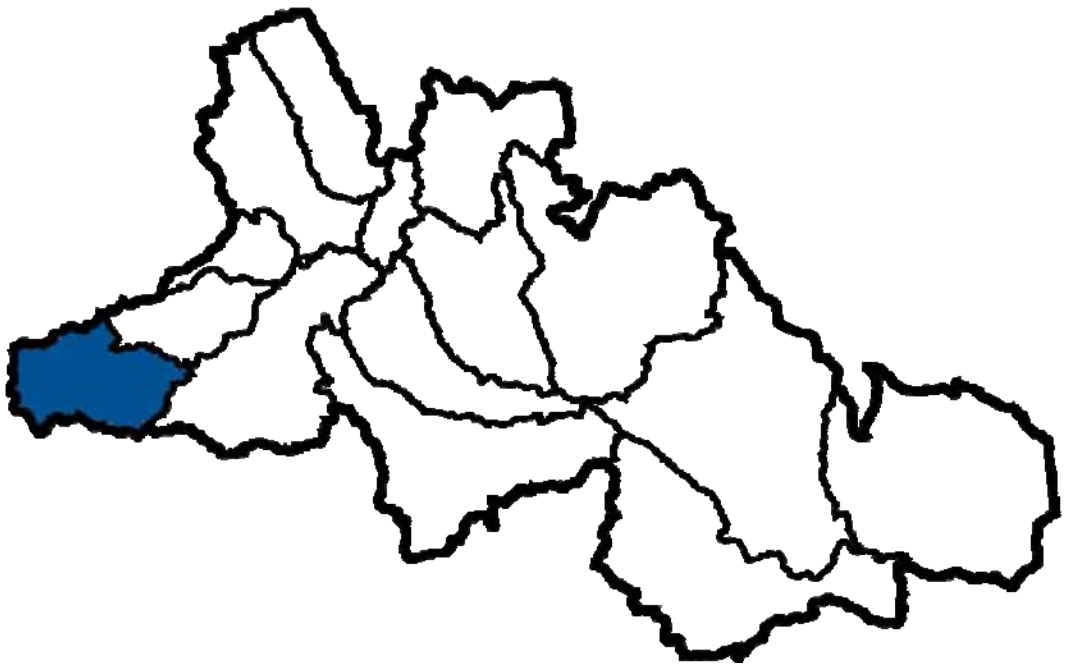
Panther Subwatershed



Red Deer River Watershed Alliance

State of the Watershed

4.0 State of the Red Deer River Subwatersheds

4.1 Panther River Subwatershed

4.1.1 Watershed Characteristics

The Panther River subwatershed encompasses about 230,087 ha and is located in the Municipal District of Bighorn No. 8 and Clearwater County. The western part of the subwatershed lies in Banff National Park (Improvement District No. 9) (Figure 56).

The Panther River subwatershed is in the headwaters of the Red Deer River watershed. This subwatershed is highly diverse and lies in the Alpine, Subalpine, Upper and Lower Foothills Subregions (Figure 57). The Alpine Subregion includes all areas above the tree line (above 2,300 m), with extensive areas of unvegetated bedrock and little or no soil. The Alpine vegetation forms a complex mosaic, in which microclimatic variations are reflected in marked changes in dominant species. The Subalpine Subregion ranges from about 1,600-2,300 m elevation. Soils vary widely, reflecting the great diversity in parent materials and ecological conditions. The vegetation communities are dominated by lodgepole pine (*P. contorta*), Engelmann spruce (*P. engelmannii*), subalpine fir (*A. lasiocarpa*) and whitebark pine (*P. albicaulis*). High elevation grasslands also occur in the Subalpine Subregion. The Upper Foothills Subregion occurs on strongly rolling topography along the eastern edge of the Rocky Mountains with an elevation limit of about 1,500 m. Upland forests are almost entirely coniferous and dominated by white spruce (*P. glauca*), black spruce (*P. mariana*), lodgepole pine (*P. contorta*) and subalpine fir (*A. lasiocarpa*). The Lower Foothills Subregion lies at an elevations of about 1,250-1,450 m and is dominated by mixed forests of white spruce (*P. glauca*), black spruce (*P. mariana*), lodgepole pine (*P. contorta*), balsam fir (*A. balsamea*), aspen (*Populus* spp.), balsam poplar (*P. balsamifera*) and paper birch (*B. papyrifera*) (Heritage Community Foundation, 2008).

The geology of the subwatershed is highly variable, consisting of the Coalspur, Brazeau, Upper and Lower Paleozoic and the Lower Mesozoic-Lower Cretaceous Formations as well as the Alberta Group (Blackstone, Cardium and Wapiabi Formations). These formations formed in the Paleocene epoch (56-65 million years ago), Upper Cretaceous period (65-100 million years ago) and Paleozoic era (251-542 million years ago). The oldest of these formations, the Upper and Lower Paleozoic Formations, consist of diverse limestones, dolomites, shales, siltstone, quartzite and intraformational conglomerates, which formed at various times during the Paleozoic era (e.g., Upper Devonian, Mississippian, Pennsylvanian-Permian, Cambrian, Ordovician and Silurian periods). The geology of the Lower Mesozoic-Lower Cretaceous Formation consists of various siltstones, dolomites, sandstones, shales, cherts and feldspars. Coal deposits occur in the central and northern foothills (Luscar Group). The Upper Cretaceous Formations (Brazeau and the Alberta Group) consist of shales, sandstone, mudstone, ironstone, some tuff and thin coal deposits. The most recent formation (Coalspur) consists of sandstone, siltstone/mudstone, tuff, claystone and coal deposits (Alberta Geological Survey, 2006).

