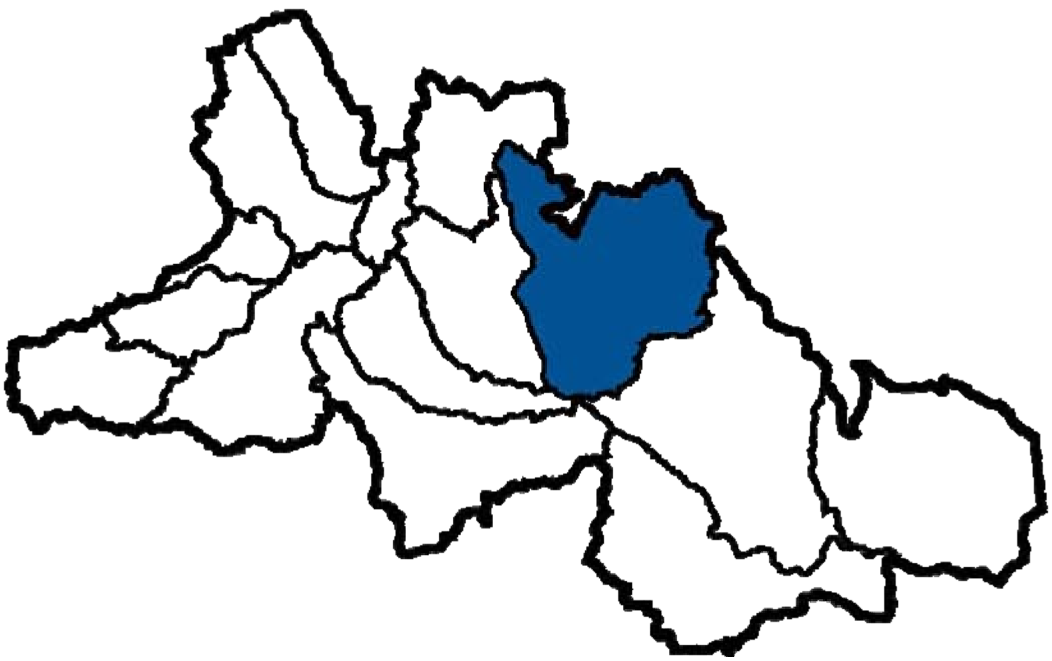
Michichi Subwatershed



Red Deer River Watershed Alliance

State of the Watershed

4.12 Michichi Creek Subwatershed

4.11.1 Watershed Characteristics

The Michichi Creek subwatershed encompasses about 620,440 ha and is located in the Counties of Lacombe, Paintearth No. 18, Starland, Stettler No. 6 and Special Area No. 2 (Figure 296).

The Michichi Creek subwatershed is located in the north-central region of the Red Deer River watershed and lies in the Central Parkland, Northern Fescue and Dry Mixedgrass Subregions (Figure 297). The Central Parkland Subregion is dominated by grassland with groves of aspen (*Populus* spp.), with the grassland vegetation being dominated by rough fescue (*F. campestris*). The Northern Fescue Subregion is dominated by rough fescue (*F. campestris*). A small pocket of the Dry Mixedgrass Subregion is located south of Dowling Lake. This subregion is dominated by spear grass (*Piptochaetium* spp.) and blue grama (*Bouteloua gracilis* (Willd. *ex* Kunth) Lag. *ex* Griffiths), with western wheat grass (*P. smithii*) and northern wheat grass (*E. lanceolatus*) also being important in hummocky moraine areas (Heritage Community Foundation, 2008).

The geology of the Michichi Creek subwatershed is dominated by the Horseshoe Canyon Formation in addition to localized deposits belonging to the Scollard and Paskapoo Formations. These formations formed in the Paleocene epoch (56-65 million years ago) and in the Upper Cretaceous period (65-100 million years ago). The oldest and most prominent formation, Horseshoe Canyon Formation (Upper Cretaceous), consists of sandstones, mudstones, shales, ironstone, bentonite and minor limestone deposits, while the Scollard Formation (Paleocene and Upper Cretaceous) consists of sandstone, mudstone and thick coal deposits. The youngest of the formations from the Paleocene, Paskapoo, consists of diverse sandstones and siltstone/mudstones and minor shale deposits (Alberta Geological Survey, 2006).

The climate of the Michichi Creek subwatershed is continental, with mean annual temperatures ranging from 2-5 °C and mean May-September temperatures ranging from 11-15 °C. The mean annual precipitation ranges from 350-500 mm, with the May-September precipitation averaging 280-300 mm (Environment Canada, 2006). There are about 90 frost-free days per annum.

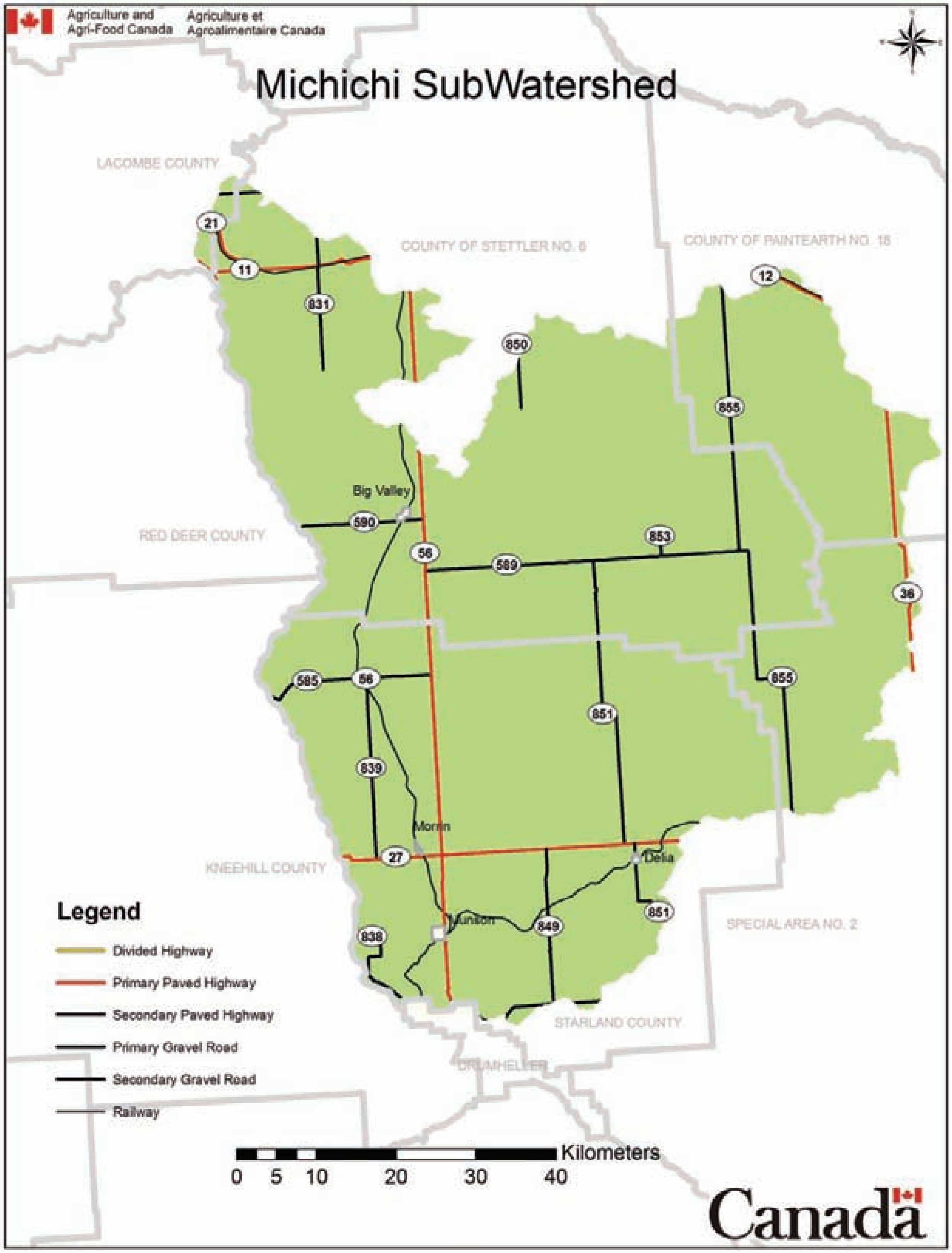


Figure 296. Location of the Michichi Creek subwatershed (AAFC-PFRA, 2008).

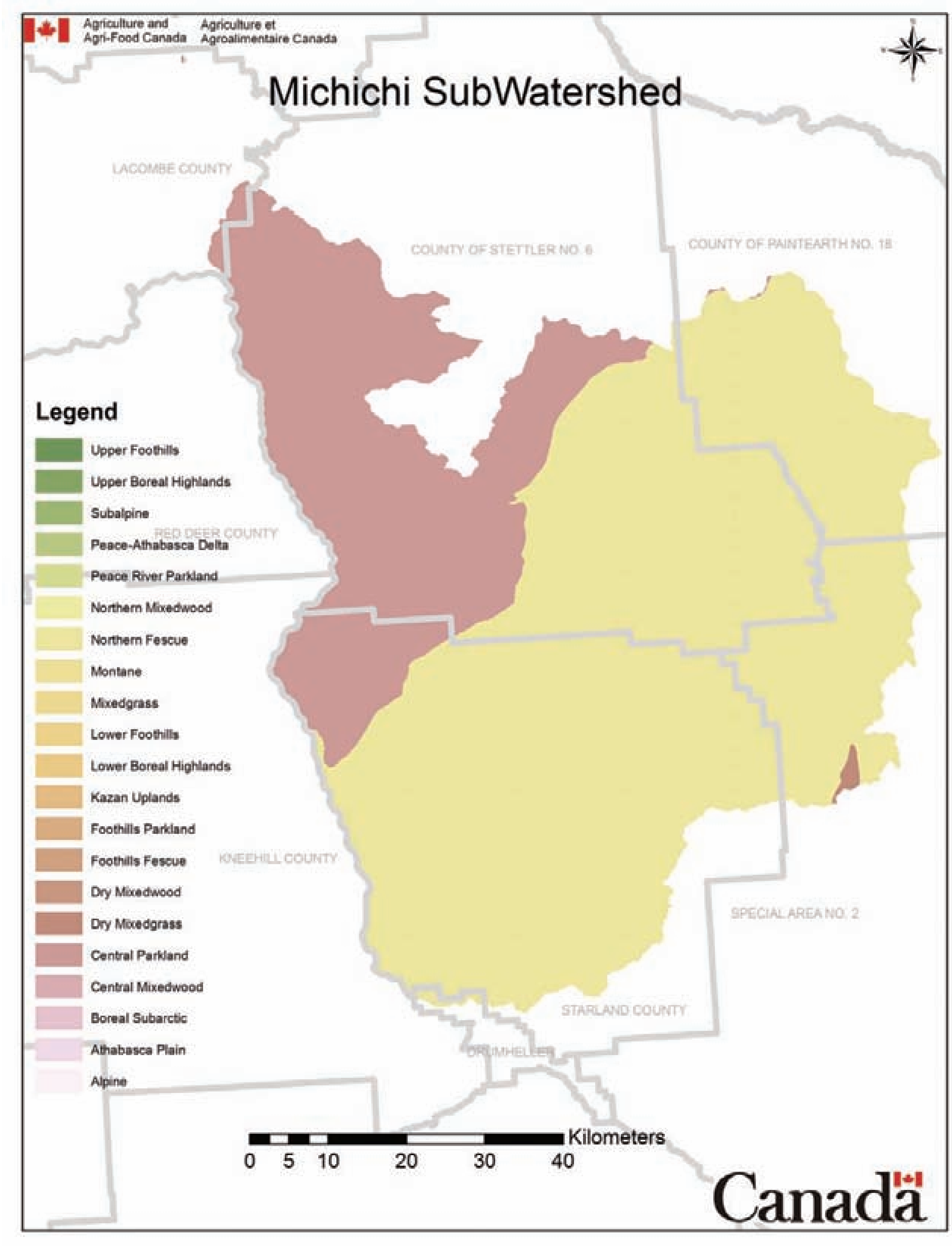


Figure 297. Natural subregions of the Michichi Creek subwatershed (AAFC-PFRA, 2008).

4.11.2 Land Use Indicators

Changes in land use patterns reflect major development trends, such as forested lands converted to agriculture and agricultural lands developed and lost to urban sprawl. Land use changes and the subsequent changes in management practices impact both the quantity and quality of water within the Red Deer River watershed. Six metrics were used to indicate changes in land use and land use practices in the Red Deer River watershed and its 15 subwatersheds:

- Wetland Loss – Condition Indicator
- Riparian Health – Condition Indicator
- Livestock Manure Production – Risk Indicator
- Urban, Rural and Recreational Developments – Risk Indicator
- Linear Developments – Condition Indicator
- Oil and Gas Activities – Risk Indicator

These six land use change indicators also reflect socioeconomic growth in a region. Hence, while human activities in a region can have negative environmental impacts, it is important to strive for a balance between socioeconomic growth and the sustainable management of natural ecosystems to ensure their long-term health and enjoyment by future generations.

4.11.2.1 Wetland Loss

Wetlands serve many functions in the natural landscape including water storage, flood attenuation, wildlife habitat, groundwater recharge and general water quality improvements (e.g., nutrient uptake, degradation of pesticides, sediment retention). Additionally, wetlands provide a cost effective and sustainable alternative to engineered treatment options. The loss of wetlands to development and/or agriculture can be deleterious to surface and groundwater r quantity and quality.

Land cover data indicate the presence of 34,334 ha of wetlands (5.53% of the total subwatershed area) in the Michichi Creek subwatershed (AAFC-PFRA, 2008); however, there are no data on the classes, forms and types of wetlands (*sensu* National Wetlands Working Group, 1997) within the subwatershed. Given the presence of lentic (lakes) and lotic (streams and rivers) systems, marshes and shallow open water wetlands and ephemeral, temporary, seasonal and semi-permanent wetlands (*sensu* Stewart and Kantrud, 1971) are likely present in the subwatershed as well.

