area, which is adversely impacting both vegetation and soils, and also likely to be affecting local wildlife. Natural Areas are managed by the province, and the County manages the adjacent land use, and development through the MDP and supporting policies. The sustainability of the site is dependent on better management of recreational use, through the policies and resources available to each jurisdiction. Finding an effective means to accomplish this may require some discussion with Alberta Community Development's Protected Areas group. The Beaverhills Initiative may provide an opportunity to discuss the situation and possible solutions, as the Protected Areas group is a participating partner in the initiative.

4.1.3 Inclusion in Conservation Policy Area

Under the current MDP, the North Bruderheim (Sandhills) Natural Area and the adjacent North Saskatchewan River Valley are considered to be part of the same Conservation Policy Area. The two natural areas are, however, quite different in terms of the significance of their constituent natural resources and their ecological functions. Further, and perhaps more importantly in terms of the MDP, those two areas currently support different land uses and, therefore, face different management issues.

The North Bruderheim (Sandhills) Natural Area supports a unique community of jack pine-dominated mixedwood and scattered wetlands. Similarly, the Natural Area provides unique habitat that likely supports a different suite of species (particularly plant species) compared to surrounding areas and, perhaps more importantly, functions as a part of a regional wildlife corridor linking the North Saskatchewan River and areas of wildlife habitat further to the south, including Elk Island National Park. Because of its accessibility and presence of sandy soils, the Natural Area attracts a large number of recreational ATV users. This has resulted in degradation of the natural features of the site and, in turn, has presented a serious management issue for the Natural Area, especially considering that such intensive use is contrary to the mandate for NAs as outlined by Alberta Community Development (2005).

Within the North Saskatchewan River Valley, native vegetation remains only along valley walls, and consists primarily of deciduous or deciduous-dominated mixedwood. Many of the flat terraces along the valley bottom have been cleared for agriculture. Despite this, the valley continues to provide habitat for a wide diversity of wildlife species and to function as an important regional wildlife movement corridor. Because of the lack of formal recreational development and access, the North Saskatchewan River Valley receives very little use from recreationists.

Considering the different natural features, land use and condition of the North Bruderheim (Sandhills) Natural Area and the North Saskatchewan River Valley, they require specific land management tailored to their specific circumstances. This would be best achieved if the two areas were separately designated as protected conservation areas, with specific management requirements outlined in the MDP. Doing so would ensure that site-specific concerns and issues are handled appropriately in management decisions for each area.

4.2 Northeast Heavy Industrial Policy Area

The Northeast Heavy Industrial Policy Area is located at the north end of Strathcona County and is bounded by the Conservation Policy Area and the North Saskatchewan River to the north and west, Highway 15 to the south and by Lamont County to the east.

4.2.1 Existing Conditions

The Policy Area remains largely undeveloped; heavy industrial development has been concentrated on the west side near the North Saskatchewan River. The north end of the Policy Area supports an extensive network of oil and gas infrastructure (e.g., well sites, pump jacks, tanks), access roads and associated utilities (e.g., pipelines, power lines). Both agricultural pasture and croplands are common in the rest of the Policy Area. Despite the above industrial and agricultural development, a large portion of the Policy Area also remains naturally vegetated. Significant hydrological features are limited to Astotin Creek, which flows northeast through the Policy Area before joining Beaverhill Creek just east of the County's east boundary and the North Bruderheim (Sandhills) Natural Area.

The natural vegetation remaining in the Policy Area effectively occurs in one large swath that extends from the center of the Policy Area well into Lamont County to the east (Appendix C). A large diversity of vegetation communities occur in this area, but the vegetation can be broadly characterized as jack pine dominated mixedwood forest interspersed with willow-sedge wetland complexes. This extensive area of native vegetation is closely associated with a band of sandy soils. Sandy soils have a strong influence on the types and diversity of vegetation communities capable of establishing in an area. The coarse textured nature of sandy soils results in well-drained and, thus, dry conditions, suitable only for species adapted to those conditions. Because those conditions are common to the north part of the County, jack pine, a species of well-drained sandy and gravelly areas (Johnson et al 1995) is the dominant tree species, with aspen present in lower numbers. Sandy soils also present severe limitations for the production of agricultural crops (Class 5 CLI agricultural crop capacity rating; Appendix C) and, because of this, much of the Policy Area has experienced relatively limited clearing for agricultural purposes. More favorable conditions for crop growth, in the form of loamy soils, occur along the southern edge of the Policy Area, north of Highway 15, and to the west, where industrial development has focused to date. In those areas the loamy soils contribute to an increased CLI rating and, considering their suitability, agricultural crops are abundant.

The extent and composition of this large forested area makes it a valuable and unique natural feature within the County. As a result of its size, it provides suitable habitat with the capacity to support the entire home ranges of larger bodied wildlife species such as deer (± 1.5 km^2; Lesage et al 2000) and moose (15 km^2; Mytton and Keith 1981). In addition, the size of the area and the continuity of vegetative cover provide an important landscape connection between the North Saskatchewan River Valley and surrounding areas of protected upland, including Elk Island National Park to the southeast.

Lastly, the jack pine mixedwood forest also provides an area of dense, mature, coniferous forest that is not available elsewhere in the County and, at a larger scale, is a relatively unique feature in the Central Parkland Subregion of Alberta. Where native parkland vegetation is still present in this subregion, it most commonly consists of aspen forests or, in wetter areas, communities dominated by balsam poplar (Achuff 1994). Alberta's Department of Community Development has conserved some of the unique jack pine community by formally designating two separate natural areas (Northwest of Bruderheim and the Astotin Natural Areas). Natural areas are intended to protect natural and near-natural landscapes of regional and local importance for nature-based recreation and heritage appreciation (Alberta Community Development 2005).

4.2.2 Site Sustainability and Management Implications

How valuable and sustainable are these patches now, within the current developed context? Should they continue to be retained and protected under some form of conservation policy? Is there potential and value in improving their condition through restoration?

As is evident by its title, the Northeast Heavy Industrial Policy Area, including the extensive woodland, is intended to support heavy industrial developments. More specifically, the current MDP outlines the following objectives for industrial development in this area:

- Provide for an adequate supply and range of industrial lands that will be available to meet the diverse needs of prospective industries.
- Facilitate industrial development through pro-active land use planning (i.e., statutory plans) and implementation (i.e., zoning, subdivision).
- Encourage the development of adequate infrastructure to meet current and future industrial needs.

While pursuing the above objectives, industrial development must also comply with the need to 'promote compatibility between industrial development and other land uses' and the need to 'maintain and enhance the quality of life of citizens by providing a buffer between industrial development and other land uses.' Further, industrial development must acknowledge the environmental management objectives stated in the MDP: 'to encourage land uses and developments that maintain and enhance the natural habitat' and 'to acknowledge and conserve significant natural resources and features within and adjacent to the County.'

Considering the inherent conflict in achieving both the industrial development and environmental management objectives as stated in the existing MDP, the long-term sustainability of the naturally vegetated areas in the Northeast Heavy Industrial Policy Area is questionable. The area is already highly fragmented with various oil and gas operations. The presence of large-scale, heavy industrial development is, however, absent within the forested area. Locating any such development within the forested area would introduce a continuing source of noise disturbance and human activity that would likely reduce the area's capacity to support significant wildlife populations. More generally, any clearing or further fragmentation of the existing forest will reduce the value of this area as wildlife habitat and as a regional wildlife corridor.

In order to provide support within the context of the current MDP, conserving the forested area will likely require some formal acknowledgement of this area's sensitivity. Formal recognition of the value and unique nature of this area may then promote compliance with the MDP's objective to acknowledge and conserve significant natural features. It may not be necessary to provide these lands with an entirely separate policy area, but perhaps some type of policy overlay could be established by which industrial developers were encouraged to consider non-forested site locations before forested areas. Promoting development of heavy industrial sites in already disturbed areas in the southwest corner of the Policy Area would help limit sprawl and would concentrate industry in less sensitive areas. That area already supports large scale petrochemical industry development and is located immediately adjacent to the industrial developments at the north end of Fort Saskatchewan. Concentrating developments into this area will limit the extent of disturbance, leaving the extensive forested area in its current condition.

Avoiding development in the forested area would help sustain the natural values and functionality of that area into the future, but it may also acknowledge the inherent development limitations of the area. The forested areas remaining in the Policy Area overlie sandy soils and a large groundwater recharge area. Sandy soils are highly permeable and, as such, present a risk of leaching surface contaminants into groundwater aquifers. Because of the extensive use of hazardous materials and the associated risk for groundwater contamination with heavy industry, much of the forested area may, therefore, not be suitable for development of petrochemical industries without large investment into preventative measures (e.g., construction of ground lining structures or materials).

4.3 Southwest Agricultural Policy Area

The Southwest Agricultural Policy Area lies in the southwest corner of the County and, west of Highway 21 and south of Highway 628. The Policy Area is sub-divided into two areas: Area 1 includes all lands south of Highway 14 and Area 2 includes all lands north of Highway 14. Area 2 is one of several sites under consideration as a future urban growth node.

4.3.1 Existing Conditions

The Southwest Agricultural Policy Area is a landscape dominated by productive soils, and thus agriculture, with rural residential development in the north. Many small woodlands and wetlands are scattered throughout the area, and a few minor drainages are also present. More than half the Policy Area overlies a groundwater recharge area and a small area along the west boundary of the Policy Area is a groundwater discharge area (Appendix C).