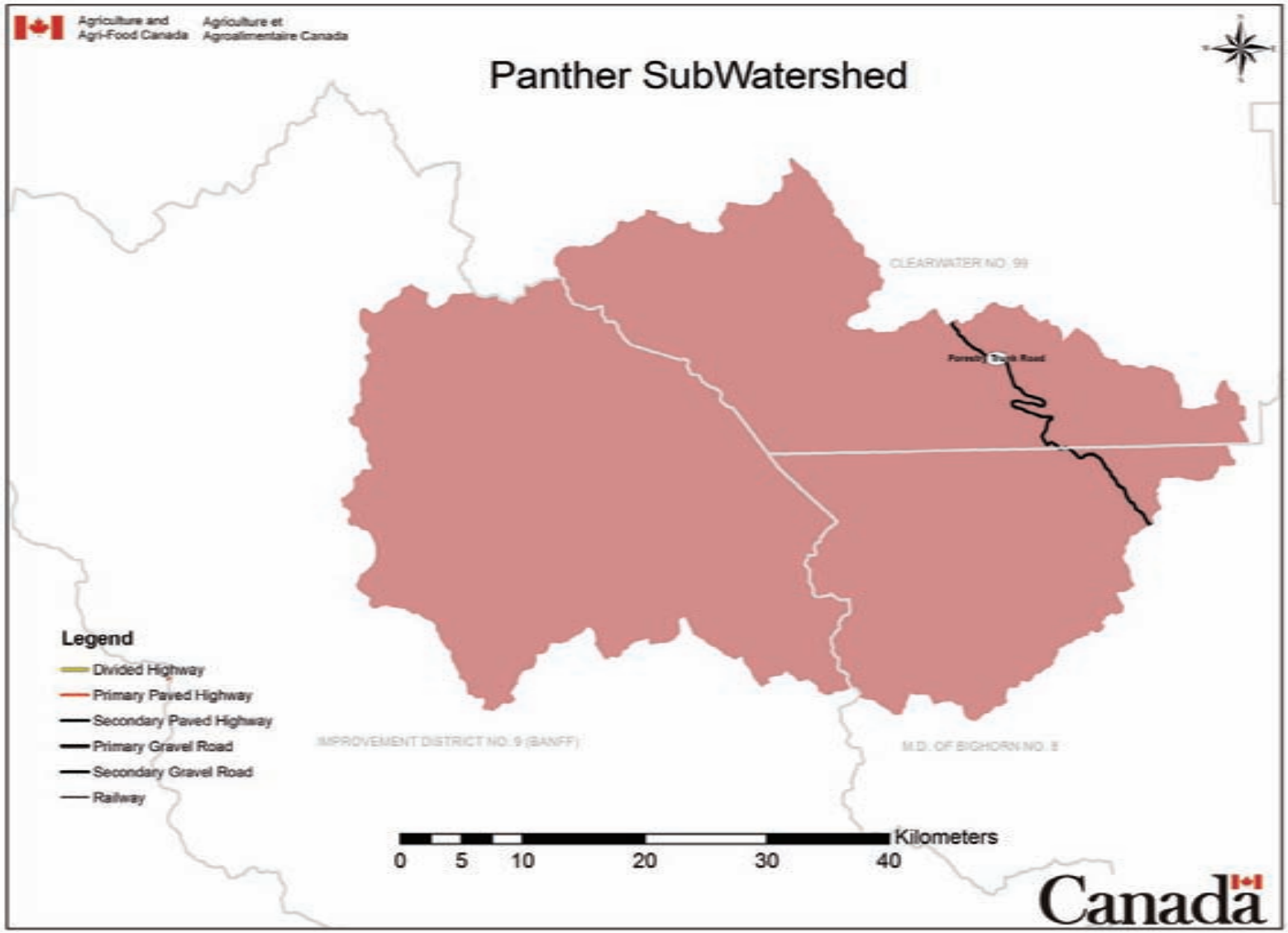


Figure 56. Location of the Panther River subwatershed (AAFC-PFRA, 2008).

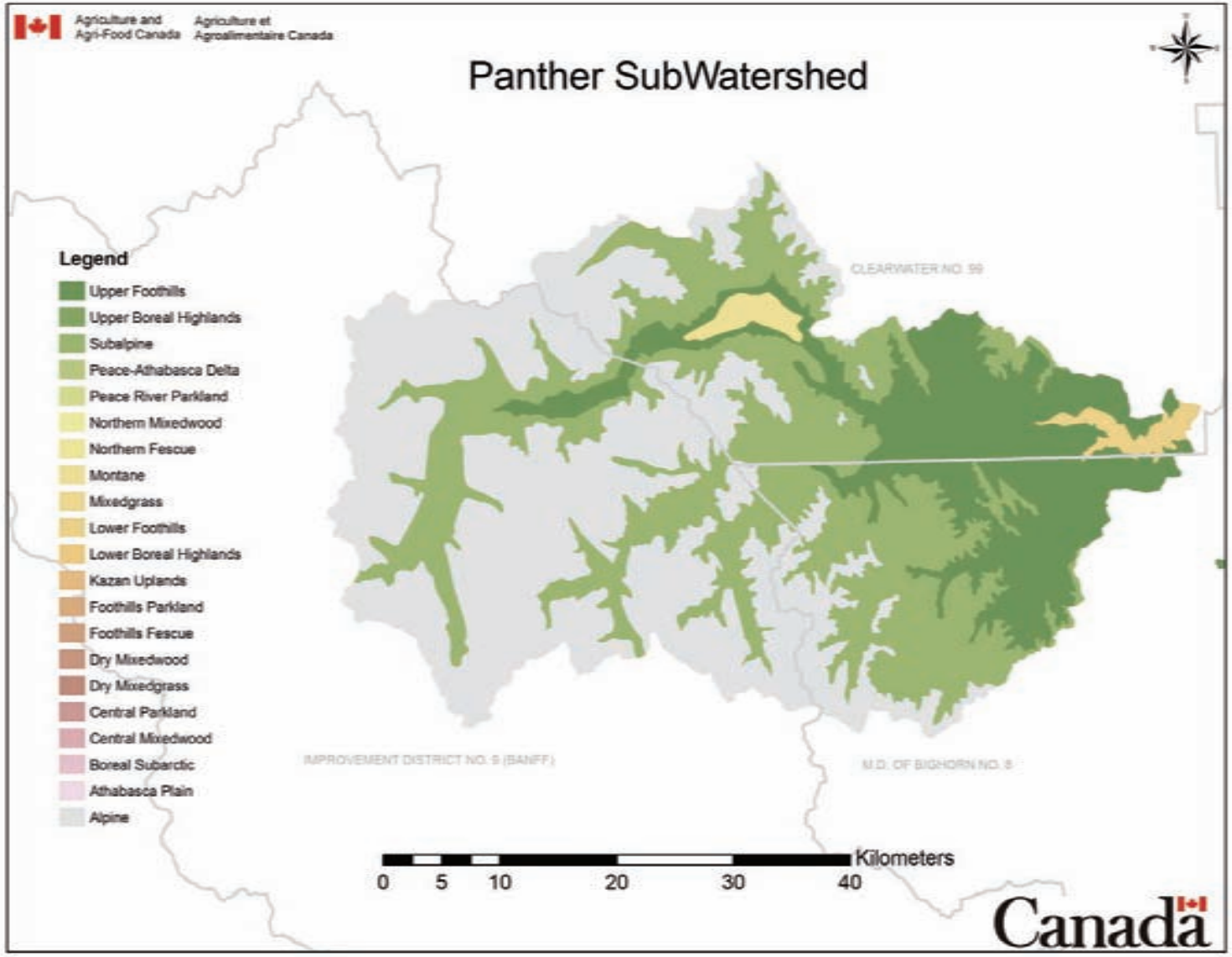


Figure 57. Natural subregions of the Panther River subwatershed (AAFC-PFRA, 2008).