The Sullivan Lake landscape has been classified by Ducks Unlimited Canada (DUC) as a critical landscape and in need of immediate action to conserve, restore and enhance its highly productive waterfowl habitat. The objectives for this landscape will include the conservation and restoration of over 1,400 wetland basins and about 7,285 ha of upland habitat. Where possible, wetland basins will be restored to their original state and protected alongside those wetlands that are still intact using landowner agreements and conservation easements. Uplands will also be restored or converted by encouraging landowners to adopt wildlife friendly agricultural practices and by planting high yield fall-seeded crops such as winter wheat that do not disturb spring waterfowl nesting (DUC, 2008).

The Prairie Habitat Joint Venture program (a partnership between federal and provincial governments, organizations and conservation groups in Manitoba, Saskatchewan and Alberta) has assessed the loss of wetlands in the Parkland Natural Region (Central Parkland Subregion) and the Grassland Natural Region (in the Northern Fescue Subregion) from 1985-2001 (Watmough and Schmoll, 2007). In Alberta, the Parkland Natural Region has lost 7% of its total wetland area and 8% of its total number of wetlands due to anthropogenic disturbances in that 16-year period. Comparatively, there have been losses of 1% in total wetland area and 5% in total number of wetlands in the Grassland Natural Region. There appears to be no change in the rate of wetland loss in the Prairie Parkland Region over the past 50-70 years. Caution must be taken when extrapolating these data to the entire subwatershed, since the Prairie Habitat Joint Venture program has assessed wetland losses along only two transects in this subwatershed, both in the Grassland Natural Region (Watmough and Schmoll, 2007).

4.11.2.2 Riparian Health

Riparian areas are an important transition zone between uplands and water. They act as buffer zones, protecting water quality and attenuating floods. Contaminants are adsorbed onto sediments, assimilated by vegetation and transformed by soil microbes into less harmful forms. They have long been proven effective in reducing nutrients, sediments and other anthropogenic pollutants that enter surface waters via overland and subsurface flow.

Riparian health has not been assessed in the Michichi Creek subwatershed.

4.11.2.3 Livestock Manure Production

Areas of higher livestock density within a subwatershed, and their associated higher manure production, are expected to have greater impacts on downstream water quality. Streams that drain land with high intensity livestock operations have higher nutrient concentrations, dissolved nutrients, mass loads, fecal bacteria and exports of total dissolved phosphorus than streams with medium or low intensity livestock operations and manure production.

There are 27 feedlots/intensive livestock operations in the Michichi Creek subwatershed, concentrated mostly in the north-western area of the subwatershed. The feedlots finish primarily poultry, cattle/cows and swine, but there are also turkey finishing feedlots and beef feeding operations (Figure 298) (AAFC-PFRA, 2008).

Cattle density is lowest in the south-central area of the subwatershed (0-0.20 cattle/ha) and increases towards the northern area of the subwatershed (0.21-0.40 cattle/ha) (Figure 299) (AAFC-PFRA, 2008). Manure production is < 2.5 tonnes manure/ha throughout the entire subwatershed (Figure 300) (AAFC-PFRA, 2008), which is considered low relative to the remainder of the Red Deer River watershed.

Agricultural intensity, expressed as the percent land cover used as croplands, shows a complex gradient of increasing intensity from the northern to the southern areas of the Michichi Creek subwatershed. Agricultural intensity is lowest in the Sullivan Lake area (0-20%) and increases to 20-40% in the north-western and north-eastern areas. It is highest in the southern area of the subwatershed, where the intensity ranges from 60-80% (Figure 301) (AAFC-PFRA, 2008).

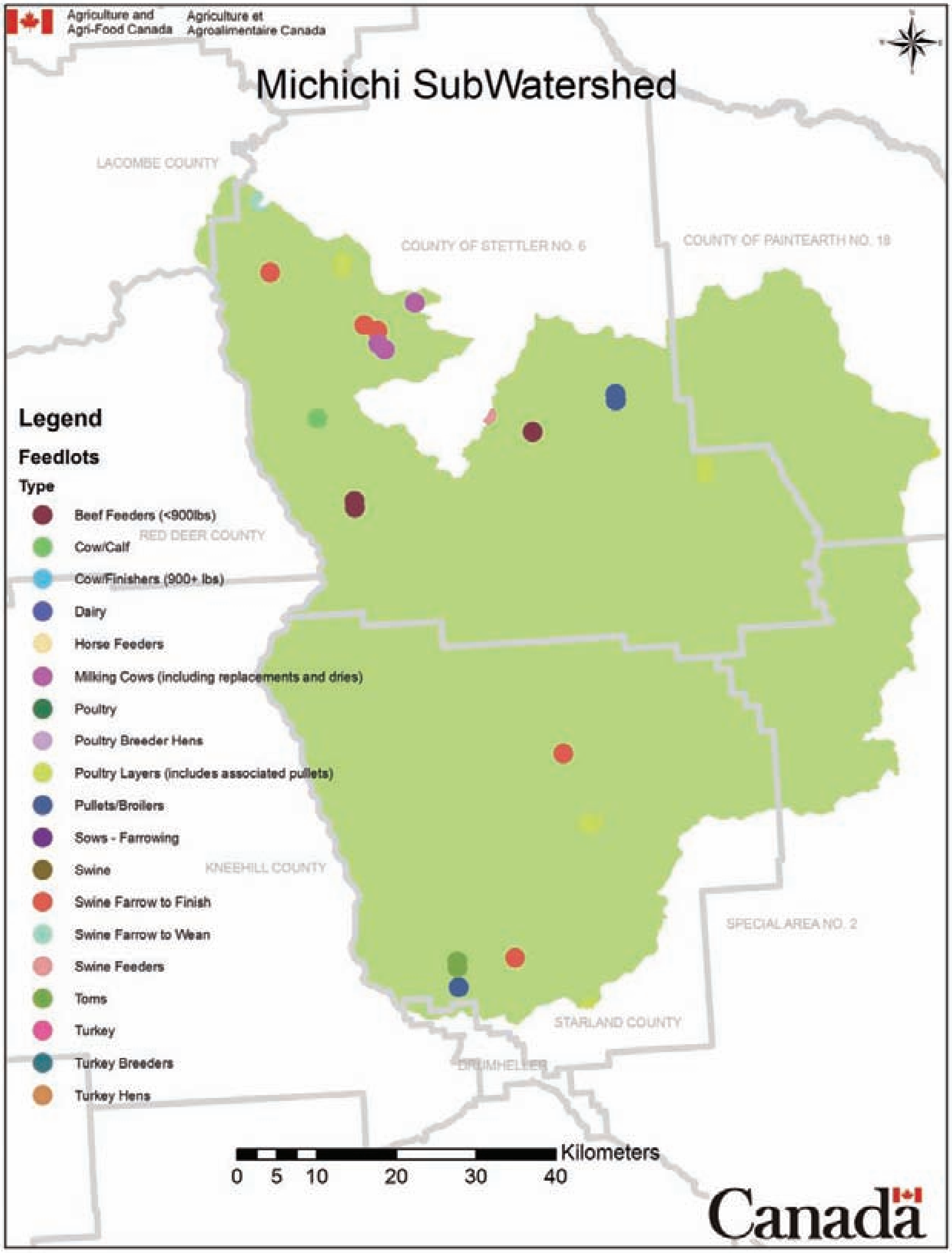


Figure 298. Feedlots and intensive livestock operations in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

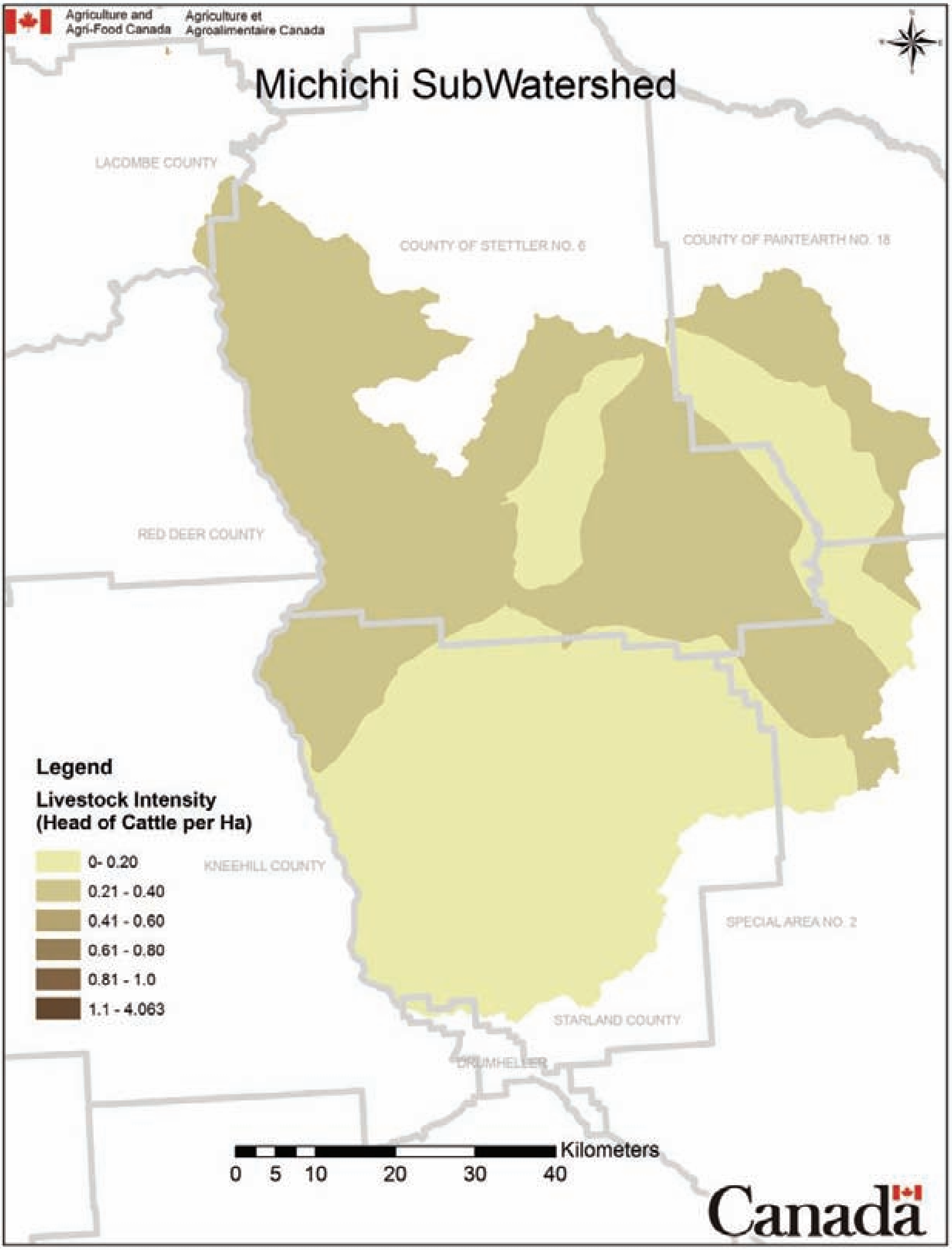


Figure 299. Cattle density (cattle/ha) in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

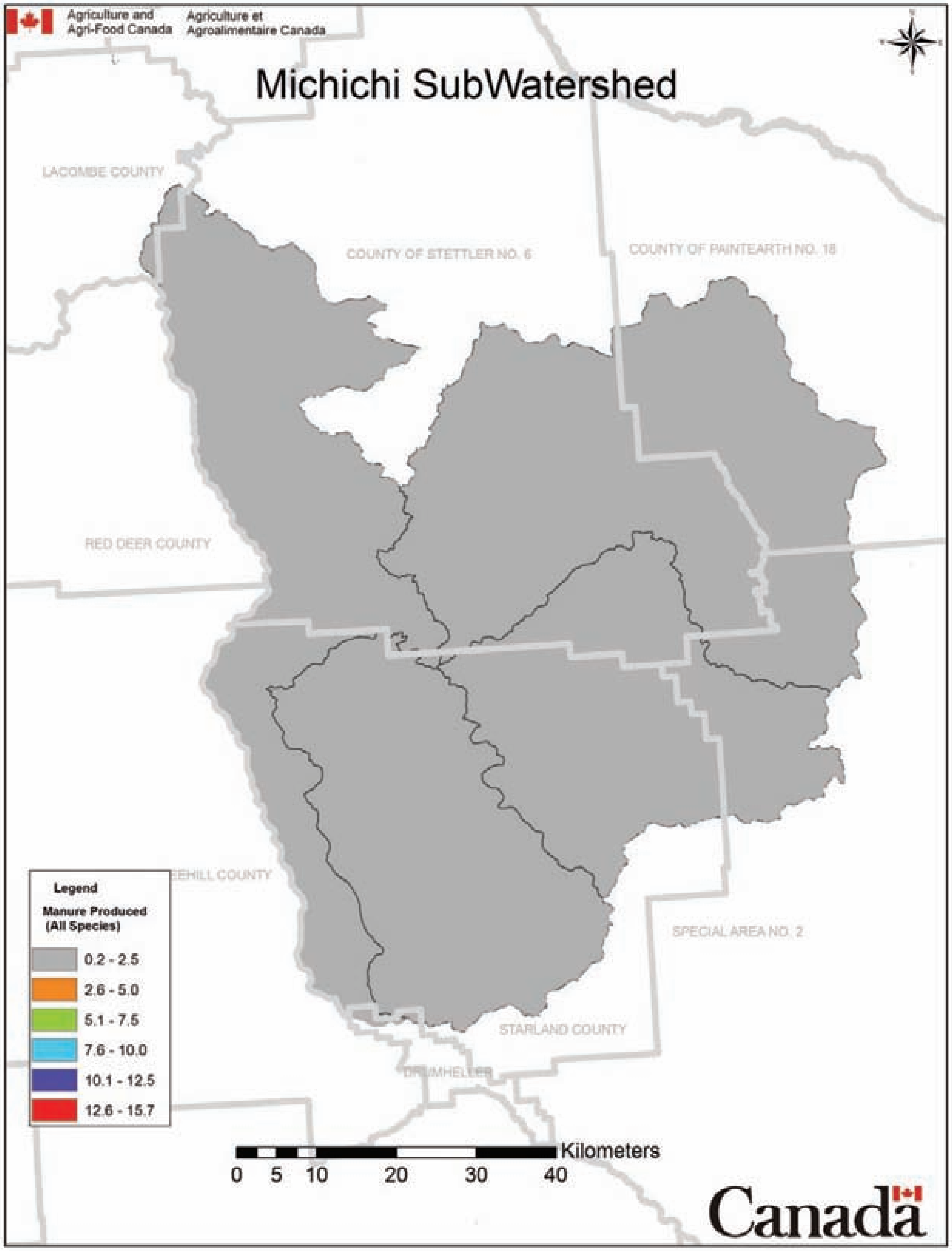


Figure 300. Manure production (tonnes/ha) in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