The soils within the Southwest Agricultural Policy Area are rated as having a high agricultural crop capability (i.e., primarily CLI Class 3; Appendix C). As a result, this area is dominated by agricultural crop and pasture, leaving only a few remnant woodlands scattered throughout the area. Although agricultural cropland is dominant in both, the area north of Highway 14 supports significantly more natural vegetation compared to the area south of the Highway.

In general, the remnant woodlands are relatively small and isolated, and are primarily aspen-dominated. Despite this, these areas can still be expected to support a diversity of native vegetation and wildlife species, including most of the locally common songbirds and small mammal species. They likely also provide habitat for wide-ranging species such as deer, red-tailed hawks, porcupines, skunks and coyotes, which travel from one treed area to the next through the surrounding open agricultural matrix. The scattered remnant woodlands are generally located on privately-owned lands, with the exception of the provincially-owned Sherwood Park Natural Area. That Natural Area, located along the northern periphery of the Policy Area, is subject to many activity restrictions (e.g., no bikes, no motorized vehicles, no horses, no off-leash dogs and closed at night) and so remains relatively undisturbed. Most of the other, non-protected woodlands receive little in the way of human use, however, many areas show signs of disturbance caused by cattle grazing (Plate 5).


Plate 5. Left: non-grazed forest in Sherwood Park Natural Area showing an extensive shrub understory; Right: an adjacent area of grazed forest shows a greatly reduced understory.

North of Highway 14 (Area 2), most of the woodlands occur in an approximate east-west belt across the Policy Area. These woodlands form the westernmost extension of the heavily-forested Lakeland Policy Area. This area may, therefore, function as a wildlife movement corridor for species traveling to habitat areas through the southwest part of the County.

Many of the watercourses in this area, including Irvine Creek, Mill Creek, Fulton Creek and several unnamed drainages, have experienced extensive alteration and degradation as a result of adjacent land uses. Some areas have been trampled and grazed by cattle, while other riparian areas have been largely cultivated, significantly reducing the upland buffer (Plate 6). Despite this, these watercourses continue to provide water to downstream areas. Of particular significance is the role Fulton Creek plays in providing the Fulton

Creek Naturalized Stormwater Management Facility, located just west of the County and inside the City of Edmonton boundaries, with a steady inflow of water to ensure maintenance of the wetland habitat at that facility.

Among the largest waterbodies in the area is Bretona Pond, located just south of Highway 14. Bretona Pond is a permanent waterbody with a fringe of marsh habitat around its periphery. It has been protected through Alberta Fish and Wildlife's 'Buck for Wildlife' program. A short trail allows for some passive recreation and the area is sometimes used as a field trip destination by the Edmonton Nature Club. Despite the nearby busy Highway 14, Bretona Pond appears to remain a productive area of wildlife habitat, particularly for waterfowl.

Plate 6. Two sections of Irvine Creek; Left: creek channel showing limited vegetative cover and grazing disturbance; Right: agricultural crops encroaching on the creek channel.

4.3.2 Site Sustainability and Management Implications

Are there natural features in this area that are sensitive to development? Is there potential and value in restoring natural features in this area to enhance ecological function and sustainability of other, intact natural features?

Despite the extensive agricultural development, there are several natural features scattered throughout the Policy Area that are sensitive to development. Among these, most notable are the remnant woodlands and surface water features. These natural features are present in both Areas 1 and 2, therefore, some aspects of land management will be similar between the two areas. However, because of the differing abundances of natural features in those areas, each area may benefit from a certain level of site-specific land management.

The remnant woodlands are already highly fragmented and, generally, small and isolated in nature, however, they continue to support local populations of native vegetation and wildlife. Additional clearing or further fragmentation would further reduce the availability of habitat and, in Area 2, would reduce the extension of the regional wildlife corridor. High density country residential development, or other less permeable features (from the perspective of wildlife movement) within or near remnant woodlands will likely result in their further isolation, unless effort is taken to retain connective linkages. Increased isolation may then result in a decreased occurrence of wide-ranging species such as deer and coyotes. Considering this sensitivity to development, consider maintaining large agricultural holdings near remnant woodlands, and particularly near the vegetation belt in Area 2, as this would help sustain the current values of those woodlands. Similarly, clustering country residential subdivisions away from potential wildlife corridors and on previously cleared land would also help maintain those same values.

Although perhaps not as numerous as elsewhere in the County, the surface water features within the Southwest Agriculture Policy Area merit consideration in land management. Specifically, the headwaters of Fulton Creek, (including the unnamed lake on Section 3-23-52-W4), Mill Creek, Irvine Creek and Bretona Pond all provide valued ecological functions, including control of downstream water supply and quality. In order to sustain those functions ensuring the health of riparian areas, needed to maintain consistent water flow and downstream water quality, will be important. In areas with wide strips of riparian vegetation, consider a form of cluster development to ensure that those riparian areas (see Appendix B) are left undisturbed. In areas where riparian areas are already degraded, active enhancement of riparian vegetation can be encouraged to enhance the water quality and habitat functions provided by those areas. Again, this could be an initiative promoted through the Beaverhills Initiative and its NGO partner organizations.

4.4 Lakeland Policy Area

Does the Landscape Management Area mapping system support the need for special management on the southeast side of the County? Does the current Lakeland Policy Area protect the key areas of high sensitivity?

The Lakeland Policy Area was previously identified as an area that required special management because of the extensive woodlands, large lakes and many small wetlands concentrated in that area. The results of the Landscape Management Area analysis confirm that assessment. Almost the entire Policy Area was rated as having at least a medium environmental sensitivity, with large areas of high sensitivity in the southeast corner and immediately adjacent to the large lakes (i.e., Cooking Lake, Hastings Lake and Antler Lake; Figure 9). The areas of high sensitivity can, for the most part, be attributed to surface water features, native vegetation, high biodiversity (i.e., occurrence of rare species) and soils with poor agricultural capacity.

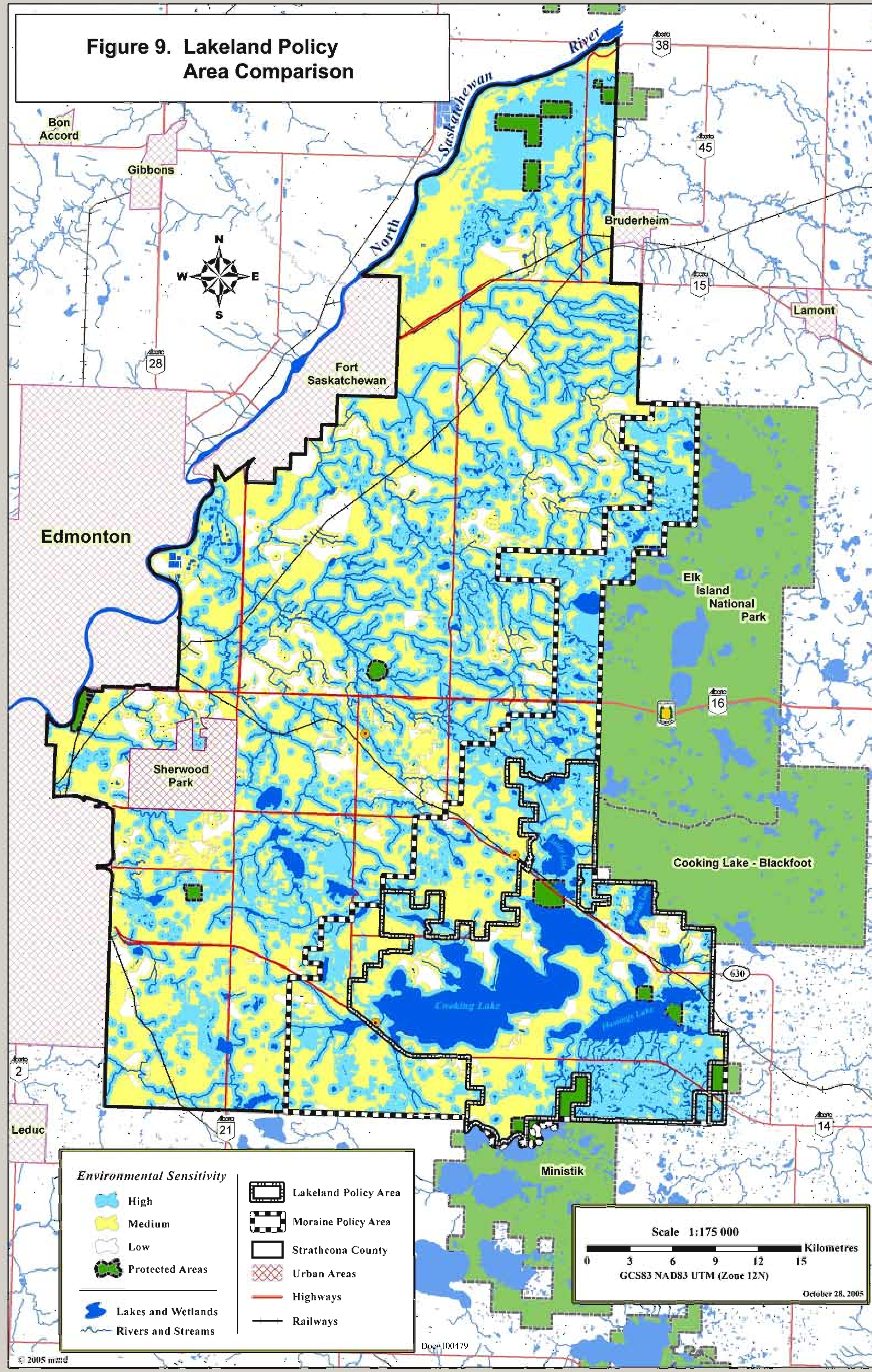
As currently delineated, the Lakeland Policy Area incorporates many of those areas of high sensitivity (Figure 9). Importantly, it protects a forested link between Elk Island National Park, the Cooking Lake-Blackfoot Reserve, the Ministik Bird Sanctuary and Miquelon Lakes Provincial Park. It also includes an extensive concentration of wetlands and creeks in the southeast corner and contains the largest lakes in the County. However, the Lakeland Policy Area currently excludes other areas that merit special management. In particular, two additional areas; the County's shared boundary with Elk Island National Park and the southwest part of the Cooking Lake catchment basin provide valuable ecological functions. Both areas are currently without any special management, which exposes them, and the adjacent protected lands, at risk.