The climate of the Panther River subwatershed typical of alpine regions, with mean May-September temperatures ranging from 6 °C in the Alpine Subregion to 10-15 °C in the Foothills Natural Region and winter temperatures rarely exceeding -25 °C. The annual mean temperature ranges from -1 °C to 3 °C. Frost-free periods are rare in the Alpine Subregion. The mean annual precipitation is highly variable and ranges from 420-1,400 mm. Winter precipitation can amount to more than 200 cm of snowfall (Environment Canada, 2006).

4.1.2 Land Use Indicators

Changes in land use patterns reflect major development trends, such as forested lands converted to agriculture. 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.

4.1.2.1 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 water treatment options. The loss of wetlands to development and/or agriculture can be deleterious to surface and groundwater quantity and quality.

While there are no wetland cover data for the Panther River subwatershed (AAFC-PFRA, 2008), Sweetgrass Consultants Ltd. (1994) and Geowest Environmental Consultants Ltd. (1995) reported the presence of wooded patterned and non-patterned fens near upper Pinto Creek (Twp. 54, Rge. 27, W 5). There are no additional data on any other classes, forms and types of wetlands (*sensu* National Wetlands Working Group, 1997) within the subwatershed; however, given the presence of lentic (lakes) and lotic (streams and rivers) systems, marshes and shallow open water wetlands are likely also present in the subwatershed. There are no engineered treatment wetlands in the subwatershed. There are no data on wetland loss due to anthropogenic impacts on the landscape.

4.1.2.2 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 Panther River subwatershed.

4.1.2.3 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.

Cattle density ranges from 0-0.2 cattle/ha in the central and eastern areas of the Panther River subwatershed (AAFC-PFRA, 2008) (Figure 58). Cattle are allowed to graze only from June 15-October 15 during the year in the subwatershed. There are no livestock manure production data available for the subwatershed, and there are no feedlots or intensive livestock operations in the subwatershed (AAFC-PFRA, 2008).

Agricultural intensity, expressed as the percent land cover used as croplands, is low in the Panther River subwatershed, ranging from 0-20% for the central and eastern areas of the subwatershed (Figure 59) (AAFC-PFRA, 2008).

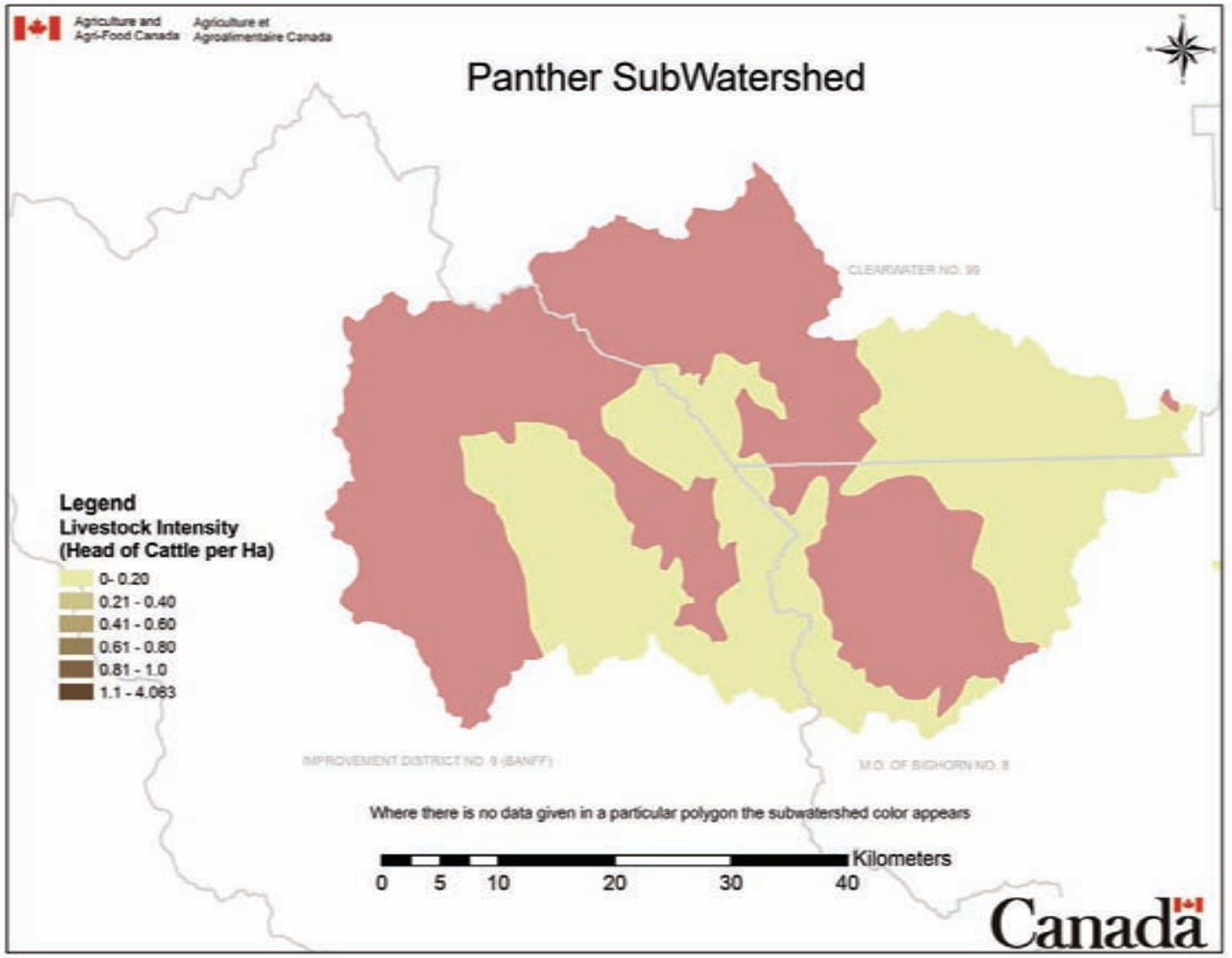


Figure 58. Cattle density (cattle/ha) in the Panther River subwatershed (AAFC-PFRA, 2008).