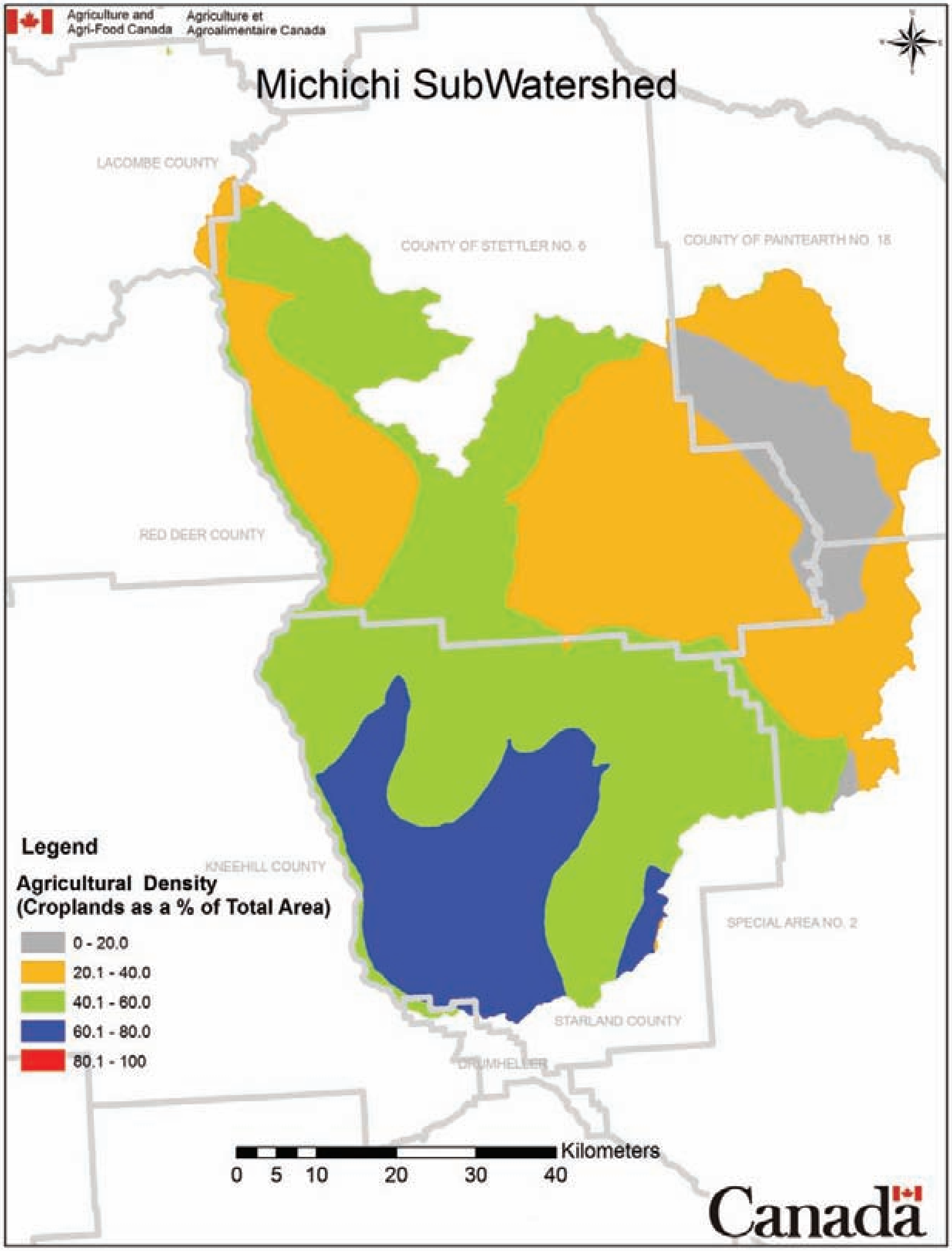


Figure 301. Agricultural intensity (% cropland) in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

4.11.2.4 Urban, Rural, Agricultural and Recreational Developments

Urban sprawl, rural and recreational development is the expansion of urban areas, rural subdivisions and recreational areas into surrounding landscape. This expansion can have many negative effects on the environment, including the loss of wetlands, riparian areas, intermittent streams and wildlife habitat, as well as increased surface runoff into neighboring creeks, rivers and lakes.

Communities in the Michichi Creek subwatershed include the Villages of Big Valley, Delia, Morrin and Munson in addition to numerous hamlets, including Byemoor, Comet, Endiang, Dinosaur, Dowling, Erskine, Fenn, Garden Plain, Garthy, Hackett, Hartshorn, Heart Lake, Michichi, Nevis, Rowley, Rumsey, Scapa, Scollard, Stonelaw, Sullivan Lake and Victor (Government of Canada, 2006). The subwatershed has one each of a Provincial Park (PP), Ecological Reserve (ER), Natural Wildlife Area (NWA) and Provincial Recreational Area (PRA) (Table 120) (Alberta Tourism, Parks and Recreation, 2008b).

Table 120. Recreational facilities in the Michichi Creek subwatershed (Alberta Tourism, Parks and Recreation, 2008b).

Facility	Characteristics
Midland PP	• 598.91 ha on the Red Deer River • 2 day use sites
Rumsey ER	• 3431.86 ha • day use sites
Spiers Lake NWA	• walking/hiking trails
Tolman Bridge PRA	• added to Dry Island Buffalo Jump PP

Note: ER = ecological reserve, NWA = natural wildlife area, PP = provincial park, PRA = provincial recreation area.

Visitation statistics for Midland PP indicate that the number of visitors to this recreation facility has been relatively consistent on an annual basis (Figure 302). For those years with available data, the average number of visitors per year was 137,338 from 1994-2003, with a peak of 163,125 visitors in 1997 (Alberta Tourism, Parks and Recreation, 2008b).

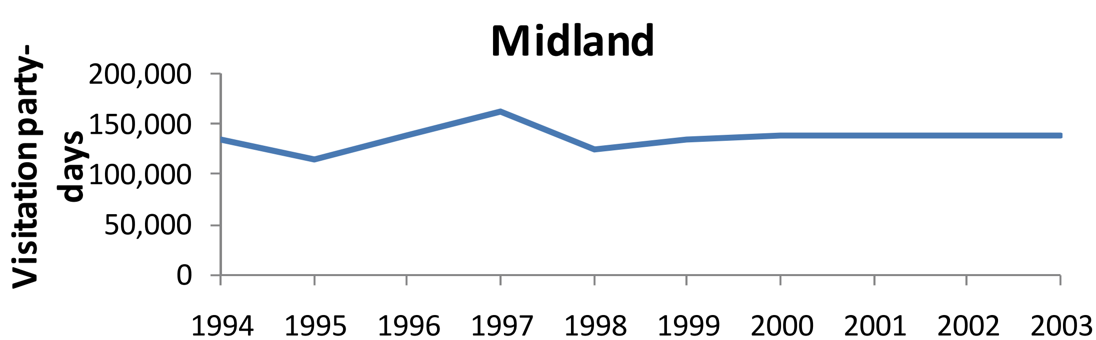


Figure 302. Visitation statistics for Midland Provincial Park in the Michichi Creek subwatershed (Alberta Tourism, Parks and Recreation, 2008b).

4.11.2.5 Linear Developments

Linear developments include seismic lines, pipelines, roads, railways and utility right of ways. Quantifying linear development will help us understand potential changes in water quality and fish and wildlife populations, e.g., wildlife corridors can be interrupted by roads, and watersheds can have their drainage patterns permanently altered by increases in impervious or compacted surfaces.

The most prominent linear developments in the Michichi Creek subwatershed are urban and rural roads, which have a total length of 4,700 km and cover 75.2 km^2 of the subwatershed's landbase. Other major linear developments include pipelines and cutlines/trails (Table 121). In total, all linear developments cover an area of 127.3 km^2, or 2.1% of the total area of the subwatershed (Figure 303) (AAFC-PFRA, 2008).

Table 121. Linear developments in the Michichi Creek subwatershed (AAFC-PFRA, 2008). The dominant linear development is highlighted.

Linear Development	Length (km)	Width (m)	Area (km^2)	Proportion of total linear disturbances (%)
All roads	4,700	16	75.20	59.1
Cutlines/trails	2,400	6	14.40	11.3
Pipelines	1,460	15	21.90	17.2
Powerlines	380	30	11.40	9.0
Railways	296.3	15	4.44	3.5
Total	**9,236**		**127.34**	

In addition to linear developments, the Michichi Creek subwatershed has 325 bridges that cross waterbodies, mostly streams and creeks, or culverts that connect waterbodies. These are primarily associated with Michichi Creek, West Michichi Creek, Big Valley Creek and Wolf Creek (Figure 304) (AAFC-PFRA, 2008). The majority of pipeline crossings in the Michichi Creek subwatershed are located in the south-central area of the subwatershed near Morrin, Munson and Delia. The pipelines cross Michichi Creek, West Michichi Creek and Wolf Creek primarily (Figure 305) (AAFC-PFRA, 2008).

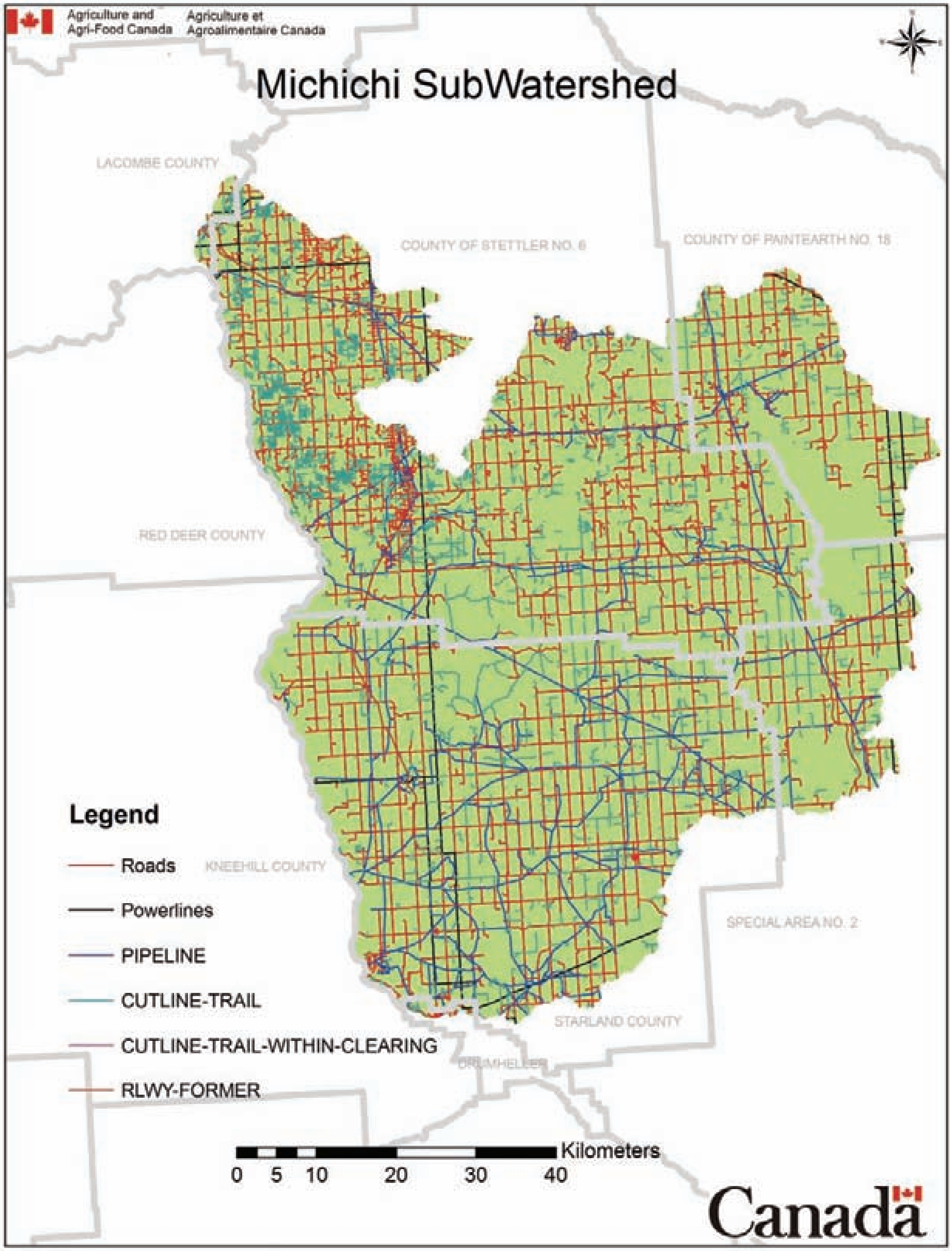


Figure 303. Linear developments in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