The east edge of the County, adjacent to Elk Island National Park, remains extensively forested. It is this abundance of native vegetation, in combination with the occurrence of groundwater recharge areas, poor agricultural capability of the soils and biodiversity, which contributes to the generally high sensitivity rating of this area (Appendix C). The extensive vegetation buffers the park from the surrounding agricultural and country residential land uses and, for many of the wildlife species occurring in the park, it provides additional habitat and an effective connection to areas of suitable habitat outside the park's boundaries. For large-bodied terrestrial species, this buffer allows travel around the largely fenced protected areas and further south into the area of Hastings and Cooking Lake, the Ministik Bird Sanctuary and Miquelon Lakes Provincial Park. Protection for this strip of land would also include Trappers Lake, which straddles the park boundary and forms the headwaters of Ross Creek.

The existing Lakeland Policy Area includes the largest lakes in the County and, for the most part, captures their catchment basins as well. However, the southwest area of Cooking Lake's catchment basin is currently excluded. That area includes two smaller drainage basins, including one that flows through McFadden Lake. Because the soils in this area have relatively low agricultural crop capacities, many remnant woodlands are also present. This combination of creeks and woodlands provides many riparian areas that are valued for their wildlife habitat, including habitat for several rare species, and, perhaps more importantly, for their water quality functions. Because of the hydrological connection between this area and Cooking Lake, the quality of upstream riparian systems has direct implications for the quality and quantity of water discharging into the lake. Protection of this area, or more specifically the management of this area to ensure the maintenance of existing ecological functions, will, therefore, help sustain Cooking Lake itself.

The proposed Beaverhills Moraine Policy Area would sufficiently include the east edge of the County and the southwest area of Cooking Lake's catchment basin. Ensuring that these two additional areas of high environmental sensitivity, in addition to the areas already included in the Lakeland Policy Area, receive the special management they require to sustain the natural features underlying their sensitivity will help maintain the natural values and ecological functions within Strathcona County's portion of the Beaver Hills/Cooking Lake moraine.

Figure 9. Lakeland Policy Area Comparison



4.5 Confined Feeding Operation (CFO) Sensitivity Analysis

4.5.1 Mapping Results

The Confined Feeding Operation (CFO) model identified the environmental sensitivity of areas based on their incompatibility with CFOs. The primary environmental concern with CFOs is the potential for contamination of either surface water or groundwater. Surface water features, groundwater flow and soil texture were, therefore, all considered as contributing to an areas CFO incompatibility. In areas close to surface water features and having groundwater flow or moderately-coarse, coarse or organic soils, the environmental sensitivity for CFOs land use was rated highest (Figure 10).

Relative to the other natural features included in the model, groundwater recharge areas had, by far, the most influence on the CFO sensitivity map. The extensive areas of medium sensitivity were identified almost exclusively because they were considered groundwater recharge areas. Only a few areas received medium ratings because they were groundwater discharge areas and even fewer areas were rated moderate because of soil texture. Where moderately-coarse, coarse and organic soils do occur, they almost invariably occur in areas that are also groundwater recharge areas. The resulting overlap results in a CFO score of two in the model, maintaining a sensitivity rating of medium.

Hydrological features are also of primary importance in determining a given area's environmental sensitivity to CFOs. The presence of creeks, wetlands and lakes is a key site-specific consideration for sensitivity to CFOs because of the potential for direct impacts to those features resulting from surface water runoff. In particular, the large quantities of manure associated with CFOs can have serious adverse impacts on surface water quality and, more generally, the aquatic environment, if not managed appropriately. Although certainly important in locating CFOs, because of the fine scale at which hydrological features affect the surrounding landscape (i.e., only 50 m buffer), they are best considered at the site specific level. Considering this, we identified areas with high density of water features as areas at risk as it would be difficult to identify specific sites of concern at this broad scale of assessment.

4.5.2 Recommendations and Management Implications

4.5.2.1 Recommended Areas

Where in the County might environmental conditions be more suitable, based on surface and groundwater conditions and soil textures?

Based on susceptibility to surface water or groundwater contamination, an ideal location for a CFO would be an area of medium to fine-textured soils that does not overlie either a groundwater recharge or discharge area and that has, at the very least, 50 m of natural vegetation surrounding any nearby surface water features. In terms of the CFO map, such areas correspond to the areas of low sensitivity.

Under provincial guidelines for intensive agriculture each facility must develop a manure management plan that identifies lands with sufficient capacity to retain nutrients and minimize run-off. Our analysis did not address this issue, which depends on site-specific soil conditions. Instead, we assumed that sufficient land is available nearby each facility and that soil conditions would be suitable for manure disposal. Regardless, locating CFO's in areas with extensive surface water drainage presents potential impacts to surface water quality. Similar concerns exist with locating CFO's in areas with coarse soils, where leaching of nutrients might contaminate groundwater. Areas with fewer streams, or where streams have merged into larger drainages, and areas with finer soils present less risk for contamination of surface water and groundwater, respectively.

Although our CFO analysis is effective in highlighting areas of concern in terms of groundwater and surface water contamination, it does not consider the full range of parameters associated with selecting appropriate sites for CFO development. Excluded are several biophysical and socio-economic sensitivities, such as native vegetation, potential for disease transmission and both current and future land uses; all of which have implications for development of CFOs.

The County has proposed two new agricultural policy areas that would allow potential development of intensive agriculture, either as CFO's or horticultural operations (Figure 10): One is located south of Highway 16 and north of the railway between Highway 21 and Secondary Highway 824 (Area A). The other is located south of Highway 15 between the Ft. Saskatchewan city limits and Range Road 204 (Area B). At a glance, it is evident that the majority of these areas have a medium sensitivity level and are, therefore, not ideal for CFOs. The soils throughout both areas are suitable (i.e., medium to fine texture; Appendix C), however, the presence of groundwater recharge areas and surface hydrology make much of the proposed area unsuitable. The east end of Area B is particularly sensitive as it supports an extensive network of drainages, comprising the headwaters of streams releasing to the North Saskatchewan River through Astotin Creek. There are, however, a few isolated quarter sections within each of the proposed areas that are free of environmental sensitivities.

Considering the environmental incompatibility of the proposed policy areas, perhaps a more appropriate approach would be to distribute proposed CFOs throughout the County. This acknowledges the distribution of low sensitivity areas within the County, which tend to occur in smaller pockets rather than in broad areas (Figure 10). It also acknowledges the distribution of streams comprising headwaters releasing to the North Saskatchewan River. The County has inherent water quality issues, due to its physical terrain and extensive headwaters, which must be addressed in land management strategies. Permitting CFOs on a case-by-case basis could avoid areas where environmental sensitivities are high, and make it possible to locate CFOs in pockets free of sensitivities using a site-specific assessment of such development proposals. Although these pockets occur in several different MDP policy areas, development of CFOs would likely be possible in most policy areas through the use of appropriate buffers and setback distances. Further, such fine scale planning would also allow for consideration of other sensitivities and, ultimately, the best sites for CFOs.

The proximity to protected natural areas should also be assessed in locating CFOs. If in close proximity to a natural area, the concentration of animals at a CFO could present a potential risk for disease transmission between livestock and wild ungulate populations. Within the County, this issue is most important along the shared boundary with Elk Island National Park and Cooking Lake-Blackfoot Reserve where resident elk, moose and herds could be susceptible, and near the North Saskatchewan River Valley and in the southeast part of the County (the current Lakeland Policy Area) where large populations of deer and moose remain. Because of this, consider restricting any further development of CFOs within the proposed Beaverhills Moraine Policy Area.

Under the *Agricultural Operation Practices Act's Standards and Administration Regulation (2001)*, seasonal feeding and bedding sites and livestock corrals cannot be located within 30 m of a waterbody. CFO's must also install a surface water control system that avoids release of contaminants to a surface water body. In particular, such control systems must not alter any non-flowing waterbody (e.g., wetlands) or be located on a fish-bearing waterbody as defined under the *Alberta Water Act's Code of Practice for Watercourse Crossings*. In addition, manure storage facilities and collection areas are not permitted:

- within 30 m of a waterbody,
- within 100 m of a groundwater spring, or
- less than 100 m of a water well.

These restrictions are also finer-scale considerations that are best implemented on a case-by case basis. Further, they provide a <u>minimum</u> level of restriction, which can be enhanced by a municipality to protect sensitive resources as required. The *Agricultural Operation Practices Act* does not, for example require a vegetated buffer separating livestock operations from waterbodies. It instead relies only on distance to protect the water quality of adjacent streams. Considering the abundance of surface waterbodies in the County, in a variety of forms, from wetlands, to smaller headwaters and collector streams (all of which are considered fish-bearing under the *Code of Practice*), more stringent restrictions may be justified.