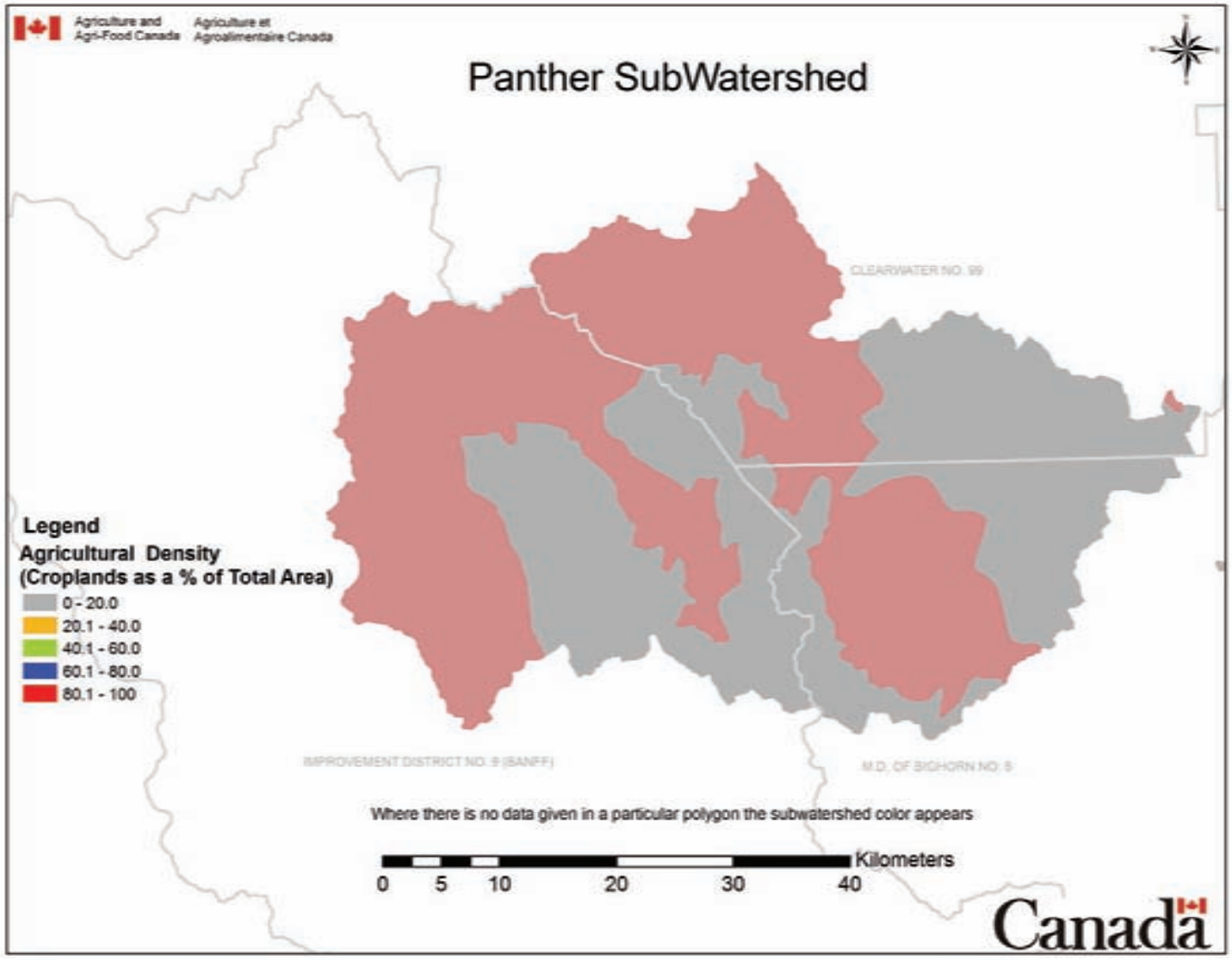


Figure 59. Agricultural intensity (% cropland) in the Panther River subwatershed (AAFC-PFRA, 2008).

4.1.2.4 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.

There are no communities located in the Panther River subwatershed (Government of Canada, 2006). Several recreational facilities are located in the subwatershed, including Provincial Recreation Areas (PRA), Forest Provincial Recreation Areas (FPRA), one Land Use Zone (LUZ) and one ranch (Table 28) (Alberta Tourism, Parks and Recreation, 2008b).

Table 28. Recreational facilities in the Panther River subwatershed (Alberta Tourism, Parks and Recreation, 2008b).

Facility	Characteristics
Burnt Timber PFRA	• 32.94 ha on Burnt Timber Creek • 30 unit campgrounds
Cartier Creek PRA	• 44.45 ha on the Red Deer River • 19 unit campground
Deer Creek PRA	• 4.91 ha on the Red Deer River • 10 unit group camp sites
Ghost Forest LUZ	• multiuse trails and campgrounds • off-highway vehicle access
Red Deer River PFRA	• 116.73 ha on the Red Deer River • 64 unit (+14 overflow) campgrounds, 10 unit group campgrounds • off-highway vehicle access
Wild Horse PRA	• 15.97 ha in Kananaskis County • 6 unit group campgrounds • horses permitted
Ya-Ha-Tinda Ranch	• 3,945 ha on the Red Deer River • lies along 27 km of the Red Deer River • about30 horses during the summer; wintering site for 170-200 horses, from November to May • about 50 groups/weekend at Bighorn Creek Campground during summer months • up to 300 horses per weekend on trail system • commercial trail rides used by about 1,000 people per year

Note: PRA = provincial recreation area, PFRA = provincial forest recreation area, LUZ = land use zone.