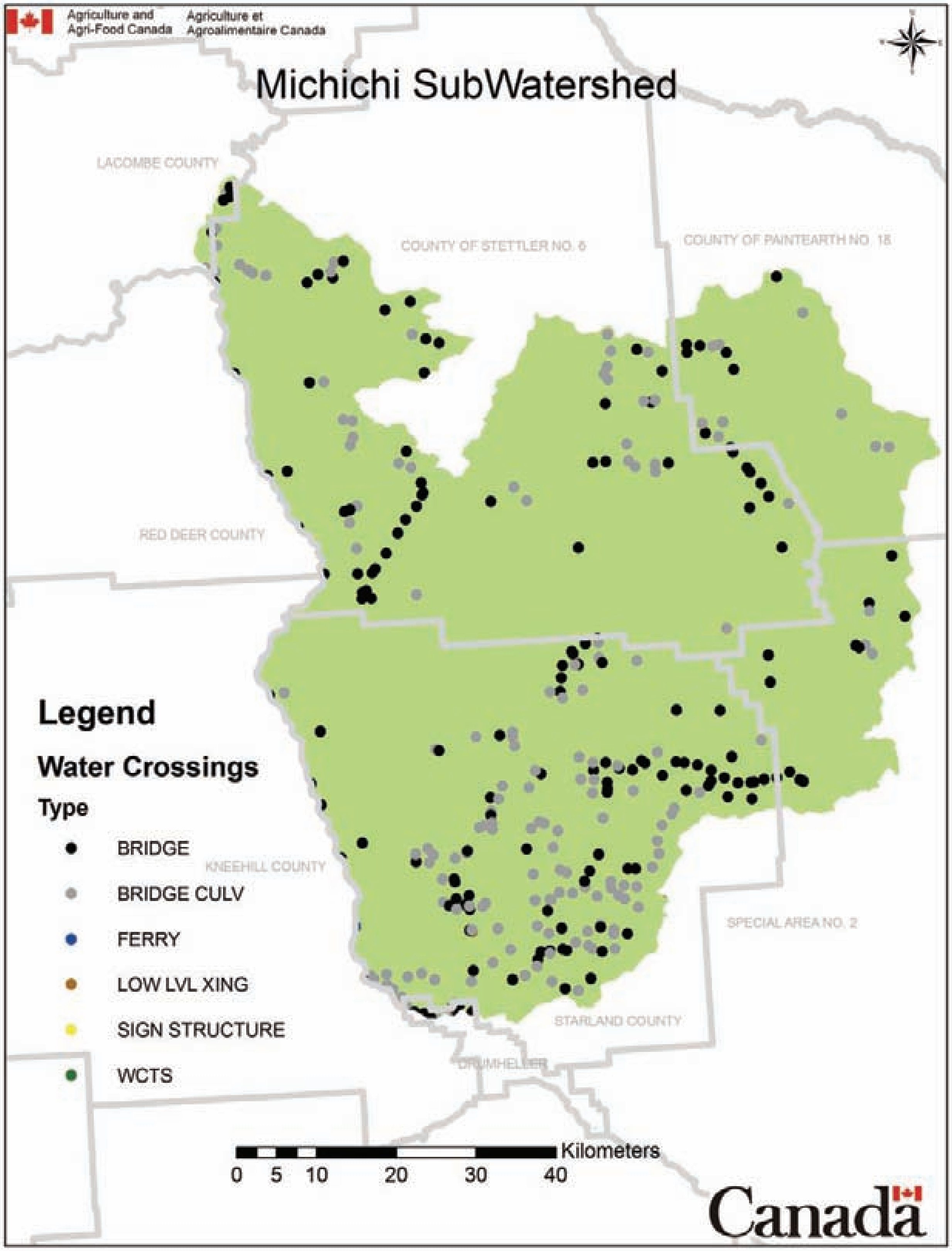


Figure 304. Waterbody crossings in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

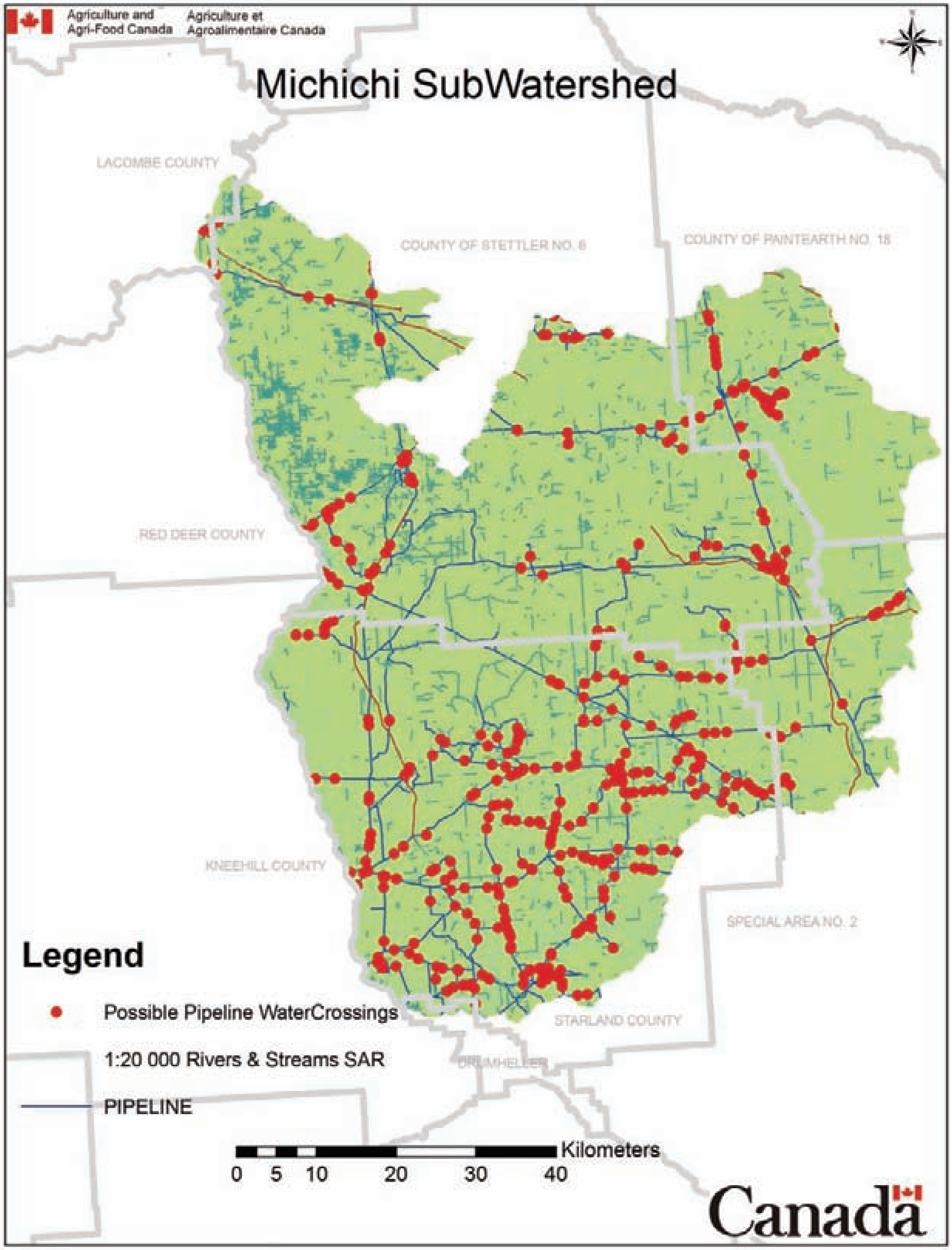


Figure 305. Pipeline crossings over waterbodies in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

4.11.2.6 Oil and Gas Activities

Oil and gas activity is very common throughout the province of Alberta. With oil and gas development there can be a number of associated impacts, including loss of wetlands, habitat fragmentation, increased water use and surface water and groundwater contamination (Alberta Centre for Boreal Studies, 2001).

The Michichi Creek subwatershed has an average well density of 1.75 wells/km^2; however, well density increases up to 10 wells/km^2 north of Drumheller near Ghostpine Creek and near Morrin as well as in the Big Valley-Scollard corridor and near Warden and Erskine in the northern region of subwatershed. Some areas near Ghostpine Creek and in the Big Valley-Scollard area have well densities of up to 40 wells/km^2 (Figure 306). About 55% of all wells are active, with the majority being gas wells, followed by unspecified and oil wells (Table 122) (AAFC-PFRA, 2008).

Table 122. Number of known active and abandoned oil, gas, water and other wells in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

Well type	Quantity
Wells – active *	2,558
Wells – abandoned *	3,532
Total	**6,090**
Gas wells – active	2,556
Gas wells – abandoned	491
Total	**3,047**
Oil wells – active	723
Oil wells – abandoned	866
Total	**1,589**
Water wells – active	79
Water wells – abandoned	43
Total	**122**
Total active wells in subwatershed	**5,916**
Total abandoned wells in subwatershed	**4,932**
Total wells in subwatershed	**10,848**

* The purpose of these wells is undefined and may include standing, newly licensed, flowing coalbed methane, testing coalbed methane, carbon dioxide injector or general exploration wells.

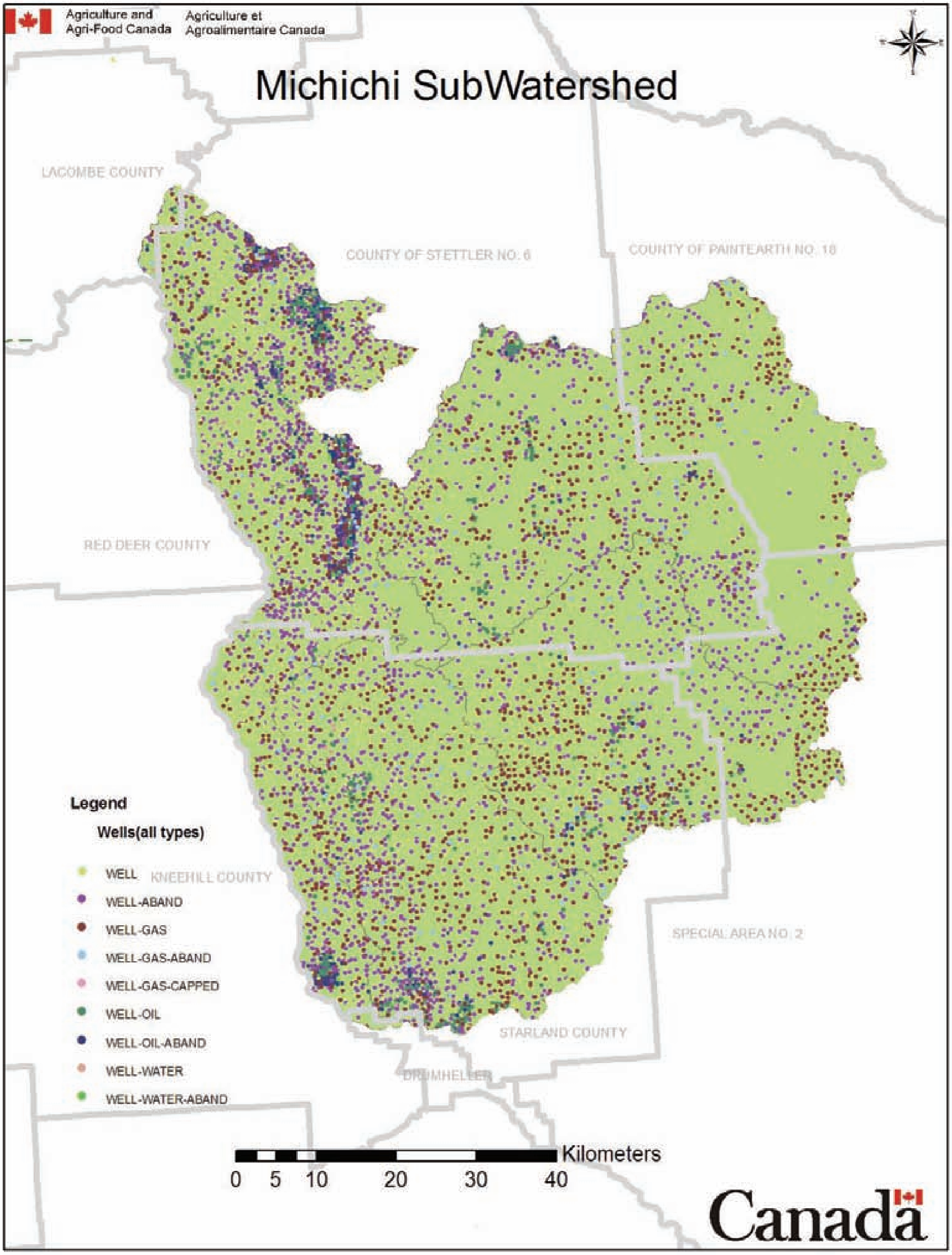


Figure 306. Known active and abandoned oil, gas, water and other wells in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

Coal bed methane (CBM) is natural gas that is found within coal formations. It has received attention recently as an additional source of energy; however, it brings with it potential environmental impacts, some of which are similar to conventional oil and gas exploration and production endeavors. Conversely, some potential impacts it brings with it are new, including an increased intensity in wells, compressors, pipeline infrastructure and completion and production of natural gas from formations above the base of groundwater protection. Some CBM wells are estimated to produce over 65,000 L of waste water per day (Lennon, 2008). In addition, common to oil, gas and unconventional gas (CBM and Shale gas) production is the risk of groundwater contamination through fracturing. Fracturing results from pumping fluids or gases into bedrock formations at high rates and pressures to 'fracture' the bedrock and increase gas or oil production. Fracturing fluids may contain toxic or carcinogenic compounds, which may leach into groundwater sources and pose a threat to human health through contaminated drinking water (Natural Resources Defense Council, 2002).