In light of the vegetation clearing restrictions that can be imposed on other land uses, it seems feasible to consider the presence of native vegetation in site-specific assessments of proposed CFOs, limiting clearing when and where possible. Specifically, consider policies that encourage retention of at least 50 m of native vegetation adjacent to surface water features to buffer new CFO developments. This is a wider buffer than that required in the *Agricultural Operation Practices Act* regulations, but one that would provide additional assurance of water quality protection. This, in addition to the surface water controls required under that act will reduce the risk of surface water runoff and take advantage of the water purification function provided naturally by the vegetation. In areas of both new and existing facilities where the 50 m vegetated buffer may not be intact, consider incentives to encourage the re-establishment of native shrubs and grasses to improve those same functions. The Beaverhills Initiative and its NGO partners may be able to help develop such incentive programs.

4.5.2.2 Suitability of Existing CFOs

Are there existing livestock operations within the Lakeland Policy Area that pose significant risk to environmental resources?

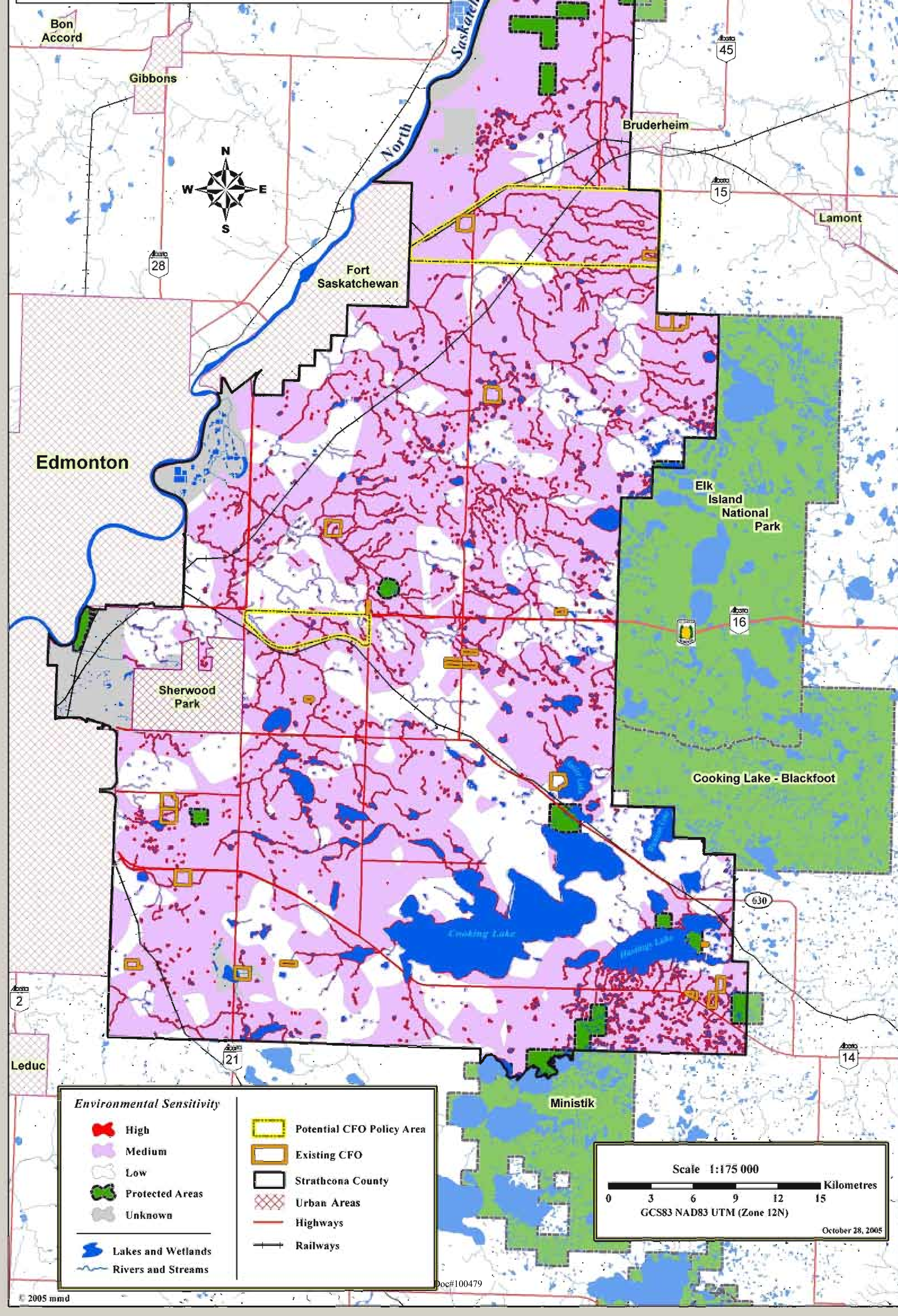
Many of the existing CFOs in the Lakeland Policy Area and, more generally, the entire County, are located in areas of medium sensitivity (Figure 10) and, more specifically, on groundwater recharge areas. Many of the existing CFO sites are, however, also characterized by either fine or medium-textured soils, reducing the risk for groundwater contamination. The greatest risk is posed by some existing CFOs that are located in close proximity to wetlands and creeks, and, in a few cases, where farming infrastructure is within the 50 m high sensitivity area surrounding these features.

Relocating facilities, although desirable, is not feasible, however, in cases of inappropriately located CFOs it may be most effective to implement incentives that would encourage the re-establishment of native shrubs and grasses adjacent to creeks and wetlands. This form of active management could improve the many ecological functions those areas provide, reducing the impacts of the CFO. The Beaverhills Initiative and its provincial and NGO partners may be able to assist in developing such incentive programs.

4.6 Top-of-Bank Analysis

The top-of-bank of the North Saskatchewan River Valley was estimated as the break of slope, where the terrain changed from steep valley slope to generally level ground (Figure 11). It was based on analysis of 5 m contour mapping (NRCAN and Parks Canada) and interpretation of aerial photography. The broad-based methods and large scale of our analysis will present a certain degree of error when the estimated TOB is considered at finer scales. Accurate and detailed mapping of the TOB will require additional field investigation. This is particularly true for areas where existing development appears to be near the TOB (e.g., northeast of Fort Saskatchewan).

Figure 10. Confined Feeding Operation Analysis



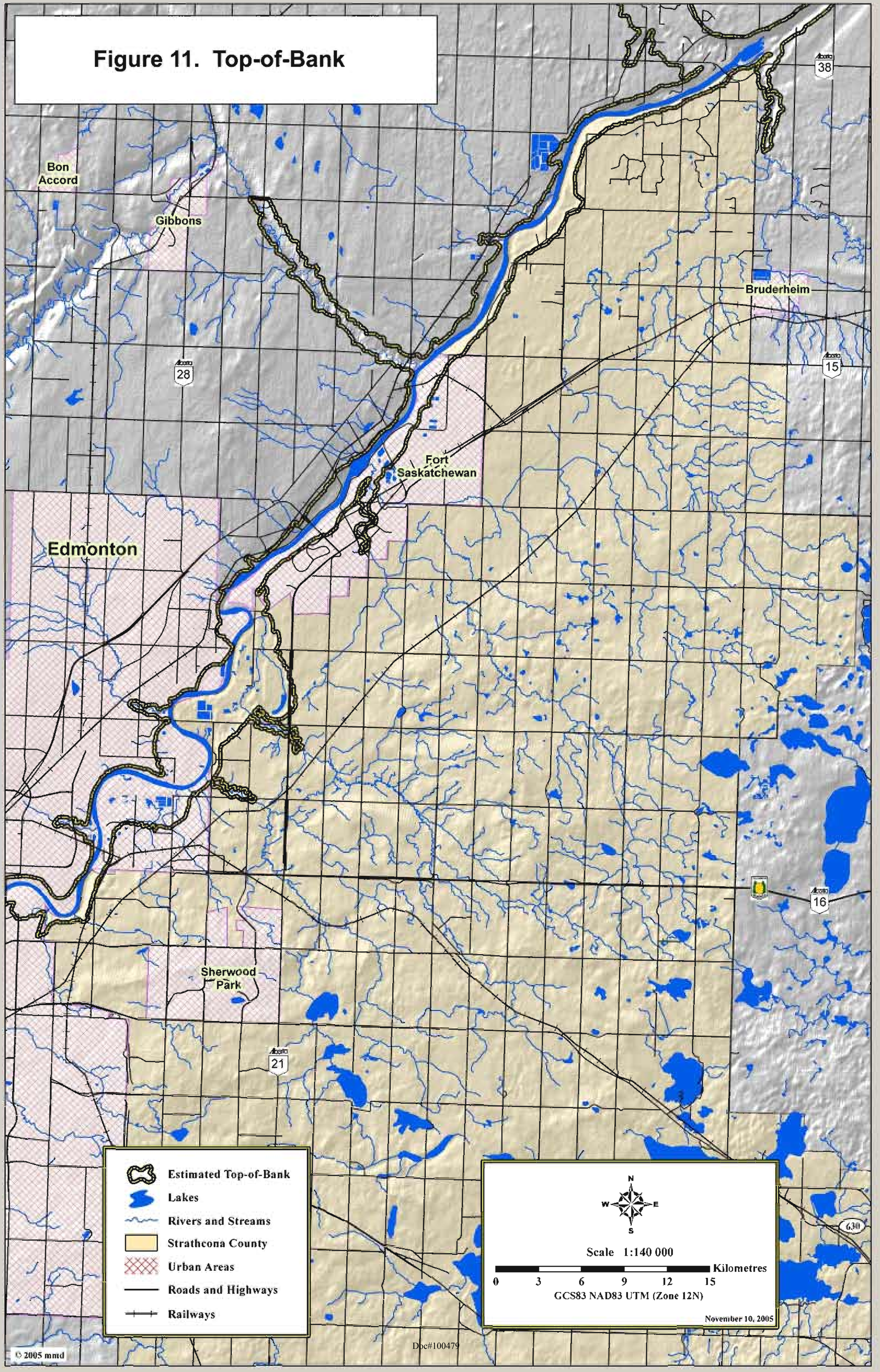


Figure 11. Top-of-Bank

5.0 CONCLUSIONS AND RECOMMENDATIONS

This report presents information pertaining to the environmental constraints and opportunities within the County as an initial stage in developing environmentally sustainable MDP policy areas and, more generally, an environmentally sensitive MDP.