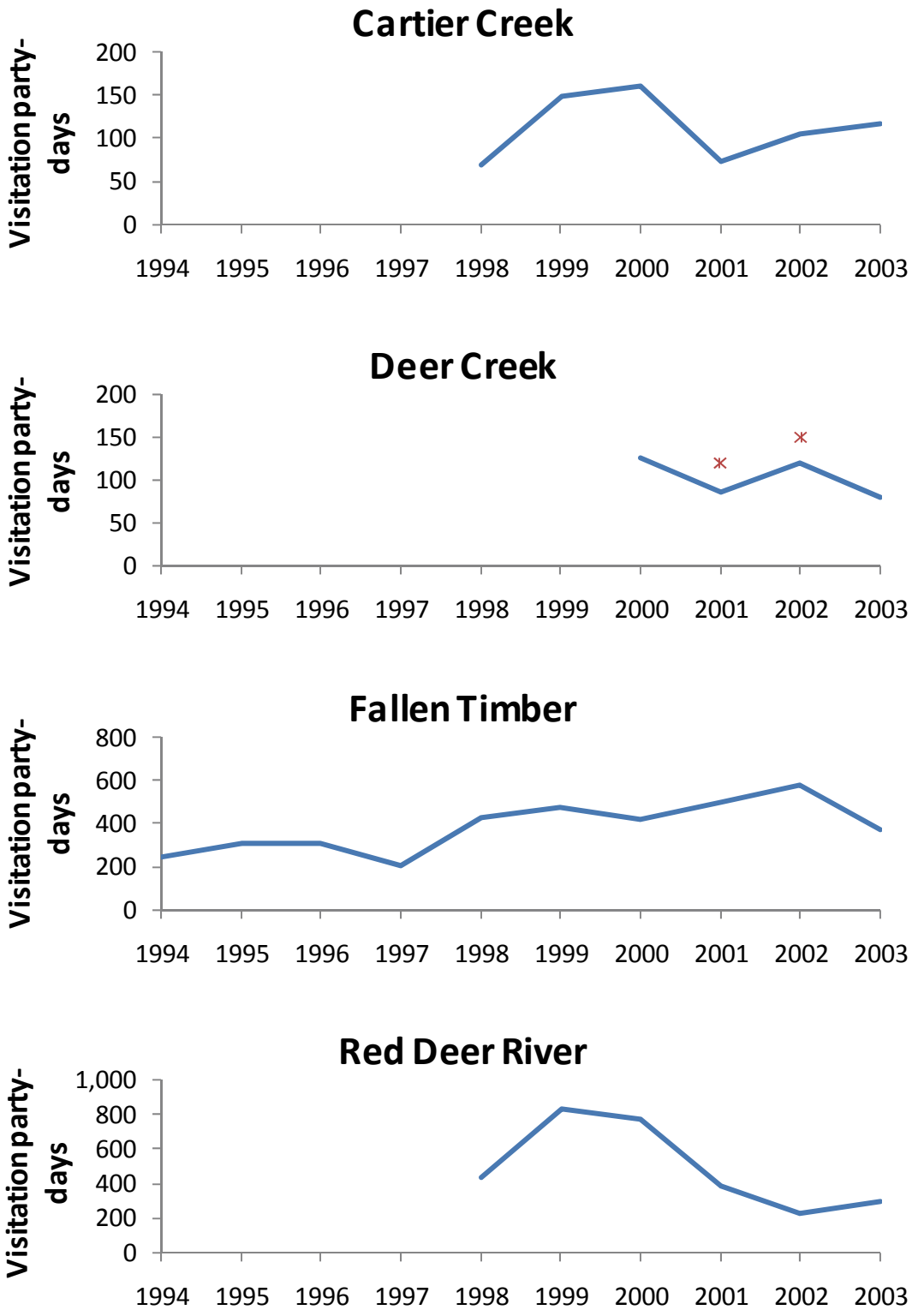


Figure 60. Visitation statistics for four recreation facilities in the Panther River subwatershed (Alberta Tourism, Parks and Recreation, 2008b). Asterisks indicate years for which group camp data were not available.

Visitation statistics for four recreation facilities in the subwatershed indicate that the number of visitors to these facilities varies considerably on an annual basis (Figure 60). For those years with available data, the average number of visitors per year was 112, 103, 383 and 490 in Cartier Creek, Deer Creek, Fallen Timber and Red Deer River PRAs, respectively. An average 785 visitors have used these four recreation facilities annually from 1994-2003 (Alberta Tourism, Parks and Recreation, 2008b).

4.1.2.5 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 Panther River subwatershed are cutlines/trails, which have a total length of 1,300 km and cover 7.80 km^2 of the subwatershed's landbase (Table 29). In total, linear developments cover an area of 14.94 km^2, or 0.7% of the total area of the subwatershed (Figure 61) (AAFC-PFRA, 2008).

Table 29. Linear developments in the Panther River 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	343	16	1.65	36.7
Cutlines/trails	1,300	6	7.80	52.2
Pipelines	110	15	5.49	11.1
Powerlines	0	30	0	0
Railways	0	15	0	0
Total	**1,753**		**14.94**	

In addition to linear disturbances, the Panther River subwatershed has 15 bridges that cross waterbodies, mostly streams and creeks, or culverts that connect waterbodies (Figure 62). These are primarily associated with the headwaters of the Red Deer River or the lower reaches of Burnt Timber Creek. The Panther River subwatershed has the lowest number of pipeline crossings over waterbodies of all the subwatersheds in the Red Deer River watershed. All of them are located in the eastern area of the subwatershed (Figure 63) (AAFC-PFRA, 2008).

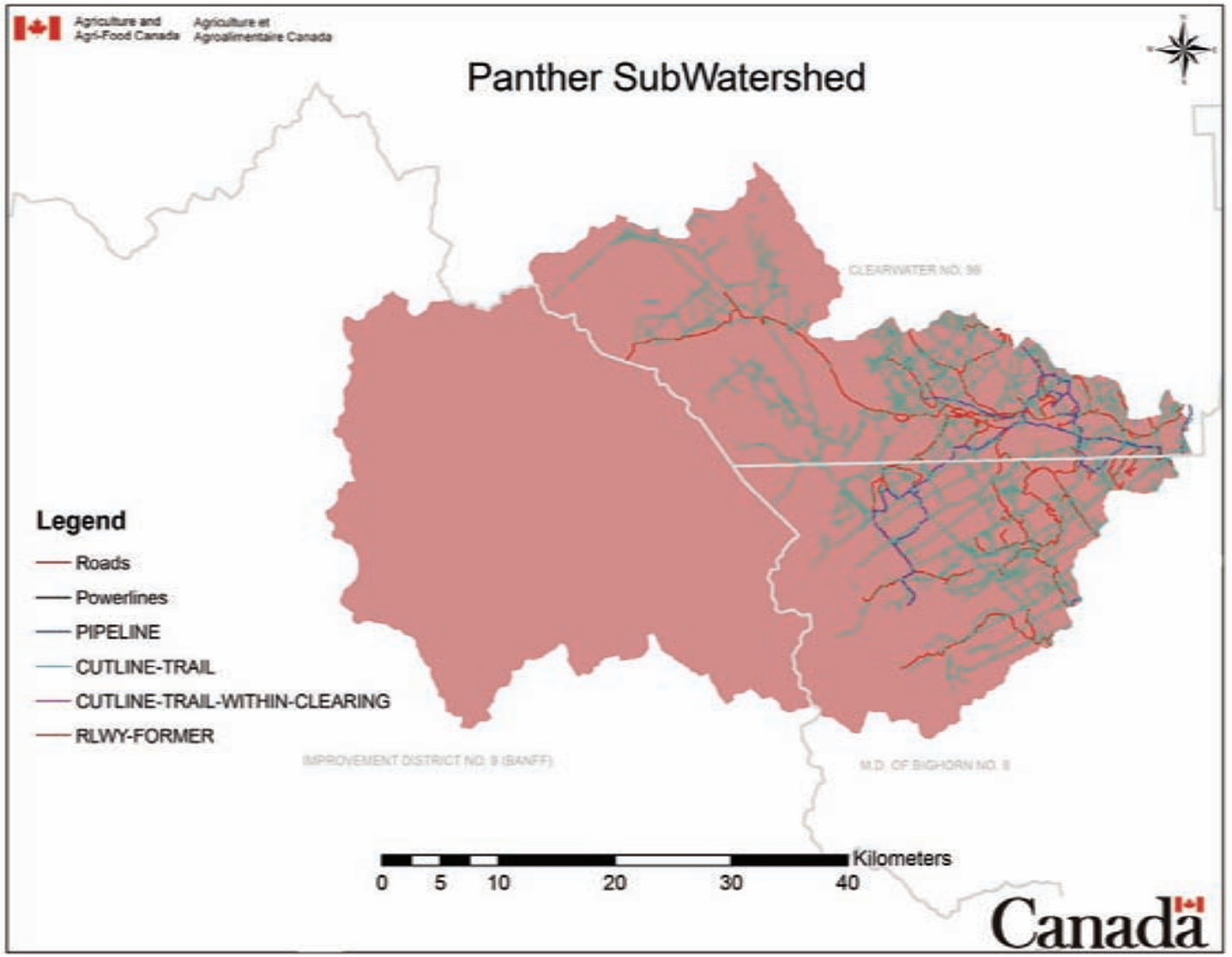


Figure 61. Linear developments in the Panther River subwatershed (AAFC-PFRA, 2008).