4.11.3 Water Quality Indicators

Changes in water quality indicate either a deterioration or improvement in the condition of the watershed and demonstrate specific areas that require further attention or protection. Changes in water quality result from changes in land use or land management practices, landscape disturbance and natural events. The major anthropogenic impacts on water quality result from natural resource extraction and processing, wetland drainage, dredging, dam construction, agricultural runoff, industrial wastes, municipal wastes, land erosion, road construction and land development. Five metrics were used to indicate changes in water quality in the Red Deer River watershed and its 15 subwatersheds:

- Nutrients – Condition Indicator
- Bacteria – Condition Indicator
- Parasites – Condition Indicator
- Pesticides – Condition Indicator
- Point Source Inputs

These five water quality indicators reflect socioeconomic growth in a region. Hence, while human activities in a region can have negative impacts on aquatic ecosystems, it is important to strive for a balance between socioeconomic growth and the sustainable management of these aquatic ecosystems to ensure their long-term health and enjoyment by future generations.

4.11.3.1 Nutrients

Nitrogen and phosphorus are essential nutrients for most aquatic plants, whereby excess nutrients can lead to eutrophication, i.e., an excessive amount of aquatic plant and phytoplankton growth. Concomitant with increased plant and phytoplankton growth, oxygen levels may significantly decrease in the water column, which may negatively impact aquatic organisms, including fish. In addition, excessive phytoplankton growth, particularly of cyanobacteria, can lead to the release of toxins into the water column, which may be harmful to aquatic organisms, waterfowl, livestock and humans.

The water quality has been assessed in the Michichi Creek subwatershed only once in the mid-1980s. At that time, TP and TN concentrations in Wolf Creek, which flows into Dowling Lake, have been above CCME PAL guidelines, averaging 0.662 mg/L and 11.46 mg/L, respectively (Table 123). Sources of phosphorus and nitrogen may include surface application of manure and/or fertilizer by agricultural producers (Carpenter et al., 1998; Chambers et al., 2001), municipal wastewater effluents (Servos et al., 2001) and urban run-off (Marsalek et al., 2001), all of which have been demonstrated to be a source of excess nutrients to surface waterbodies. Both agricultural and livestock operations occur in the vicinity of Wolf Creek in the subwatershed and may contribute to the nutrient loading of the creek.

Table 123. Water quality in Wolf Creek. Data are values from a single sample taken October 1986 (data from Alberta Environment, 2008). n = sample size. All concentrations in mg/L unless otherwise noted. Concentrations exceeding water quality guidelines are highlighted *.

Parameter	**Mean**	**n**
TP	0.662	1
TDP	---	---
TN	11.46	1
NO_3^--NO_2^-	7.70	1
NH_3	0.120	1
DO	---	---
Chl. *a* (µg/L)	---	---
pH	7.63	1
Specific Conductivity (µS/cm)	790	1
TDS	---	---

* TN from ASWQG PAL chronic exposure guideline; all others from CCME PAL. Variable abbreviations as in Table 10.

4.11.3.2 Bacteria

Coliforms are a broad class of bacteria found in human and animal wastes. Total coliforms include *Escherichia coli*, fecal bacteria and other coliforms that occur naturally in warm blooded animals. *E. coli* is one of three bacteria commonly used to measure the direct contamination of water by human or other mammal wastes. Ingestion of or exposure to fecal bacteria can have negative health impacts. Sources of this type of bacteria include agricultural and municipal runoff, wildlife, faulty septic systems and septic fields.

Bacteria data were not located for any waterbody in the Michichi Creek subwatershed.

4.11.3.3 Parasites

Waters that are polluted may contain several different disease-causing organisms, commonly called parasites. Enteric parasites, those that live in the intestine of warm blooded animals, can carry or cause a number of infectious diseases. *Cryptosporidium* and *Giardia* spp. are two such parasites. Both occur in almost all environments, including lakes, rivers, reservoirs and groundwater. They come from the feces of rodents, birds, cows, pigs and humans, and the ingestion of these parasites causes gastrointestinal conditions known as cryptosporidiosis and giardiasis.

Parasite data were not located for any waterbody in the Michichi Creek subwatershed.

4.11.3.4 Pesticides

Pesticides are a group of chemicals, including herbicides, insecticides, rodenticides and fungicides, used for many purposes, including pest control and aesthetics in urban areas, golf courses and in forestry and agricultural production. Pesticides are a common contaminant of streams and dugouts in the high intensity agricultural areas of Alberta.

Pesticide concentrations have been assessed in only one waterbody in Michichi Creek subwatershed, Foxall Lake. Although two pesticides had concentrations above detection limits, neither concentration exceeded CCMA PAL guidelines (Table 124).

Table 124. Pesticide concentrations in Foxall Lake. n = ample size. All concentrations in µg/L. Highlighted values exceed CCME PAL guidelines.

Pesticide	**Mean range ***	**Maximum**	**CCME PAL**	**n**
2,4-D	0.141-0.147	0.36	4.0	4
MCPA	0.139-0.144	0.39	2.6	4

* A precise mean could not be determined because the analytical methods used do not distinguish between values of zero and values that are below the detection limit (BDL). The range of the mean was calculated by first assuming that all BDL samples were equal to zero (providing the lower end of the range), and then by assuming that all BDL samples were equal to the detection limit (providing the upper end of the range). Where no values below the detection limit were present, a single average value was calculated. Samples were collected August 1995-September 1996 (data from CAESAA).

4.11.3.5 Point Source Inputs

Point source inputs include effluents from waste water treatment plants (WWTP), stormwater outfalls and industry. Effluent from WWTP's, although regulated, generally has higher concentrations of certain compounds (e.g., nutrients, solids, pharmaceuticals, metals, etc.) than the receiving environment. Similarly, stormwater outfalls contain elevated levels of nutrients, salts and solids compared to the receiving environment, and industrial effluents can contribute elevated levels of a suite of different contaminants, such as metals, solids, hydrocarbons and/or salts, as well as other chemicals used in processing or manufacturing, to aquatic ecosystems.

More than 100 upstream oil/gas facilities and three oil/gas refining/storage facility have released pollutants continuously or sporadically into the air in the Michichi Creek subwatershed since 2000. Pollutants from the upstream oil/gas facilities include carbon monoxide (CO), nitrous oxide (N_2O) and particulate matter < 10 µm in size. The pollutants from the oil/gas processing facilities include N_2O, CO, volatile organic compounds (VOCs), particulate matter < 10 µm in size, sulphur dioxide (SO_2), sulphuric acid (H_2SO_4), alcohols and ethylene glycol (NPRI, 2008). No pollutants were released directly into aquatic ecosystems according to the National Pollution Release Inventory.

4.11.4 Water Quantity Indicators

Water quantity is important for the maintenance of aquatic habitat, it has functions related to water quality and it is essential for the treatment and production of sufficient volumes of drinking water to meet current demands. Irrigation, industry and livestock production are highly dependent on a minimum amount of water. Sufficient water quantity is necessary for many recreational activities, and in recent years many cottagers and recreational lake users across Alberta have voiced concerns about the decreasing volumes of water seen across the province. Five metrics were used as water quantity indicators in the Red Deer River watershed and its 15 subwatersheds:

- Volume
- Minimum Flows to Maintain Ecological Integrity – Condition Indicator
- Contributing Areas to the Watershed
- Allocations
- Groundwater Recharge/Discharge

Water discharge rates, allocations and minimum flow rates to maintain ecological integrity can reflect socioeconomic growth in a region. Human activities in a region frequently reduce available water quantities required to maintain healthy aquatic ecosystems. It is important to balance socioeconomic growth and the sustainable management of these aquatic ecosystems to ensure their long-term health and enjoyment by future generations.

4.11.4.1 Volume

Water volume is the amount of water flowing past one point over a given time, or in the case of lakes or other standing waterbodies, the total amount of water present in the waterbody at a given time. This amount varies seasonally and annually with shifts in weather patterns. Water withdrawals for consumptive uses have increased dramatically in recent years and have resulted in some watersheds within the province being closed to new water licenses.

The total length of all water courses in the Michichi Creek subwatershed is about 2,150 km (Figure 307) (AAFC-PFRA, 2008). The major streams in the subwatershed are Big Valley Creek, Michichi Creek, Tail Creek and Wolf Creek. The subwatershed is characterized by a large number of lakes and reservoirs, including Chain, Cornish, Cutbank, Dowling, Ewing, Erskine, Farrell, Foxall, Gough, Lanes, Lee, Marion, McKee, Mudspring, Pearl, Rishaug, Ross, Shooting, Snake, Spiers and Sullivan Lakes, as well as Michichi Reservoir. In addition, there are numerous small creeks and sloughs in the subwatershed (Government of Canada, 2006).

Alberta Environment has been monitoring water discharge rates in Michichi Creek near Drumheller (real-time active, 05CE020) and at two lakes (Sullivan Lake near Sullivan, discontinued, 05CF001; Dowling Lake near Dowling, discontinued, 05CF002) (Government of Alberta, 2008c). In Michichi Creek, water discharge rates are highest in early spring (0.3 m^3/sec) and then decrease to negligible quantities by mid-summer (July-August). Historically, water discharge rates have reached maxima of 2 m^3/sec in early spring and sustained discharge rates of about 0.05-0.1 m^3/sec into early fall before ceasing in late fall (mid to late September). In 2008, water discharge rates were well above average levels for most of the year, frequently approaching and/or exceeding 1 m^3/sec (Figure 308) (Government of Alberta, 2008c).