The GIS mapping, modeling and analysis performed for the Landscape Management Areas and the Confined Feeding Operations (CFOs) maps highlight the level of risk to environmental sensitivities at a given site. High sensitivity does not preclude development: it highlights area in which land use decisions will require special, site-specific considerations. In some cases, a high rating may dictate that no further development should occur, but these instances are likely to be relatively rare. In all cases, future land use will need to consider the resources underlying the high sensitivity rating, and adapt to the associated limitations. In essence, the Landscape Management Area and CFO mapping systems allow land managers to design land use and land management strategies tailored to **land capabilities**, through a quick reference system of potential environmental sensitivity.

Accordingly, the results of these maps must be interpreted to understand the risk associated with the underlying natural features in the High, Moderate and Low Sensitivity areas. In most areas, it is the complex interaction between several natural features that drives a high sensitivity rating; not just a single feature. For example, coarse soils over a groundwater recharge or discharge area presents a risk of contamination to underlying aquifers that may not be compatible with some land uses (e.g., septic fields). Such features might not prevent residential subdivision in the area, but should dictate waste management strategies.

Both the Landscape Management Area and CFO models were additive, with the sensitivity ratings representing all natural resources present at a given location. Knowledge of both the natural resources that drive an area's sensitivity, and the interactions between them, will help identify site-specific development constraints that will sustain those resources in the face of development, or incompatible levels of development.

The Landscape Management Area mapping completed for this report clearly illustrates the unique environmental sensitivity of Strathcona County. Large areas of native vegetation, widespread groundwater recharge areas, abundant wetlands and headwaters, and low capability agricultural soils all contribute to that high sensitivity. Those abundant natural features have intrinsic value to the County, but also to the function of the regional ecosystem, outside the County's boundaries (e.g., the North Saskatchewan River Valley, Elk Island National Park). Considering this, the County has a responsibility to ensure that those values and ecological functions are sustained into the future by carefully considering both the location and nature of future development. We have provided in this report examples of potential management considerations that apply within certain parts of the County based on the Landscape Management Area mapping. The site specific assessments requested for the MDP review are summarized here, but they incorporate aspects of those more general comments on the Landscape Management Area map.

In many cases, best management recommendations included programs and incentives designed to raise the awareness of landowners and enlist their aid in correcting currently unsustainable situations. In other cases, cross-jurisdictional management is required to conserve existing protected lands (e.g., managing off-recreational use of the Natural Areas and industrial development of the surrounding lands in the Northeast Heavy Industrial Policy Area). The Beaverhills Initiative, with its membership of municipal, provincial and federal agencies and NGO partners could assist in developing such programs or facilitating management discussions among government representatives.

Investigation of site-specific concerns began with explicitly stating several objectives on a site-by-site basis. The results of those assessments included various conclusions and the identification of several recommendations. The originally stated objectives of those assessments (Section 1.3.2), are revisited below, with the resulting conclusions and recommendations.

- **What are the key natural values of the North Bruderheim (Sandhills) Natural Area? Is it sustainable in the current and potential future developed context? What is required to effectively conserve the site in light of its current context?**

  The provincially-designated North Bruderheim (Sandhills) Natural Area protects a unique vegetation community within the County, consisting primarily of jack pine-dominated mixedwood forest. It also forms part of a large and relatively continuous belt of native vegetation that functions as an important regional ecological linkage. The Natural Area does, however, receive extensive use from ATVs, which has adversely impacted the vegetation and soils, and also likely has alienated some local wildlife from the available habitat. The long term sustainability of this unique resource will be dependent on the ability of the Province, perhaps with assistance from the County, to better manage recreational use of the Natural Area. Discussions with Alberta Community Development's Protected Areas group, facilitated through the Beaverhills Initiative, may be the most effective starting point for management of this area.

- **Should the North Bruderheim (Sandhills) Natural Area and the North Saskatchewan River Valley continue to be combined under the same MDP policy area? Do their respective natural values require different management approaches?**

  The North Bruderheim (Sandhills) Natural Area and the nearby North Saskatchewan River Valley have very different natural features and support different land uses. As a result, the two areas require specific land management tailored to their circumstances. This would be best achieved if the two areas were separately designated as protected conservation areas, with specific policy requirements outlined in the MDP.

- **How valuable and sustainable are the remnant natural areas in the Northeast Heavy Industrial Policy Area, within the current developed context? Should they continue to be retained and protected under some form of conservation policy? Is there potential and value in improving their condition through restoration?**

  Within the Northeast Heavy Industrial Policy Area, both the significant natural features and the existing heavy industrial development are currently clustered in the north and southwest parts of the policy area, respectively. The large forested area in the north has already been protected, in part, within two provincial natural areas, however, the value and unique nature of this area merits further attention. Consider means of retaining lands to maintain a connection between the existing protected Natural Area's with each other, the North Bruderheim (Sandhills) Natural Area and the North Saskatchewan River Valley. That, in combination with promoting development of heavy industrial sites in already disturbed areas, before expansion into more natural areas, would help to concentrate industry and limit sprawl, and ultimately, help to sustain the natural values of the area.

- **Are there natural features in the Southwest Agricultural Policy Area that are sensitive to development? Is there potential and value in restoring natural features in this area to enhance ecological function and sustainability of other, intact natural features?**

  Despite the extensive agricultural development in this policy area, there are several natural features within it that are sensitive to development; most notably the remnant woodlands and surface water features. The key to sustaining these features is to limit further clearing and fragmentation of the remnant woodlands. This is particularly true in riparian areas, where those naturally-vegetated buffers will help protect water quality, as well as provide riparian habitat.

- **The Lakeland Policy Area, on the southeast side of the County, was previously identified as an area that required special management because of the extensive woodlands, large lakes and small wetlands concentrated in this area. Does the Landscape Management Area mapping system support this need? Does the current Lakeland Policy Area protect the key areas of high sensitivity?**

  The Landscape Management Area mapping clearly shows that the east, and particularly the southeast, part of the County is highly sensitive. That sensitivity is driven by several features: abundant surface water bodies (wetlands and lakes), groundwater recharge areas, native forests, rare species (indicating high potential biodiversity) and the associated ecological functions (water quality and quantity, connectivity). The existing Lakeland Policy Area incorporates many of the natural features that drive that sensitivity. However, as it is currently delineated, the policy area excludes two sensitive areas that merit special management: the lands bordering Elk Island National Park and the lands southwest of Cooking Lake. Those two areas are, however, included in the proposed Beaverhills Moraine Policy Area. Assuming that the land use policies outlined for this new policy area provide management guidelines for the natural features driving the high sensitivity of these areas, inclusion in this new policy area will ensure that they receive the special management they require.

- **Where in the County might environmental conditions be more suitable for development of CFOs, based on surface and groundwater conditions and soil textures? Are there existing CFOs within the Lakeland Policy Area that pose significant risk to environmental resources?**

  Based on surface water, groundwater and soil texture conditions, many of the existing CFOs, as well as the proposed CFO policy areas, are located on lands that have some level of risk of contamination and, are thus, incompatible with CFO development. In fact, much of the County has high to moderate risk spread throughout; there are no large areas free of any sensitivity. This is due in part to the broad areas of groundwater recharge but also the diffuse network of headwaters along the edge of the Beaverhills/Cooking Lake moraine. A more appropriate approach under these circumstances would be to distribute proposed CFOs across the County, targeting the small pockets of low sensitivity. Such fine scale planning could allow for consideration of other sensitivities and, ultimately, the best placement of CFOs.

The current MDP includes several policy statements concerning conservation and sustainable management of the environment. By incorporating the management recommendations outlined in this report, and more broadly, ensuring that the capability and the abundance of the natural resources found in the County are addressed in site-specific development, the updated MDP will promote sustainable and long-term land use in the County.