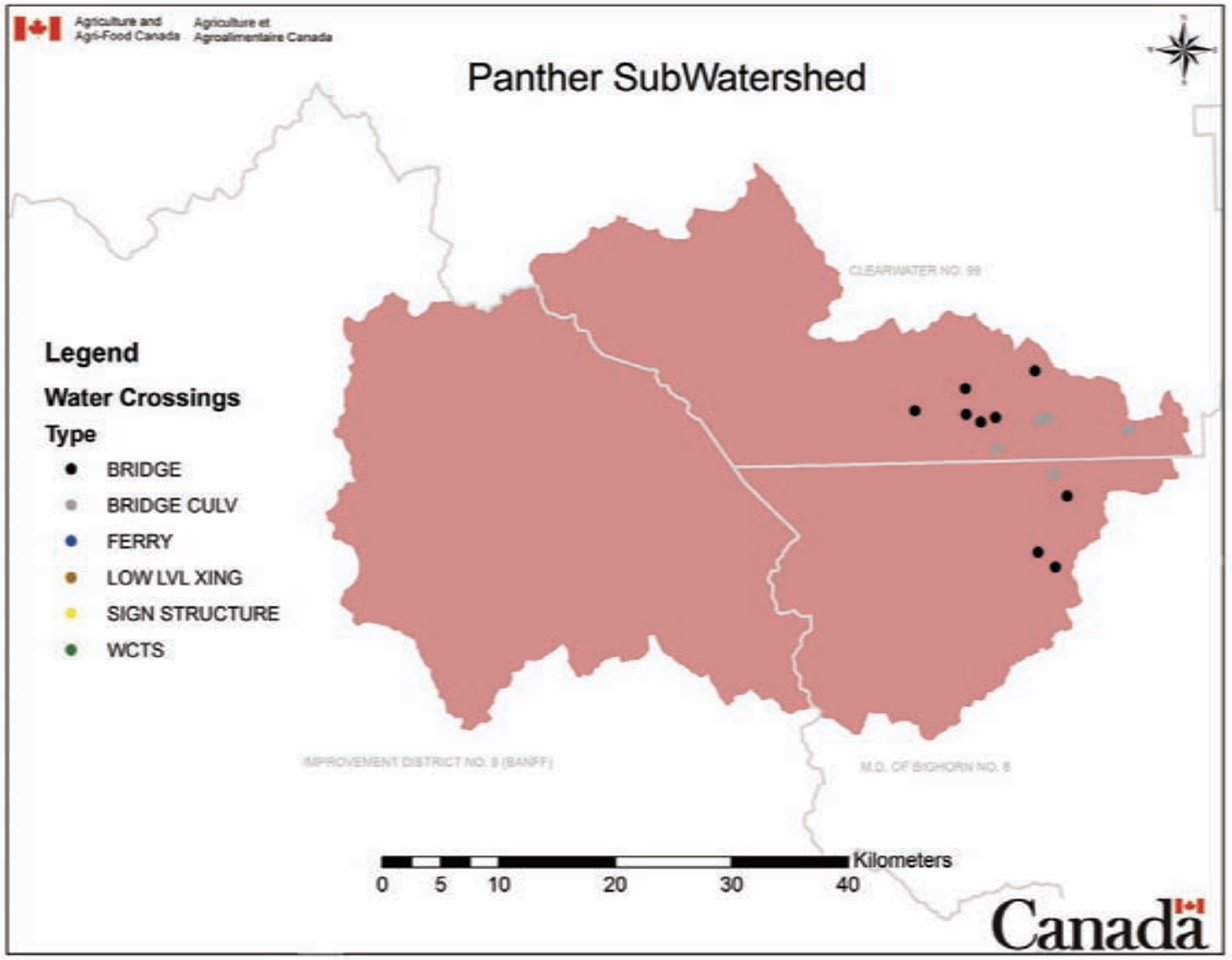


Figure 62. Waterbody crossings in the Panther River subwatershed (AAFC-PFRA, 2008).