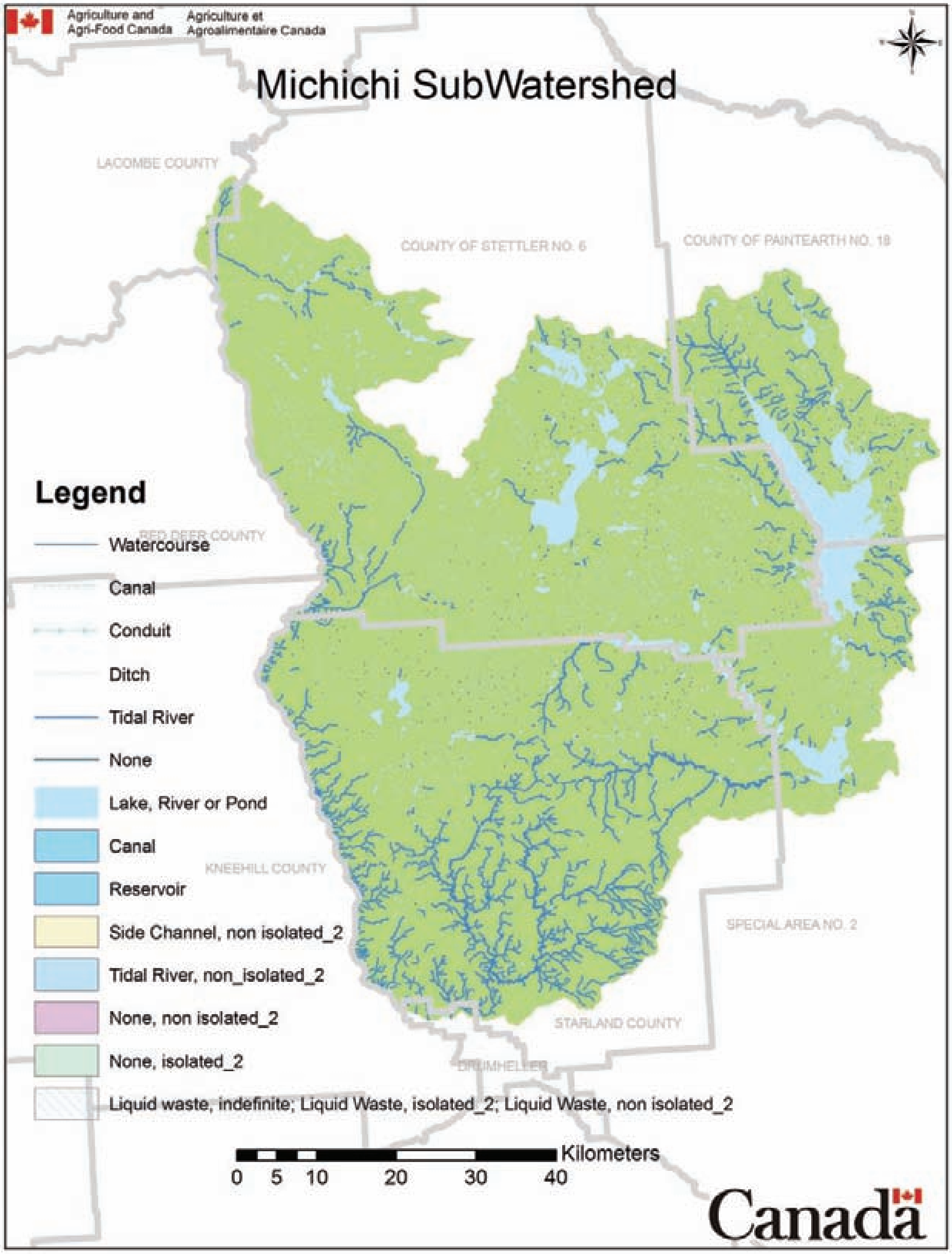


Figure 307. Waterbodies in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

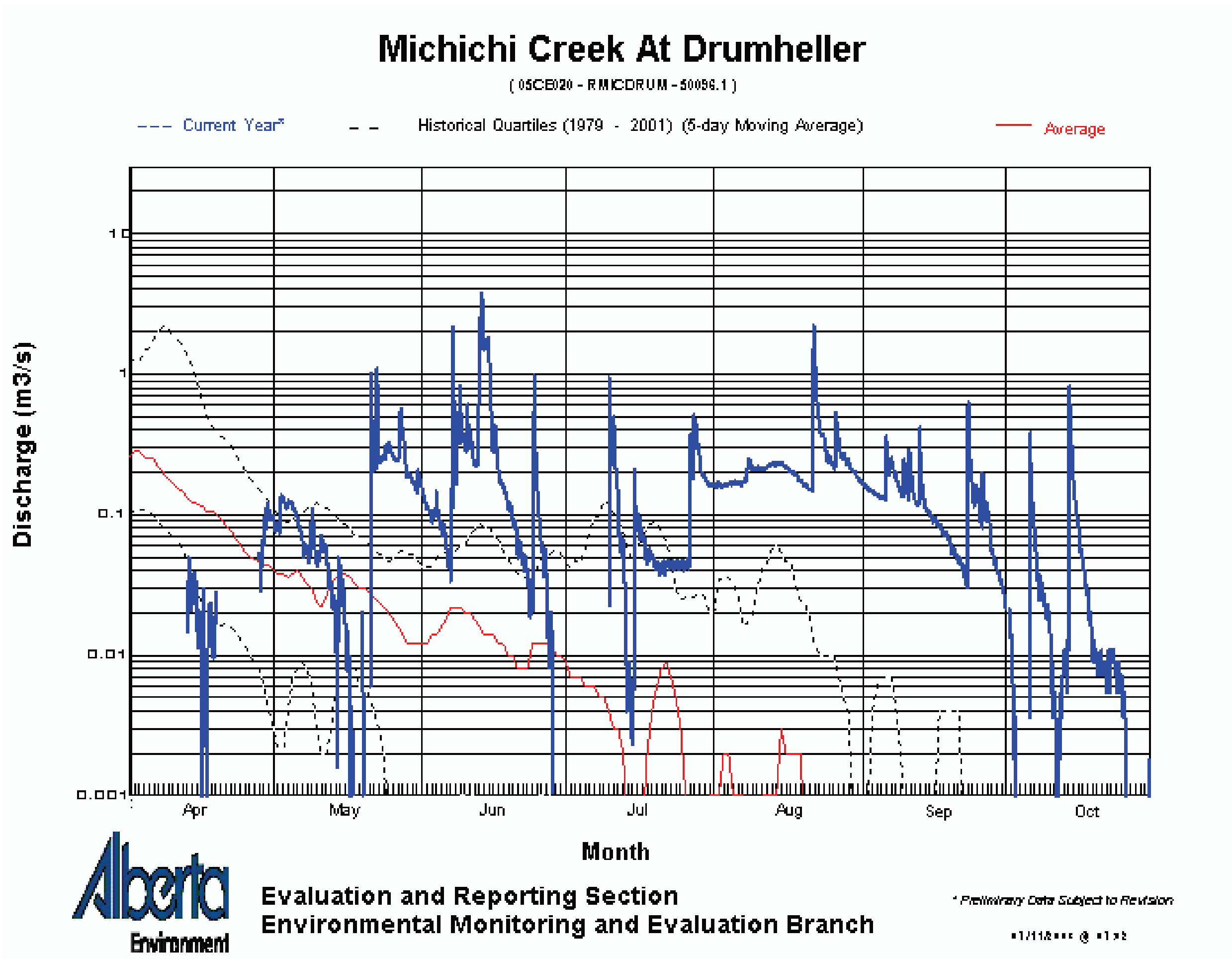


Figure 308. Discharge rates in Michichi Creek near Drumheller (Government of Alberta, 2008c). "Current year" indicates water discharge rates in 2008.

There are nine major dams in the Michichi Creek subwatershed (Figure 309). McLaren Dam is located on Farrell Creek west of Farrell Lake, Scapa Lake North and South Dams are located on an unnamed creek and form Scapa Lake and Michichi Dam forms Michichi Reservoir south of Michichi. In addition, three dams are located near Sullivan Lake in the north-east of the subwatershed and two dams are located near Ewing Lake in the north-western area of the subwatershed. In addition, there are numerous smaller water infrastructures in the subwatershed, e.g., small dams, sluices, weirs and dykes, which control water flow.

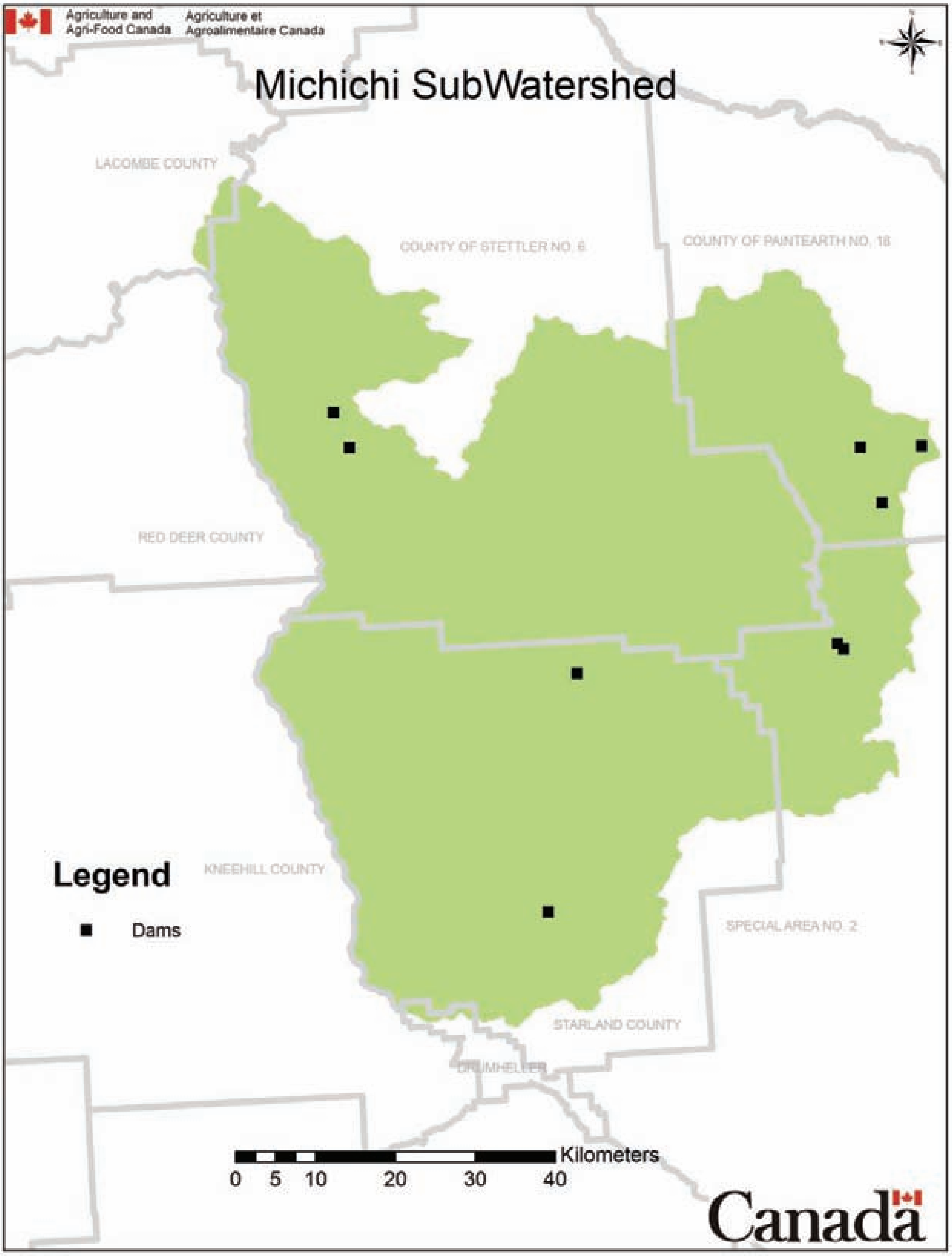


Figure 309. Major dams in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

4.11.4.2 Minimum Flows to Maintain Ecological Integrity

Minimum flows to maintain ecological integrity are the lowest flows or volumes (lakes) required to sustain native aquatic species and natural ecosystem functions. Minimum flows must be determined before allocation of water can safely take place to preserve the ecological functionality of aquatic ecosystems.

Minimum flow requirements for the maintenance of ecological integrity have not been determined in the Michichi Creek subwatershed.

4.11.4.3 Contributing Areas to the Watershed

Contributing areas to the watershed are areas from which runoff flows into the lakes, creeks and rivers of the watershed. These data are used to determine an estimated volume of water contributed to the river on an annual basis.

In the Michichi Creek subwatershed, 366,415 ha (or 62.8% of the total area of the subwatershed) of land do not contribute to the drainage of the subwatershed (Figure 310). These areas are located primarily throughout central and northern areas of the subwatershed, e.g., north of tributaries of the Red Deer River and in the vicinity of major waterbodies, including Marion Lake, Gough Lake, Farrell Lake and Chain Lakes, where the topography is generally flatter than in the remainder of the subwatershed (Figure 311) (AAFC-PFRA, 2008).

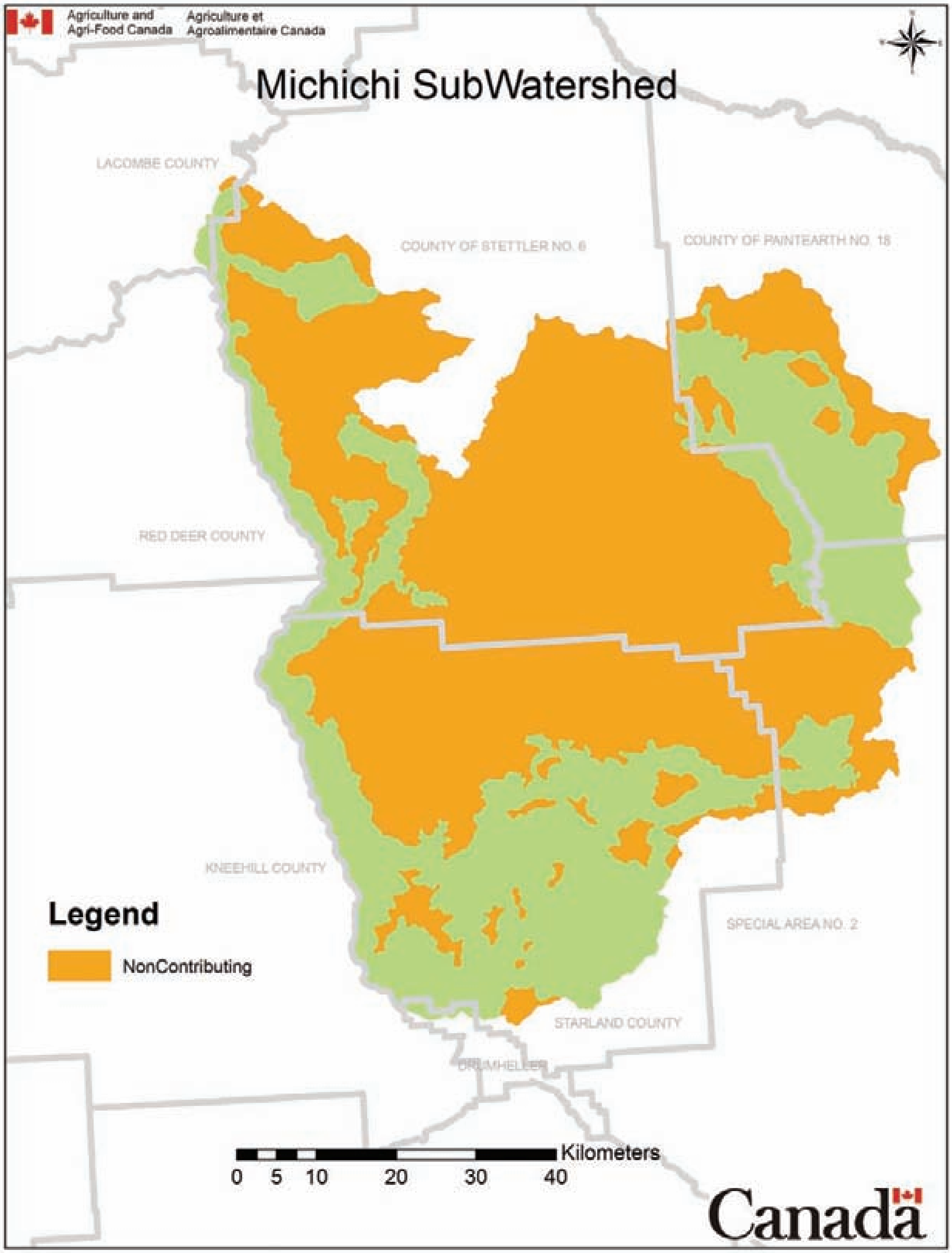


Figure 310. Non-contributing drainage area in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

Figure 311. Topography (10-m contour intervals) of the Michichi Creek subwatershed (AAFC-PFRA, 2008).

4.11.4.4 Allocations

Surface and groundwater water withdrawal permits for the watershed are quantified by user sector along with information on licenses, consumption and return flows. This information will be used along with water flow data to identify areas of potential future constraints on surface water availability, which may have implications for future development.

In the Michichi Creek subwatershed, 3,296 surface water licenses and 1,187 groundwater licenses have been issued for water diversion projects (Figures 312, 313, respectively) (AAFC-PFRA, 2008). They are distributed throughout the entire subwatershed.

About 10.83 million m^3 of surface and groundwater are diverted annually in the Michichi Creek subwatershed (Government of Alberta, 2008d). The most prominent uses of surface water are for habitat enhancement (35% of total surface water diversions) and water management (27% of total surface water diversions), while the most prominent users of groundwater are agricultural operations (61% of total groundwater diversions) and municipalities (28% of total groundwater diversions) (Table 125). The majority of water diverted in the entire subwatershed comes from surface water sources, e.g., lakes, streams and rivers (91%) (Government of Alberta, 2008d). Additional groundwater diversion information is provided in HCL (1998, 1999a, b, 2000b, 2001a).

Table 125. Surface and groundwater diversions in the Michichi Creek subwatershed (Government of Alberta, 2008d). The highest uses for water have been highlighted. Data reported exclude any water diverted from the Red Deer River mainstem.