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APPENDIX A. Beaverhills Initiative GIS Datasets

Table A1. Datasets Used in MDP Analyses

Datasets - Original File Names	Explanation
Base Data	
ab_muni_02.shp	County boundaries
mdp_utm.shp	Strathcona MDP policy areas
Beaver_Hills_Towns_Clip.shp	Towns
Built_up_Areas_Clip	Cities
bhi_properties.shp	Property boundaries
Railways_polyline_Clip.shp	Railways
Study1_collector	Roads
Study1_major_highways.shp	Highways
Groundwater	
Transition_Select.shp	Groundwater transition zones
Recharge_Select.shp	Groundwater recharge zones
Discharge_Select.shp	Groundwater discharge zones
Hydrology	
WC_River_major_area_reproj.shp	North Saskatchewan River
Waterbodies_New	Lakes
WC_major	Major streams/creeks
WC_manmade_channels.shp	Manmade/channeled watercourses
WC_minor	Minor streams/creeks
WB_manmade.shp	Manmade waterbodies
islands.shp	Islands
reservoir.shp	Reservoirs
Wetlands	
wetlands.shp	Wetlands
Native Vegetation	
natural_veg.shp	Native vegetation
Protected Areas	
ESA_Park_Protected.shp	Protected areas (all jurisdictions)
Rare Species	
species_risk_clip.shp	Alberta Sustainable Resource Development, Fish and Wildlife Management Information System (FWMIS) species at risk records
BHI_Query_Results.shp	Alberta Natural Heritage Information Center (ANHIC) species at risk records
Soils	
agrisoils_Clip.shp	Soils (including CLI Class)
Aerial photo mosaic	
2003_Strathcona.sid	Air photo base image

APPENDIX B. RIPARIAN BUFFER DISTANCES

Riparian Buffer Distances

Riparian buffers perform a variety of ecological functions. Among the many accepted functions, some of the most commonly recognized include improving water quality, providing wildlife habitat and allowing for wildlife movement. Some functions require wide buffers, while others require relatively narrow buffers. Regardless, there is no universally accepted buffer width recommended for any given function. Instead, recommended buffer widths typically vary between references and agencies. Most of the research agrees that wider buffers are more effective in performing ecological functions. Accordingly, when determining an effective buffer width, it is generally wise to provide the widest buffer possible.

To develop the Landscape Management Areas and Confined Feeding Operation models used in this assessment, we required buffer widths suitable for the intended management goals. For the Land Management Areas analysis, water quality protection, wildlife habitat and wildlife movement were the key management factors. Ideally, a policy would protect sufficient land to provide all three functions. For the Confined Feeding Operation analysis, water quality was the chief concern. Accordingly, a smaller buffer would be appropriate.

We reviewed a variety of references to identify the range of buffer widths recommended for these different ecological functions (Table 1). Based on these data, and the principle that a wider buffer would provide maximum protection, we selected appropriate buffer widths for each model, according to the ecological function of interest. To a certain extent, our decisions were based on the minimum mapable unit – generally speaking, buffers less than 50 m were not distinguishable at the map scales used for this assessment. Accordingly, a 50 m buffer was the minimum unit feasible for these analyses.

Much of the research on wildlife corridors has focused on wilderness areas (e.g., the Bow Valley system in Banff National Park). As a result, the buffer widths recommended by those studies is much wider than would be feasible in a rural environment. We selected a buffer of 200 m for the Landscape Management Area analysis, which represented a compromise between sufficient wildlife habitat and a minimum width for wildlife connectivity. For the Confined Feeding Operation analysis, we selected 50 m as a water quality function buffer, which recognized the 30 to 36 m buffer recommended by most authors, and acknowledged our mapping limitations.

Table 1. Comparison of Recommended Riparian Buffer Widths to Achieve Different Ecological Functions

Ecological Function	**Buffer Width***	**Description**	**Reference**
Water Quality	30 m	Protect water quality in wetlands by filtering sediment, contaminants, nutrients and pesticides	Fischer et al 2000, Connecticut River Joint Commissions 2000
	36 m	Reduces the concentration of nutrients and microorganisms to acceptable levels in feed lot runoff from summer storms	Young et al 1980
Wildlife Habitat	100 m	Accommodate resident populations of all three locally common amphibian species	Spencer Environmental 2004
	100 m	Provide for increased avian diversity in natural vegetation surrounding wetlands	Fischer et al 2001
	100 m	Provides habitat for wetland and riparian species	Fischer and Fischenich 2000, Alberta Sustainable Resource Development 2001
	10-200 m	Provide habitat for all life stages of wildlife dependent on wetlands or watercourses	Connecticut River Joint Commissions 2000
Wildlife Connectivity	600 m	Minimum corridor width for white-tailed deer	Nelson and Mech 1987 *in* Meffe and Carroll1994
	1000 m+	Corridors several kilometers in width may be necessary for use by large mammal species	Paquet et al 1994

* buffer widths listed are *minimums*; it is widely accepted that wider buffers are more effective