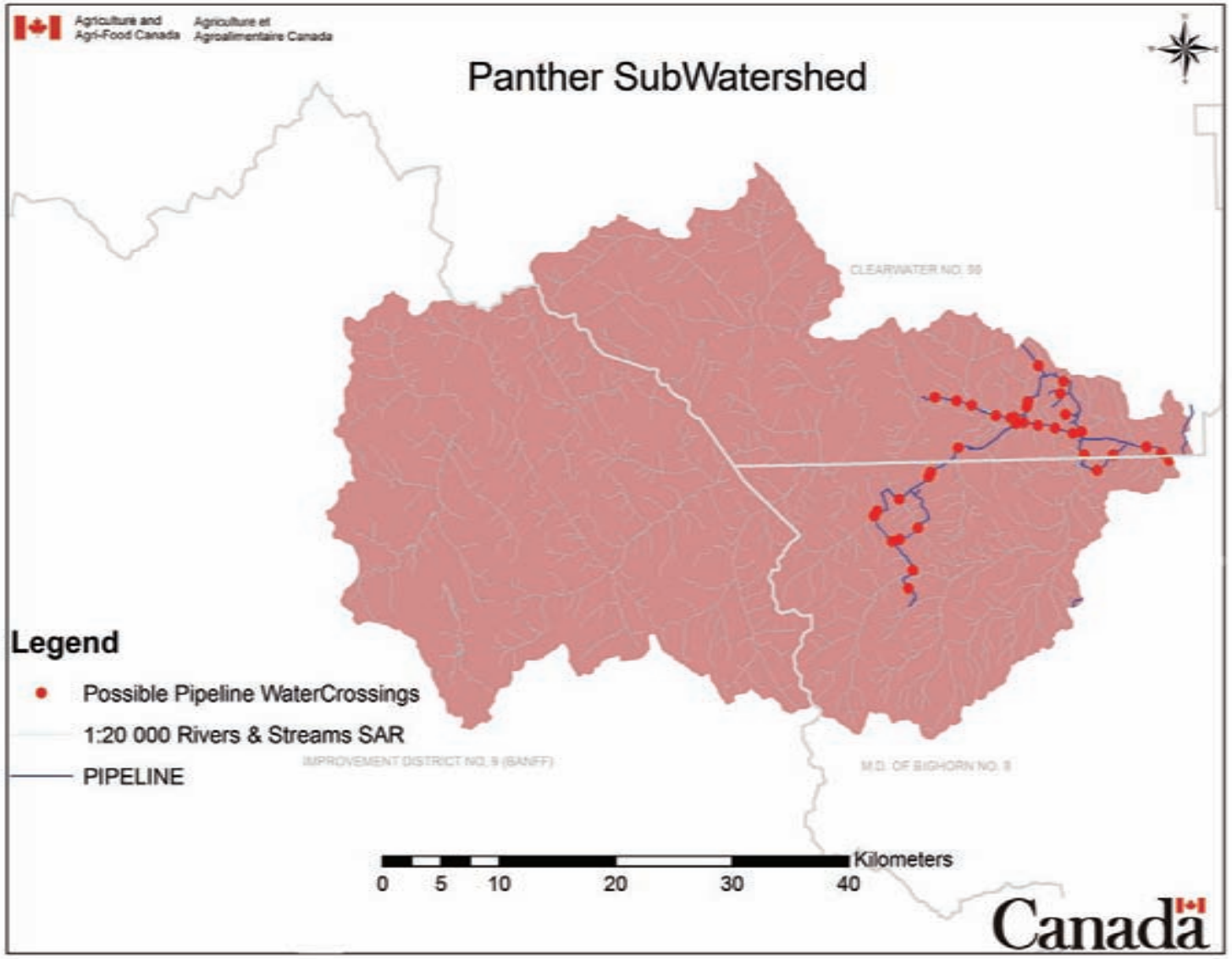


Figure 63. Pipeline crossings over waterbodies in the Panther River subwatershed (AAFC-PFRA, 2008).

4.1.2.6 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 Panther River subwatershed has the lowest oil/gas well density among the 15 subwatersheds of the Red Deer River watershed. There are a total of 107 wells in the subwatershed, of which only 57 are active wells (53%), and most of those are gas wells (Table 30). Well density averages 0.05 wells/km^2, with most wells located near Red Deer River and Burnt Timber Creek in the eastern region of the subwatershed (Figure 64) (AAFC-PFRA, 2008). There are no wells of any kind in the headwaters of the Red Deer River, since it lies in Banff National Park.

Table 30. Number of known active and abandoned oil, gas, water and other wells in the Panther River subwatershed (AAFC-PFRA, 2008).

Well type	Quantity
Wells – active *	14
Wells – abandoned *	40
Total	**54**
Gas wells – active	43
Gas wells – abandoned	10
Total	**53**
Oil wells – active	0
Oil wells – abandoned	0
Total	**0**
Water wells – active	0
Water wells – abandoned	0
Total	**0**
Total active wells in subwatershed	**57**
Total abandoned wells in subwatershed	**50**
Total wells in subwatershed	**107**

* 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.

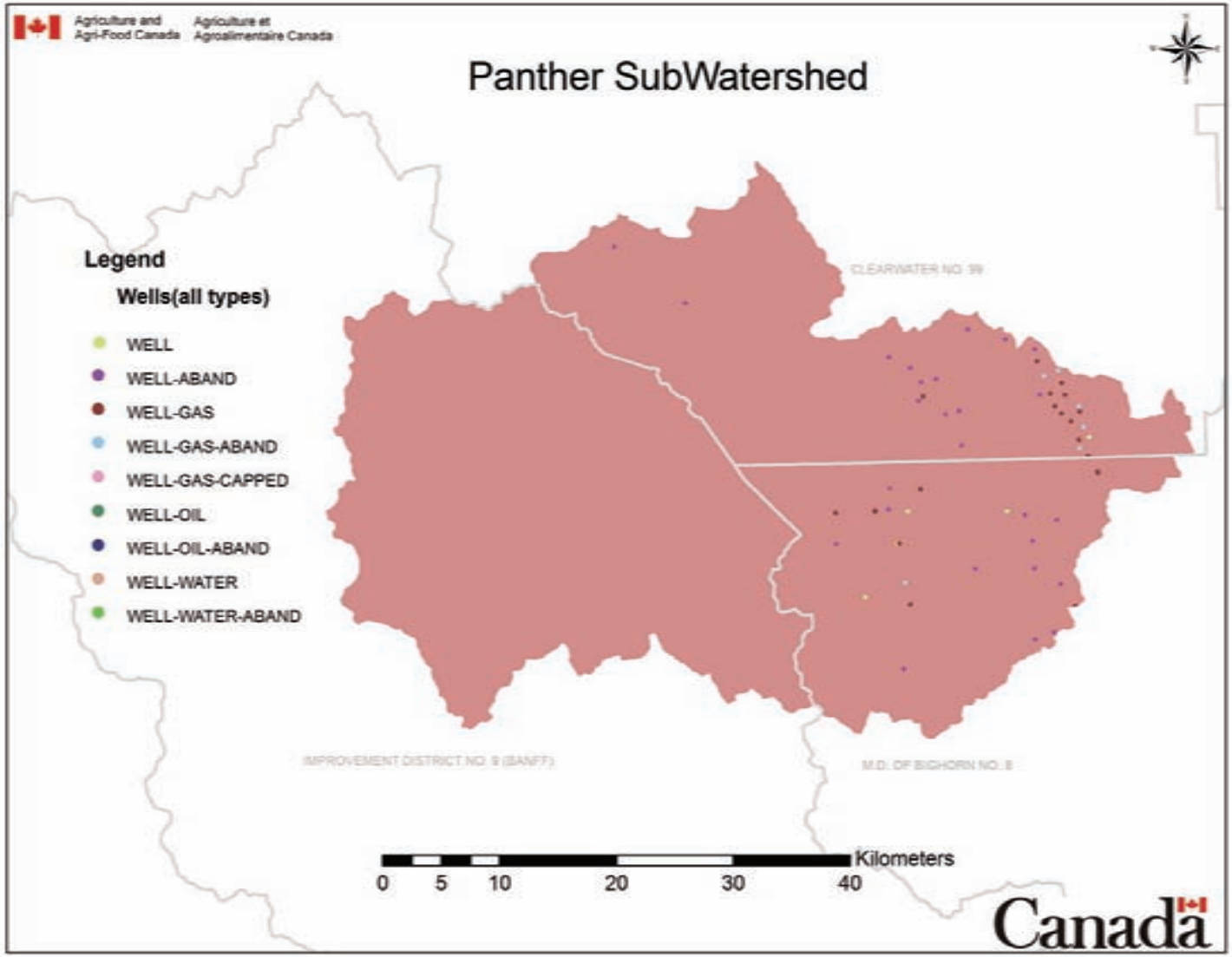


Figure 64. Known active and abandoned oil, gas, water and other wells in the Panther River subwatershed (AAFC-PFRA, 2008).

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).

4.1.3 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.

4.1.3.1 Nutrients

Nitrogen and phosphorus are essential nutrients for most aquatic plants, as a result, 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 become significantly reduced 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.

Water quality data from any waterbody in the Panther River subwatershed are rare, with only one sample having been collected in the past (1991). At that time, both TP and TN in Douglas Creek exceeded ASWQ and CCME PAL guidelines (0.05 mg/L and 1.0 mg/L, respectively) (Table 31).