Purpose	Surface water (m^3/yr)	Groundwater (m^3/yr)
Agriculture	1,059,464	594,125
Commercial	227,038	94,690
Habitat enhancement	3,451,120	---
Irrigation	2,017,935	---
Management of fish	38,240	2,500
Municipal	370,040	271,335
Recreation	---	7,400
Water management	2,696,740	---
Total	**9,860,577**	**970,050**
Grand total		**10,830,628**

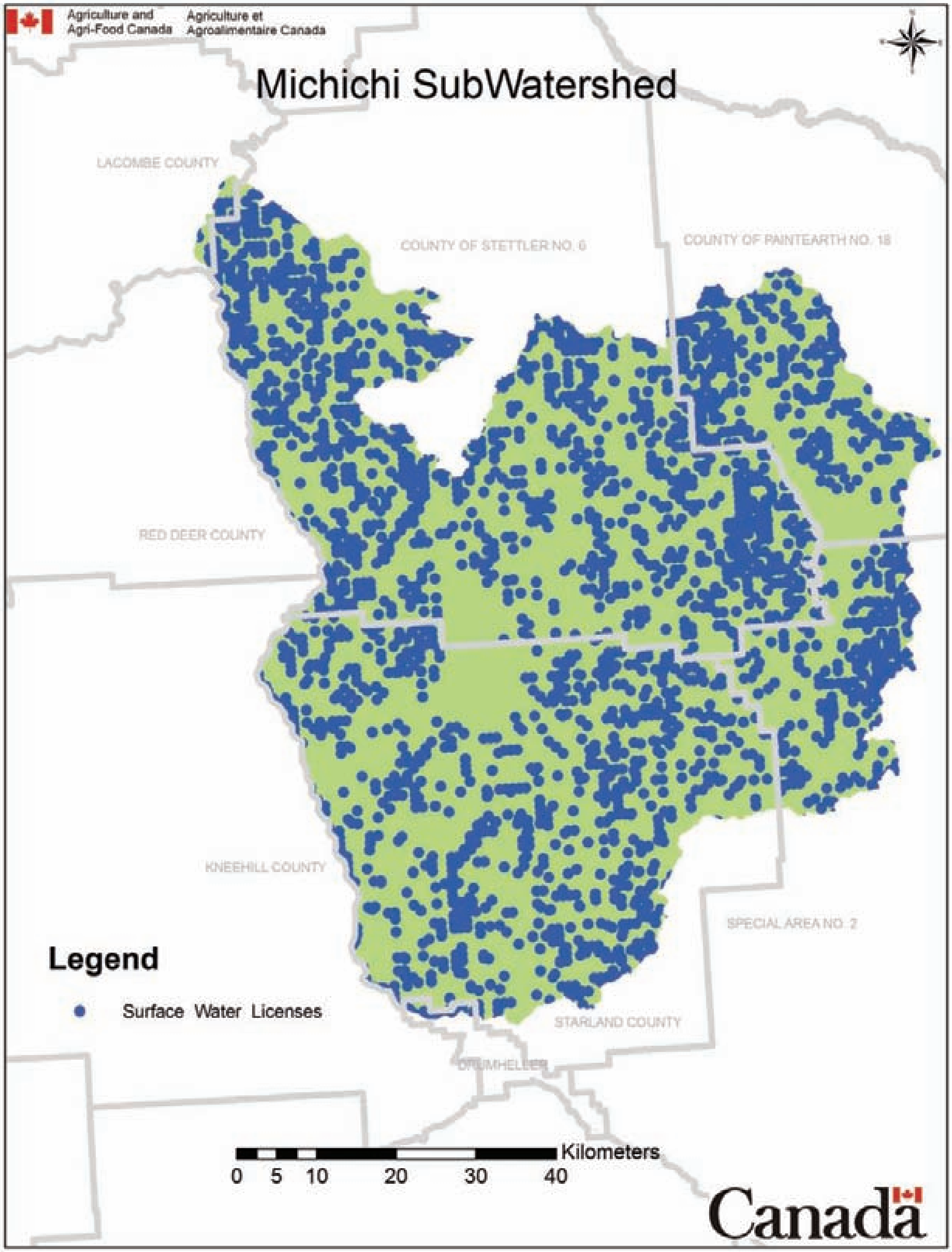


Figure 312. Surface water licenses in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

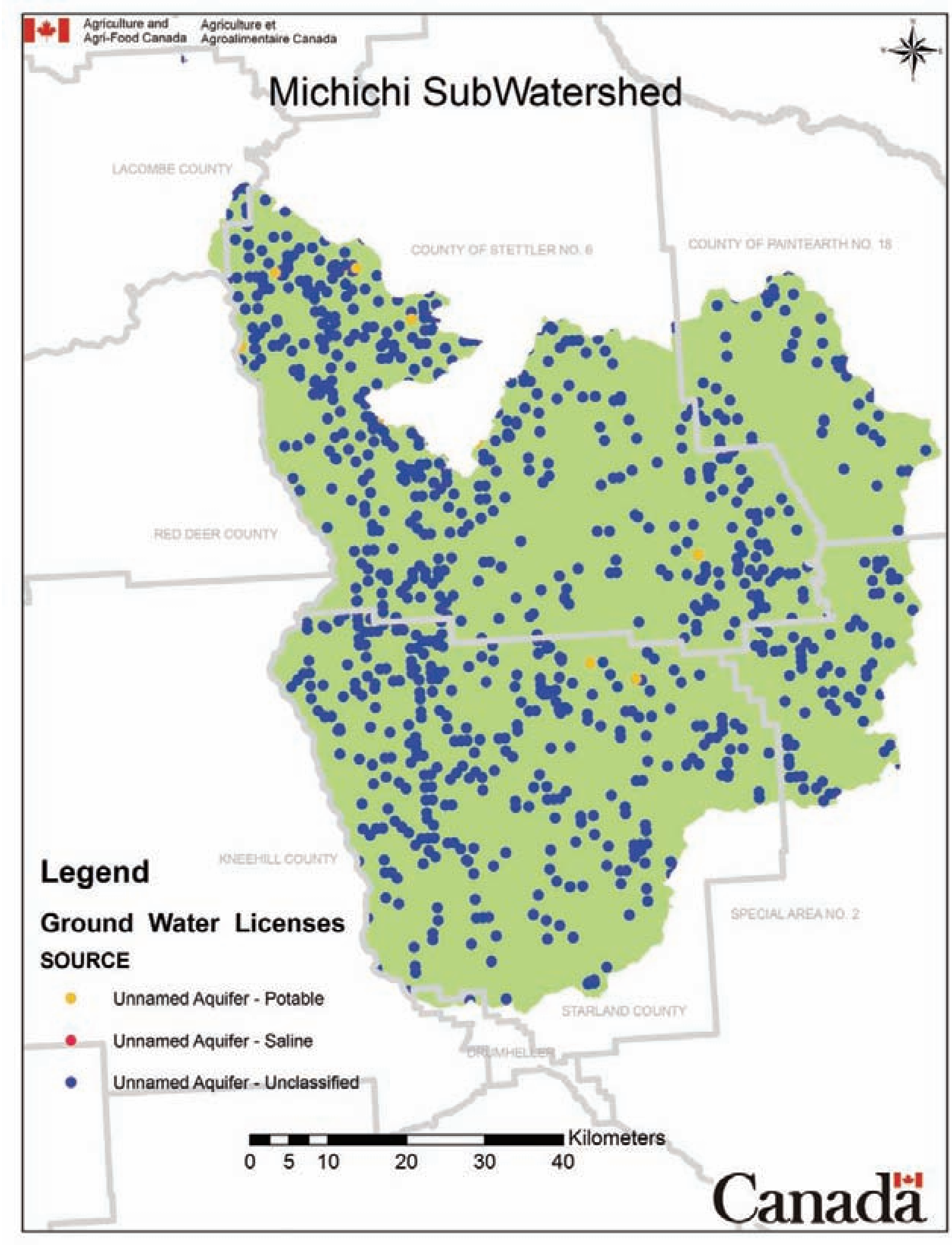


Figure 313. Groundwater licenses in the Michichi Creek subwatershed (AAFC-PFRA, 2008).

4.11.4.5 Groundwater Recharge/Discharge

Areas where groundwater gets recharged or discharges to the surface indicate areas where the groundwater table is close to the surface and the soils are generally more permeable. These areas are at greater risk of becoming negatively impacted from development or agricultural and/or industrial activities. Knowing where groundwater recharges and discharges occur will help to identify areas requiring special protection and limitations to land use.

Freshwater springs are points in the landscape where the aquifer surface meets the ground surface, i.e., freshwater springs are areas of groundwater discharge. The Michichi Creek subwatershed has about 25 freshwater springs, of which most are located in the vicinity of Dowling Lake in the eastern area of the subwatershed and the Hamlet of Caprona and the Village of Big Valley in the northwest area of the subwatershed.

The Michichi Creek subwatershed lies in the Counties of Lacombe, Paintearth No. 18, Starland and Stettler No. 6 and Special Area No. 2. Groundwater assessments have been conducted for these municipalities by HCL (1998, 1999a, b, 2000b, 2001a). The assessments indicated that the majority of the area of this subwatershed is a groundwater recharge area (i.e., water moves from the surface into groundwater reservoirs) or a transition area (i.e., neither a groundwater recharge or discharge area). There are very few groundwater discharge areas (i.e., water moves from groundwater reservoirs to the surface). Specific areas of groundwater recharge include small depressions in the landscape and temporary and ephemeral wetlands, which collect rainwater and snow melt and release a proportion of this accumulated water into shallow groundwater and regional aquifers (van der Kamp and Hayashi, 1998; Hayashi et al., 2003). Additional information on aquifers, water quantity and quality of the groundwater associated with each aquifer, hydraulic relationship among aquifers and possible groundwater depletion areas associated with each upper bedrock aquifer is provided in HCL (1998, 1999a, b, 2000b, 2001a, 2005).

4.11.5 Biological Indicators

Bioindicators are biological (plant and animal) data from which various aspects of ecosystem health can be determined or inferred. The presence, absence and abundance of such data can be linked to water quality, quantity and ultimately to overall watershed health. Four metrics were used as biological indicators in the Red Deer River watershed and its 15 subwatersheds:

- Wildlife Biodiversity
- Fish
- Land Cover – Condition Indicator
- Species at Risk

Changes in biological populations often reflect socioeconomic growth in a region. Human settlement and the subsequent exploration and extraction of natural resources alters the landscape and with it the habitat of the indigenous flora and fauna. It is important to balance socioeconomic growth with the preservation of natural habitat integrity to ensure the long-term health of natural biological populations.

4.11.5.1 Wildlife Biodiversity

Wildlife inventories to determine the biodiversity within the watershed will indicate changes in environmental conditions (e.g., habitat fragmentation, loss of nesting and breeding sites, nutrient enrichment, etc.). A loss of biodiversity can cause an ecosystem to become less stable and more vulnerable to environmental change. A change in diversity may also affect nutrient cycling and/or energy flow through the ecosystem.

Wildlife biodiversity assessment data have not been located for the Michichi Creek subwatershed.

4.11.5.2 Fish

Inventories of selected fish populations may show increases or declines through introductions or changes in environmental conditions. Indicator species sensitive to environmental pollution may show areas of concern through their absence, while others may show similar with their presence. Invasive species, if present, will indicate areas of concern requiring future monitoring.

Fish population data were not located for any waterbody in the Michichi Creek subwatershed.

4.11.5.3 Land Cover

Land cover is the type of vegetation, or lack thereof, covering the landscape. Inventory of vegetation populations may show increases or declines through introductions or changes in environmental conditions. Indicator species that are sensitive to environmental pollution may show areas of concern with their absence, while others may show areas of concern with their presence. Changes in land cover can indicate a change in land use and identify areas that need restoration, are at risk of erosion and/or areas with rare plant species that need protection. Land cover is a separate measurement from land use even though these two terms are sometimes used interchangeably.

Table 126. Land cover in the Michichi Creek subwatershed (AAFC-PFRA, 2008). The most prominent land cover types are highlighted.

Land cover type	Area (ha)	Proportion of subwatershed area (%)
Waterbodies	21,587	3.48
Exposed land	7,336	1.18
Developed land	260	0.42
Shrubland	32,938	5.31
Wetland	34,334	5.53
Grassland	66,540	10.72
Annual cropland	248,496	40.05
Perennial cropland/pastures	167,010	26.92
Coniferous forests	130	0.02
Deciduous forests	5,517	0.89
No data	33,951	5.47
Total	**620,440**	

The majority of the land base of the Michichi Creek subwatershed is covered by annual and perennial croplands/pastures (40% and 27%, respectively). Grasslands are much less common, occupying about 11% of the land base. The remaining land cover types cover about 5% or less individually (Figure 314, Table 126) (AAFC-PFRA, 2008).

There are 11 Ecologically Significant Areas in the Michichi Creek subwatershed: Chain-Farrell Lakes, Dowling Lake, Erskine Lake, Ewing Lake, Gough Lake, Lanes Lake, Marion-Shooting Lakes, Mudspring Lake, Rumsey North, Rumsey South and Sullivan Lake (Table 127) (Alberta Environmental Protection, 1997).

4.11.5.4 Species at Risk

Identifying species at risk and their habitats will help to determine sensitive areas and level of protection required. The *Species at Risk Act* (*SARA*) was introduced in June 2003 to provide legal protection of wildlife species and conservation of biological diversity. The Act aims to prevent Canadian indigenous species, subspecies and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species and encourage the management of other species to prevent them from becoming at risk. Currently, there are 363 species listed as either endangered (169 species), threatened (110 species) or of special concern (84 species) (Species at Risk, 2008).

“Endangered species” are those species that face imminent extirpation or extinction, while “threatened species” are those that are likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction. “Species of special concern” are those species that warrant special attention to ensure their conservation.

The Michichi Creek subwatershed is home to two endangered species (burrowing owl, *A. cunicularia*; piping plover, *C. melodus circumcinctus*), three threatened species (loggerhead shrike, *L. ludovicianus excubitorides*; peregrine falcon, *F. peregrinus anatum*; Sprague’s pipit, *A. spragueii*) and three species of special concern (long-billed curlew, *N. americanus*; monarch butterfly, *D. plexippus*; yellow rail, *C. noveboracensis*). Detailed treaties of these species can be found in section 3.1.3.7.