APPENIDX C. NATURAL RESOURCE MAPS

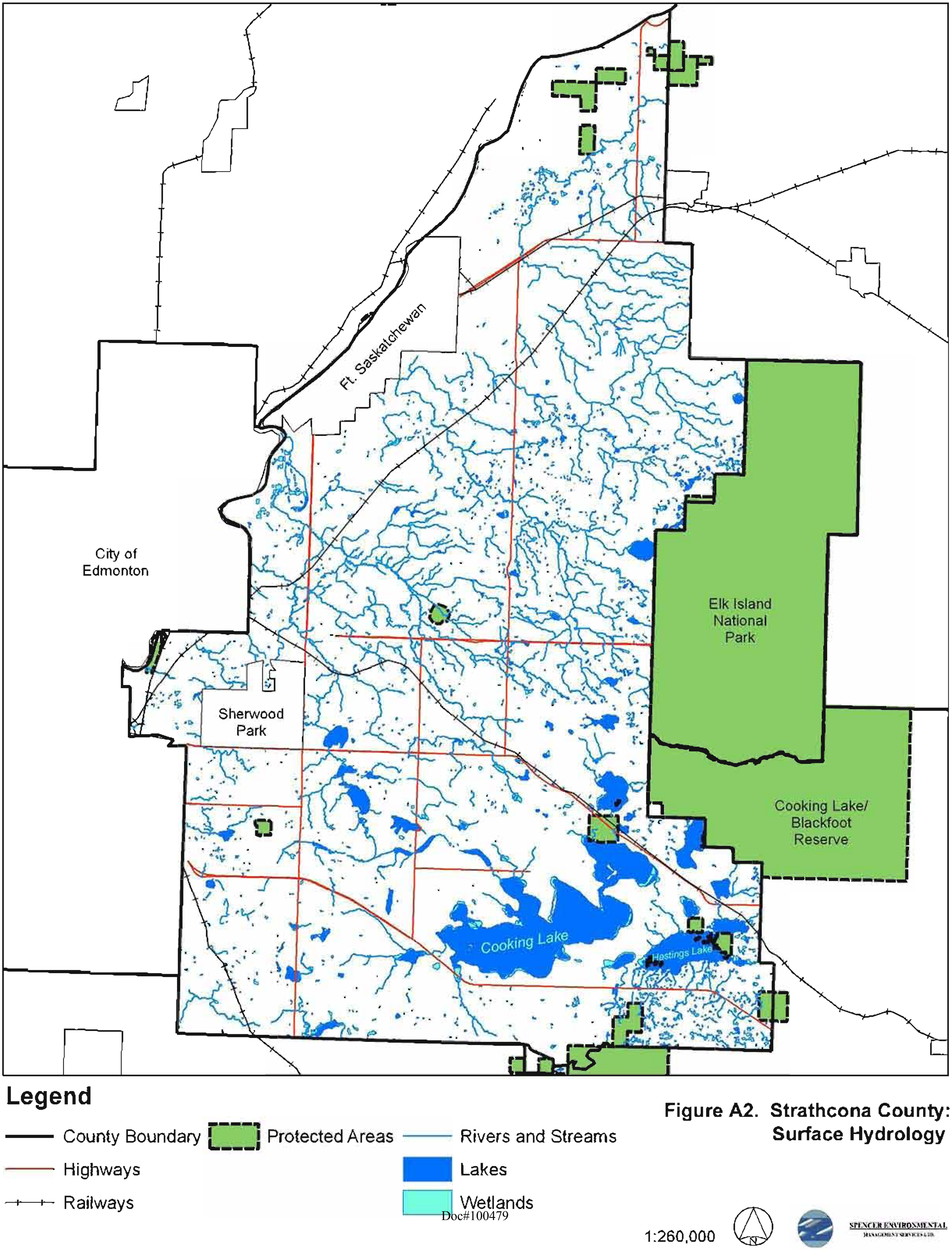


Figure A2. Strathcona County: Surface Hydrology

Doc#100479

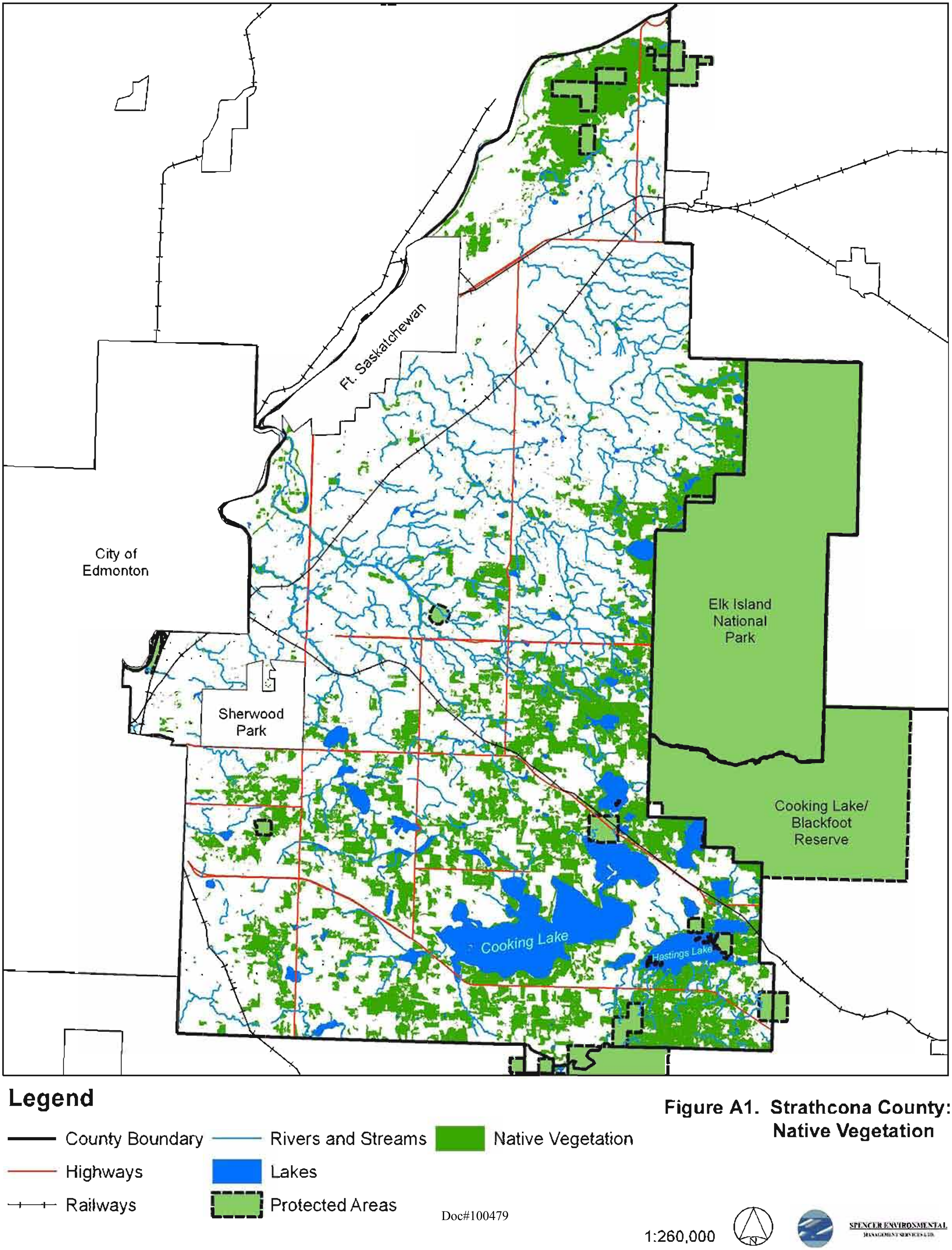
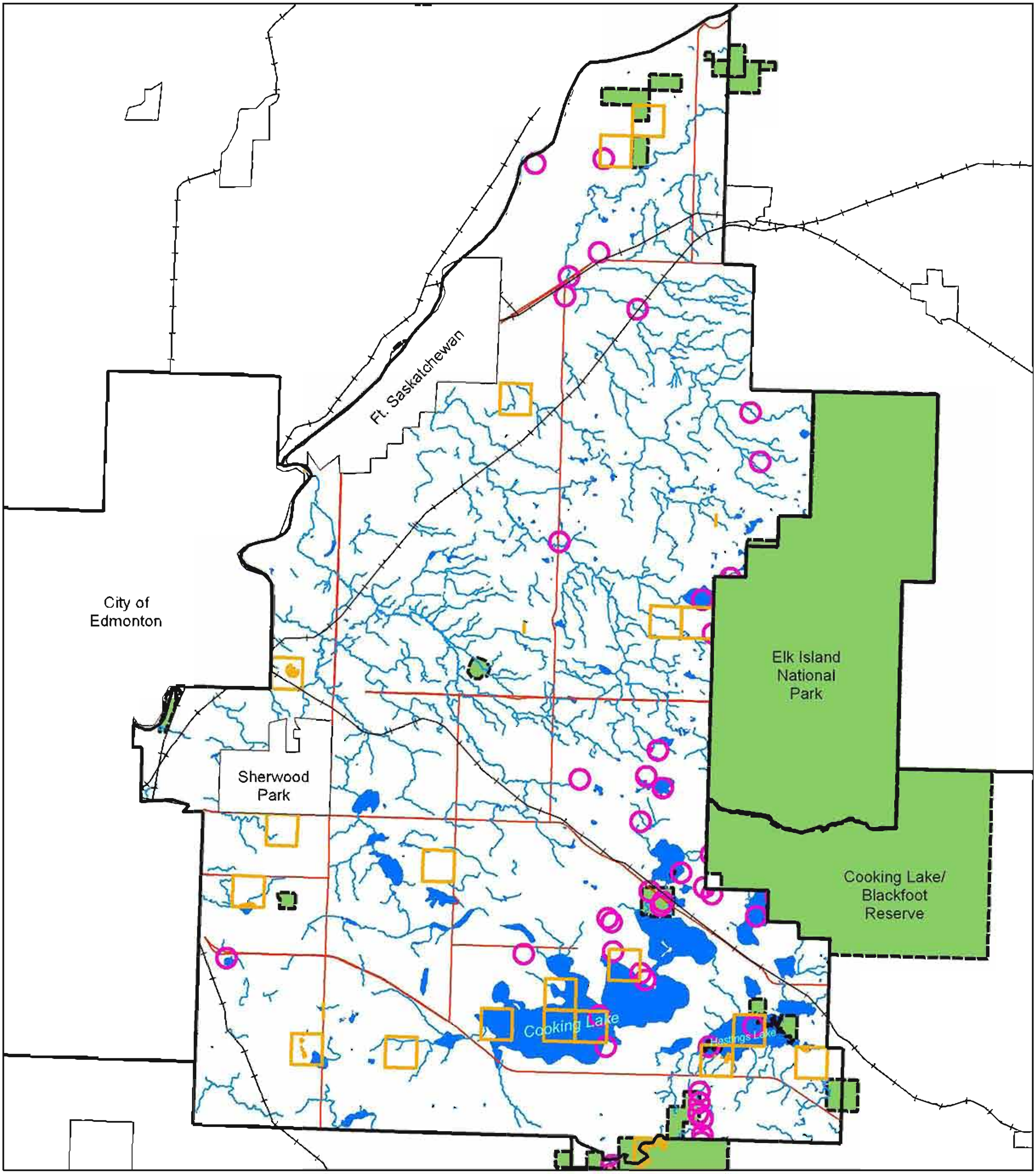


Figure A1. Strathcona County: Native Vegetation

Doc#100479



Legend

- County Boundary
- Highways
- Railways
- Rivers and Streams
- Protected Areas
- Lakes
- Alberta Natural Heritage Information Centre Species At Risk
- Fish and Wildlife Management Information System Species at Risk

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Figure A3. Strathcona County: Species at Risk

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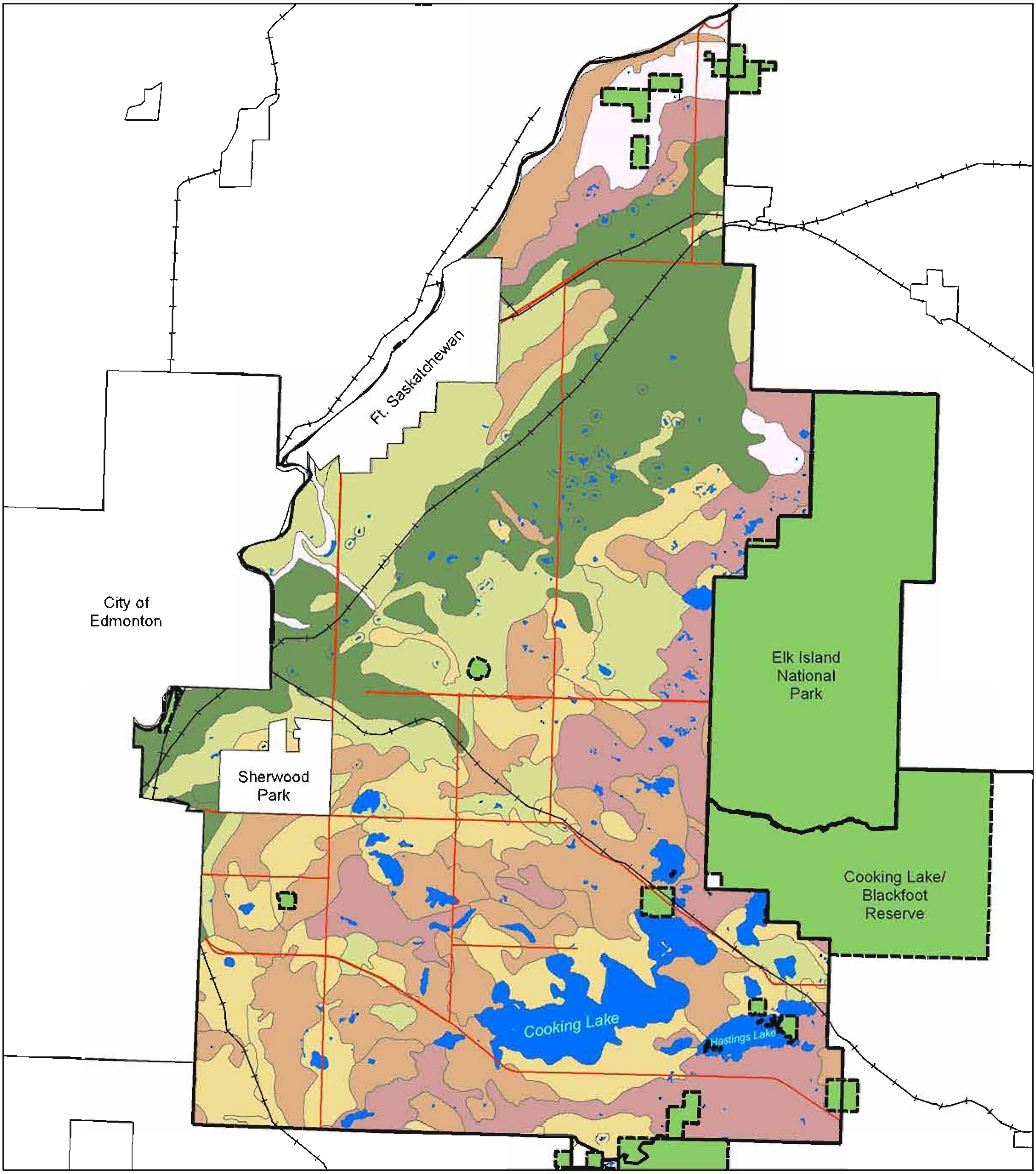


Legend

County Boundary
Highways
Railways
Lakes
Protected Areas
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6

Figure A4. Strathcona County: Canada Land Inventory Agricultural Soil Capacity Rating

1:260,000

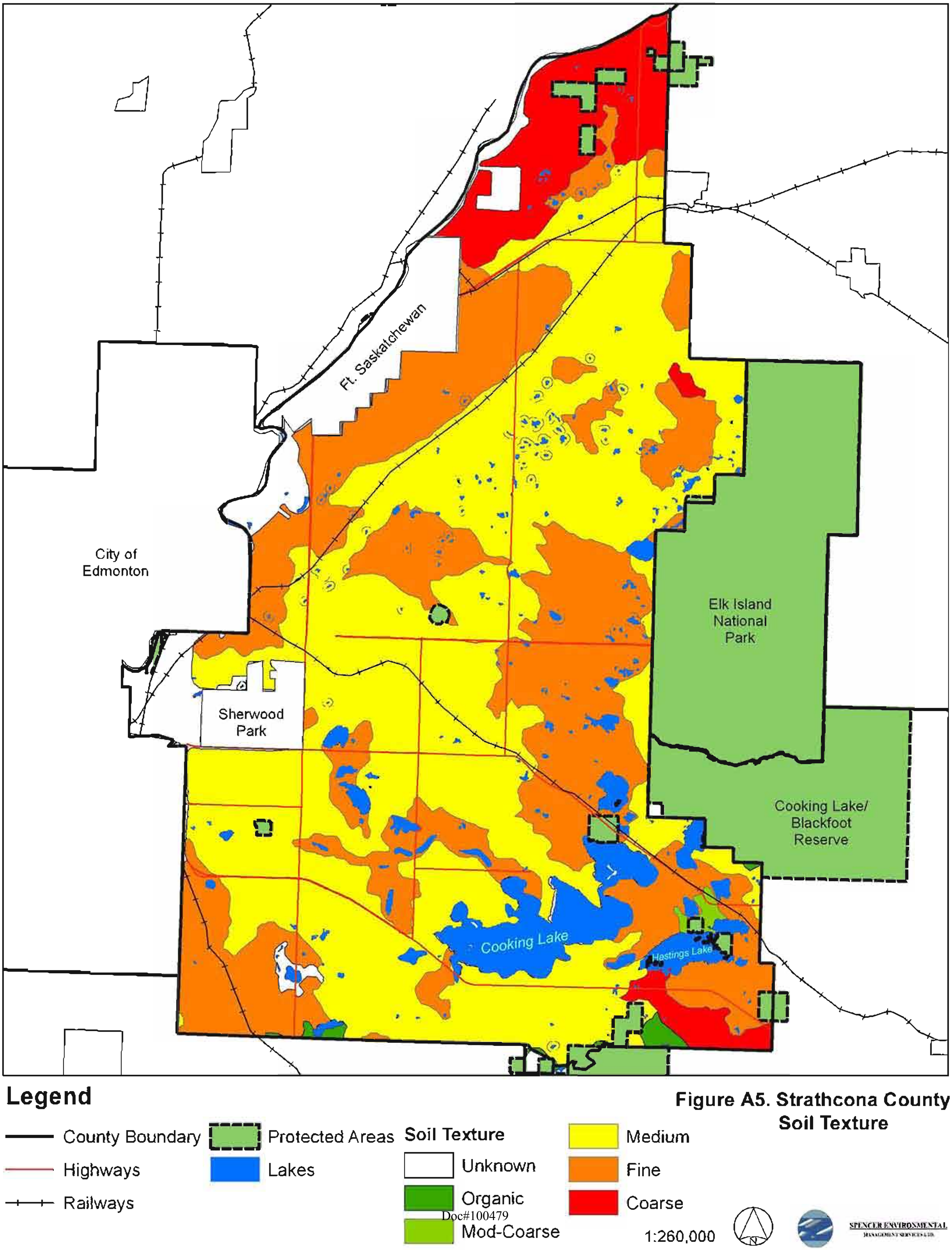
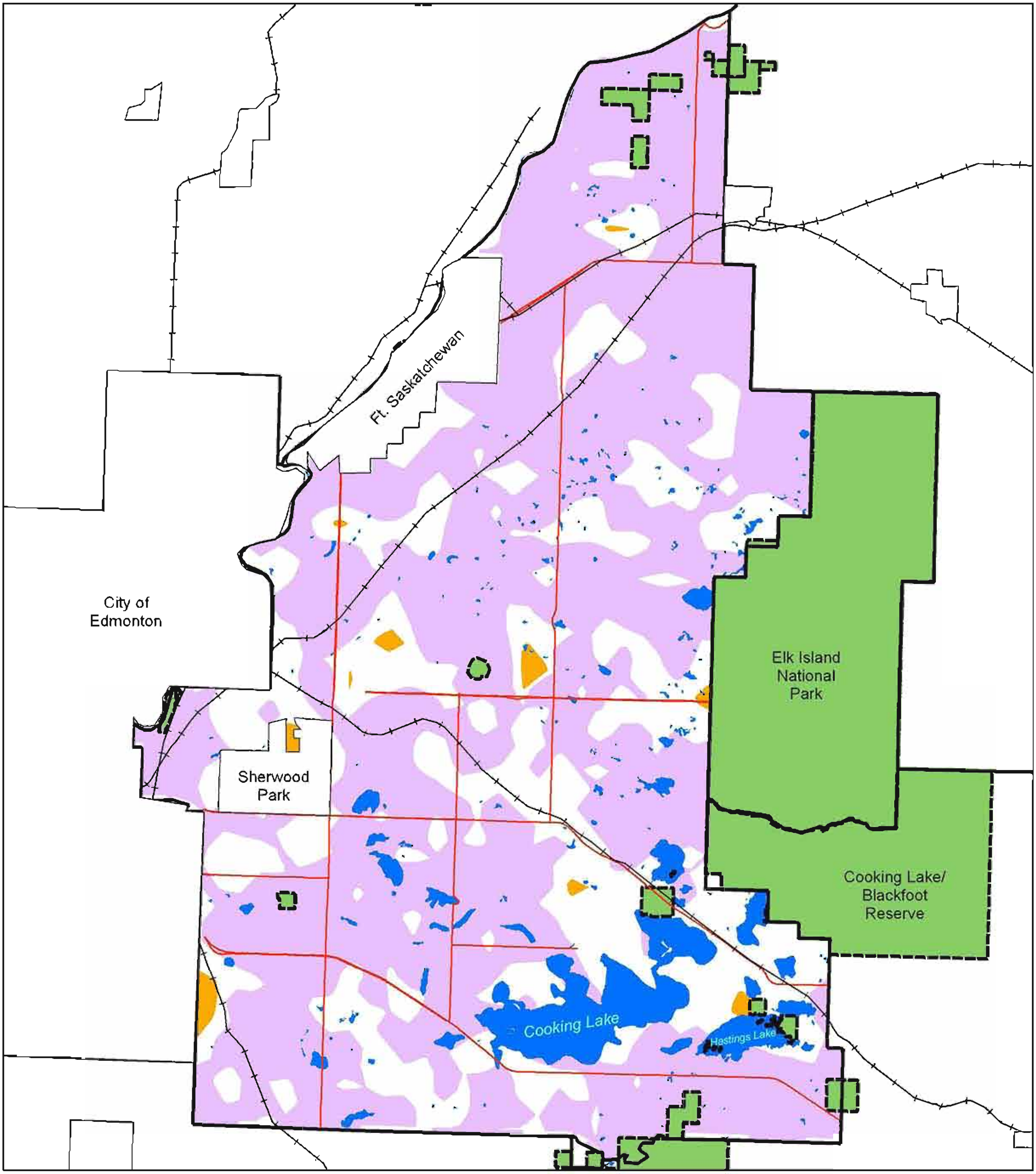


Figure A5. Strathcona County: Soil Texture



Legend

- County Boundary
- Highways
- Railways
- Lakes
- Protected Areas
- GW Recharge Area
- GW Discharge Area

Figure A6. Strathcona County: Groundwater Recharge and Discharge Areas

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