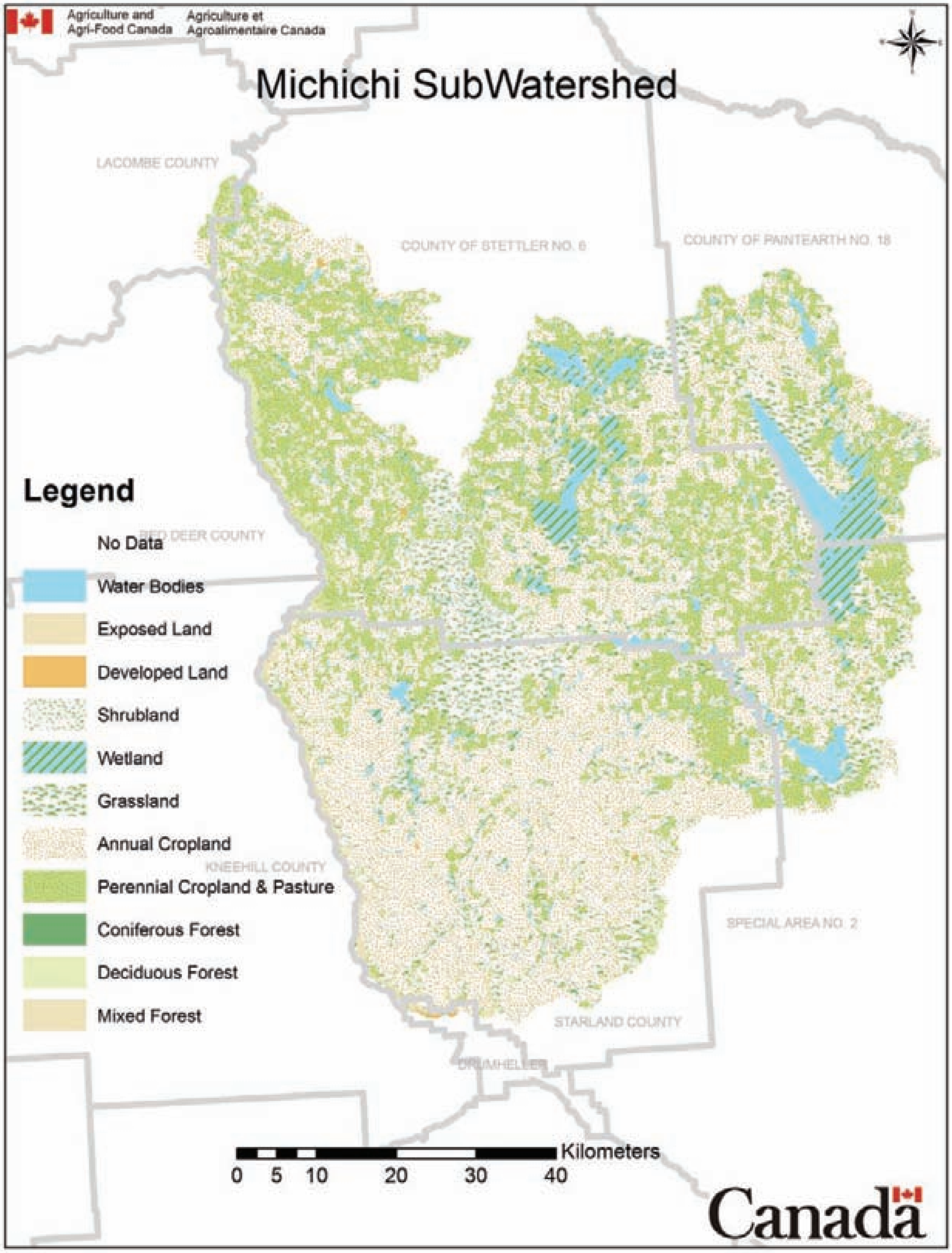


Figure 314. Land cover of the Michichi Creek subwatershed (AAFC-PFRA, 2008).

Table 127. Ecologically Significant Areas in the Michichi Creek subwatershed (Alberta Environmental Protection, 1997).

Ecologically Significant Area	Location	Area (ha)	Significance	Description
Chain-Farrell Lakes, including Clear and Pearl Lakes and adjacent parkland and grassland	Twp. 32-34, Rge. 15-17, W 4, County of Stettler No. 6, Starland County and Special Area 2	7,625	Internationally	Shallow alkali lakes that may dry up for extended periods, some grassy meadows and alkali springs on adjacent lands; important nesting habitat for piping plover, a COSEWIC endangered species in Canada and a red-listed species in Alberta; significant migratory shorebird habitat; waterfowl production and staging at Farrell Lake and middle Chain Lakes; Baird's sparrow, a yellow A-listed species in Alberta, breeds in backshore areas; provincially significant goose staging habitat
Dowling Lake	Twp. 32, Rge. 15, W 4, Special Area 2	4,584	Internationally	Large alkali lake surrounded by wetland complexes consisting of ephemeral marshes, wet meadows and alkali marshes; fed by alkali springs, which rare in the region; significant habitat (exposed mudflats) for shorebirds; evidence of nesting piping plovers; historical great blue heron colony noted; the lake is also used by waterfowl when water levels are high
Erskine Lake	Twp. 38, Rge. 20, W , County of Stettler No. 6	336	Nationally	Discontinuous wetlands within a cultivated upland, variety of marshes, including extensive bulrush marshes; provincially significant duck breeding habitat; waterfowl production and staging habitat; productive habitat for a variety of marsh birds
Ewing Lake	Twp. 37, Rge. 20-21, W 4, County of Stettler No. 6	1,373	Nationally	Variety of wetlands and adjacent parkland and grassland within a cultivated matrix; nationally significant duck staging habitat; waterfowl staging and production area during wet years; habitat for migrating shorebirds

Gough Lake	Twp. 35-36, Rge. 17-18, W 4, County of Stettler No. 6	10,517	Provincially	Ephemeral, large, alkali lake and adjacent parkland and grassland; provincially significant duck breeding and goose staging habitat; productive waterfowl habitat in wet years; regionally local and uncommon birds in dry, grassy lake bottom: Baird's Sparrow and Sprague's pipit; variety of saline wetland plant communities; pronghorn, an uncommon mammal, and heliotrope (*Heliotropium curassavicum*), an uncommon plant, in the region
Lanes Lake	Twp. 37-38, Rge. 14-15, W 4, County of Paintearth No. 18	1,208	Provincially	Provincially significant duck breeding and goose staging habitat; waterfowl production in wet years; regionally local and uncommon birds in dry, grassy lake bottom: Baird's sparrow and Sprague's pipit
Marion-Shooting Lakes	Twp. 37, Rge. 16-18, W 4; County of Stettler No. 6	9,525	Provincially	Diverse wetlands from shallow sedge meadows to deep bulrush-cattail marshes and open water, extensive marsh development and mudflats, part of one of the largest areas of unbroken solonetzic grassland in the region; provincially significant black-crowned night heron and duck breeding habitat; staging, moulting and production wetlands for waterfowl, shore birds and marsh birds; Baird's sparrows and upland sandpipers, uncommon bird species in the region, in grassy backshores; great blue heron feeding habitat, concentrations of terns and gulls; a regionally uncommon plant, hawthorn (*Crataegus rotundifolia*), on islands in Marion Lake
Mudspring Lake	Twp. 33, Rge. 20, W 4, Starland County	2,344	Provincially	Alkali lake, meadows and springs, largest number of soapholes in the grassland/parkland region of Alberta; waterfowl and shorebird staging area; potential for rare plants in springs; potential for Baird's sparrows, a threatened bird species

Rumsey North	Twp. 34-36, Rge. 19-20, W 4, County of Stettler No. 6	11,481	Provincially	Native parkland with patches of cultivation, aspen woodland, fescue grassland and a variety of shrubbery and wetlands (extensive tracts of aspen parkland are rare in Alberta), classic moraine plateau (flat-topped glacial hills); productive deer habitat; waterfowl production
Rumsey South	Twp. 32-34, Rge. 18-20, W 4, County of Stettler No. 6 and Starland County	25,852	Internationally	Part of the largest remaining block of non-sandy aspen parkland in the world, relatively undisturbed aspen woodland, lush fescue grassland and a variety of shrubbery and wetlands, eskers, classic moraine plateau, mesa-like geomorphic features; waterfowl production; provincially rare plant, crowfoot violet (*Viola pedatifida*); regionally uncommon birds include Baird's sparrow and upland sandpiper; a rare bird species in Canada, Cooper's hawk; productive deer habitat; numerous sharp-tailed grouse dancing grounds
Sullivan Lake and associated grasslands and badlands in the Sullivan Lake drainage basin	Twp. 35-37, Rge. 14-16, W 4, Paintearth, Stettler No. 6 and Starland Counties and Special Area 2	28,035	Nationally	Native grasslands and badlands adjacent large alkali lake, extensive alkali mud shore, contains one of the largest blocks of native solonetzic mixed grassland in the region; nationally significant goose and duck staging and production area, especially in wet years; ring-billed gull colony observed during aerial survey; sharp-tailed grouse dancing ground; nesting area for ferruginous hawk, a COSEWIC vulnerable species, and probably prairie falcon; key mule deer habitat

4.11.6 Subwatershed Assessment

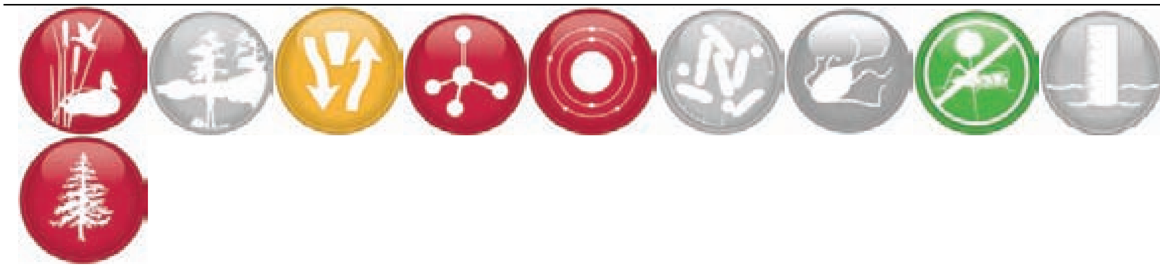
The Michichi Creek subwatershed lies in the Central Parkland, Northern Fescue and Dry Mixedgrass Subregions and is characterized by low livestock intensity and medium agricultural intensity relative to the Alberta average. Its 27 feedlots are located near urban centres, which include several villages and hamlets located throughout the subwatershed. There are no towns or cities within the Michichi Creek subwatershed. Resource exploration and extraction activities have contributed to a complex network of linear developments (mostly roads) and the establishment of 5,916 wells (primarily natural gas wells and wells for unspecified purposes). Despite these land use practices, no data on riparian health were located and there are very limited data on water quality. In Wolf Creek, both TN and TP exceeded CCME PAL guidelines, and two pesticides were detected in Foxall Lake, although neither exceeded any water quality guidelines. No bacteria or parasite data were located for any waterbody in the subwatershed. Since substantial areas of the subwatershed do not contribute to drainage, water discharge rates in Michichi Creek are low throughout the year and peak at maximally 3 m^3/sec following the spring freshet. A total of 4,483 water diversion licenses have been issued in the subwatershed, which permit the diversion of 10.83 million m^3 of water annually. Most of this water is used for water management and habitat enhancement efforts. Despite the presence of several large lakes, little is known about fish populations or overall biodiversity in the subwatershed; however, the subwatershed has 11 ecologically significant areas, attesting to the significant values of habitats and ecosystems to the flora and fauna. The land base is dominated by annual and perennial croplands and pastures, which are home to two endangered species, three threatened species and three species of special concern.

An Indicator Workshop held in March 2008 identified a total of 20 indicators to be used to assess the overall health of the Red Deer River watershed and its 15 subwatersheds. These indicators included land use, water quality, water quantity and biological indicators. In November 2008, a subset of these indicators was selected to indicate the overall condition of, or risk to, the individual subwatersheds. There were nine “condition indicators” and three “risk indicators”. The condition indicators were ranked “good”, “fair” or “poor” based on existing guidelines, while risk indicators were ranked “low”, “medium” or “high” relative to the other subwatersheds. The overall subwatershed ranking is based on an “A”-“B”-“C” ranking system with “+” and “-” subrankings. The overall ranking system is based on a subjective evaluation of the combined rankings of the condition and risk indicators.

Based on the available data, the Michichi Creek subwatershed receives a rating of “poor” for the condition indicators and a rating of “low” for the risk indicators (Tables 128, 129). Overall, this subwatershed receives a ranking of “C+”. There are substantial data gaps, and several of the condition rankings are based on limited data. Consequently, it is recommended to implement a detailed water quality sampling program, conduct a wetland inventory and regularly monitor riparian health conditions along the major waterbodies in the subwatershed. Of particular concern are (1) nutrient concentrations that occasionally exceed water quality guidelines, likely due to widespread impaired riparian area health conditions and excessive agricultural runoff, municipal effluent and urban runoff that reach waterbodies throughout the subwatershed, (2) the loss of wetlands, which likely occurred as a result of agricultural land conversions, drainage, infilling and the disruption of their hydrology following linear developments and (3) the conversion of the landbase from its natural state into annual and perennial croplands and pastures.

Table 128. Condition and risk indicator summary for the Michichi Creek subwatershed. Gray logos indicate data gaps.

Condition Indicators



Risk Indicators

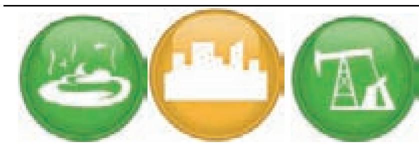


Table 129. Condition and risk assessments of the Michichi Creek subwatershed. Indicators with a "poor" or "high" ranking are highlighted.

Indicators		**Rating**
Condition	Wetland loss	POOR
	Riparian health	---
	Linear developments	FAIR
	Nutrients	
	Total phosphorus	POOR
	Total nitrogen	POOR
	Bacteria	---
	Parasites	---
	Pesticides	GOOD
	Minimum flows to maintain ecological integrity	---
	Land cover	POOR
Overall		**POOR**
Risk	Livestock manure production	LOW
	Urban, rural, agricultural and recreational developments	MEDIUM
	Oil/gas wells	LOW
Overall		**LOW**