Table 31. Water quality in Douglas Creek. Data are values from a single sample taken August 1991 (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	0.058	1
TDP	0.056	1
TN	1.245	1
NO_3^--NO_2^-	0.005	1
NH_3	0.03	1
DO	9.4	1
Chl. *a* (µg/L)	---	---
pH	8.13	1
Specific Conductivity (µS/cm)	1,023	1
TDS	---	---

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

4.1.3.2 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 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 Panther River subwatershed.

4.1.3.3 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 Panther River subwatershed.

4.1.3.4 Pesticides

Pesticides are a group of chemicals, including herbicides, insecticides, rodenticides and fungicides, which are 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 data were not located for any waterbody in the Panther River subwatershed.

4.1.3.5 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.

There are no waste water treatment facilities or stormwater outfalls located in the Panther River subwatershed. At least four upstream oil/gas facilities have released pollutants into the air annually since 2003. These pollutants include nitrous oxide (N_2O), carbon monoxide (CO) and particulate matter < 10 µm in size (NPRI, 2008). No untreated pollutants were released directly into aquatic ecosystems according to the National Pollution Release Inventory.

4.1.4 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.

4.1.4.1 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 water courses in the Panther River subwatershed is about 1,774 km (Figure 65) (AAFC-PFRA, 2008). The dominant streams in the subwatershed are the Panther River, Dormer River, Bighorn Creek, Divide Creek, Dogrib Creek, Douglas Creek, McConnell Creek, North Burnt Timber Creek, Pinto Creek, Scalp Creek, Sheep Creek, Snow Creek, Stud Creek, Timber Creek, Tyrell Creek, Wigwam Creek, Wildhorse Creek, Vam Creek, Winchester Creek and Yara Creek. Larger lakes in the subwatershed include Douglas Lake, Eagle Lake, Grouse Lake, Klein Lake, Pipit Lake, Prisoner Point Lake, Skeleton Lake and Snowflake Lake. In addition, there are numerous small creeks and sloughs in the subwatershed (Government of Canada, 2006).

Alberta Environment (Government of Alberta, 2008c) has been monitoring water discharge rates at five locations in the Panther River subwatershed: above the confluence of the Panther River (real-time active, 05CA004), at the confluence of Wigwam Creek (discontinued, 05CA008), above the confluence with Burnt Timber Creek (discontinued, 05CA003, 05CA005) and below the confluence of Vam Creek (real-time active, 05CA009).

Above the confluence with the Panther River, discharge rates range from 2-10 m^3/sec in early spring (April) and late summer and fall (September and October) to a maximum of up to 30 m^3/sec in spring and early summer (June and July) (Figure 66) (Government of Alberta, 2008c).

The only major water infrastructure located in the Panther River subwatershed is Klein Lake Dam, which controls the waterflow of the Panther River near its confluence with the Red Deer River; however, there are several smaller water infrastructures in the subwatershed, e.g., small dams, sluices, weirs and dykes, which control water flow rates.

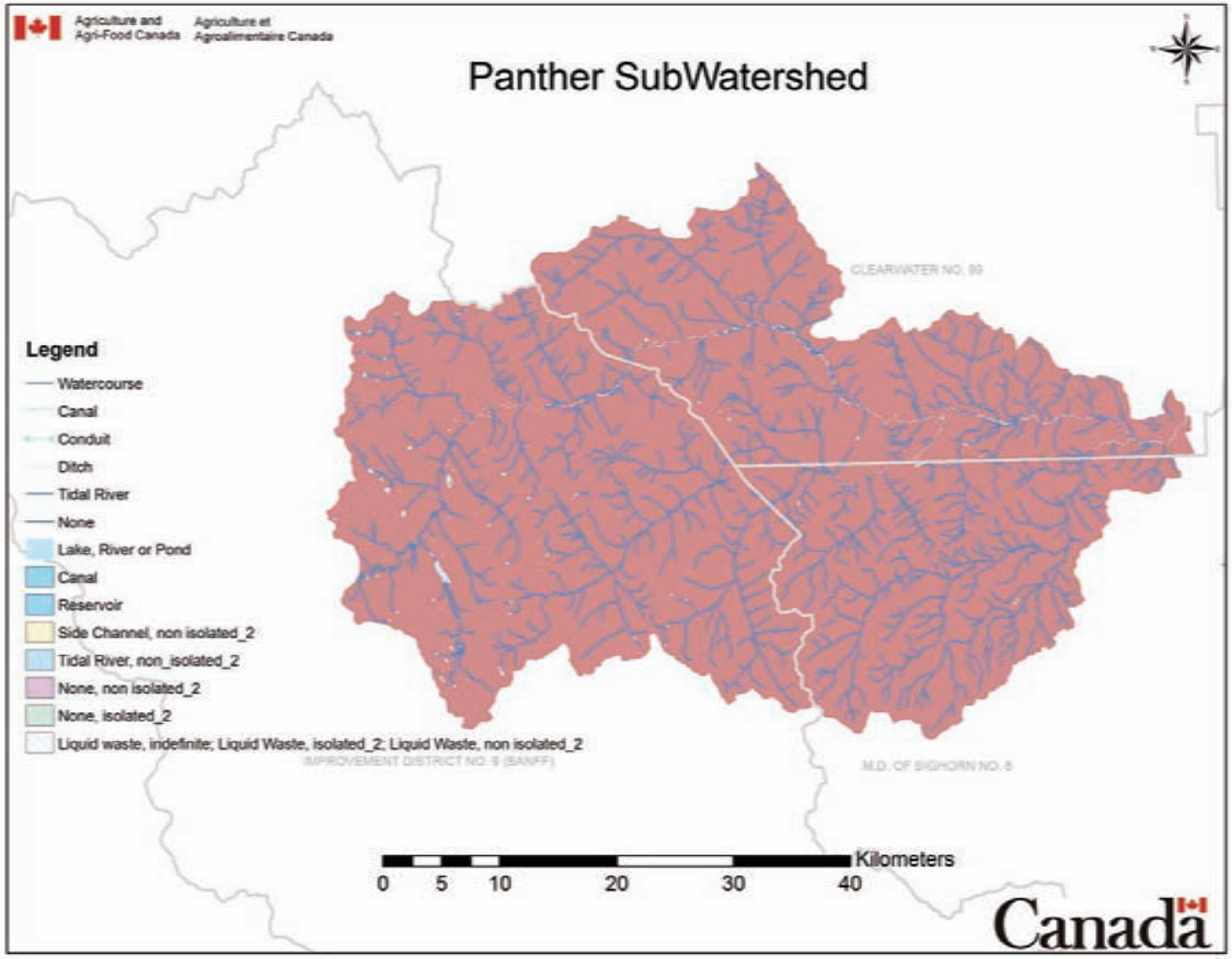


Figure 65. Waterbodies in the Panther River subwatershed (AAFC-PFRA, 2008).

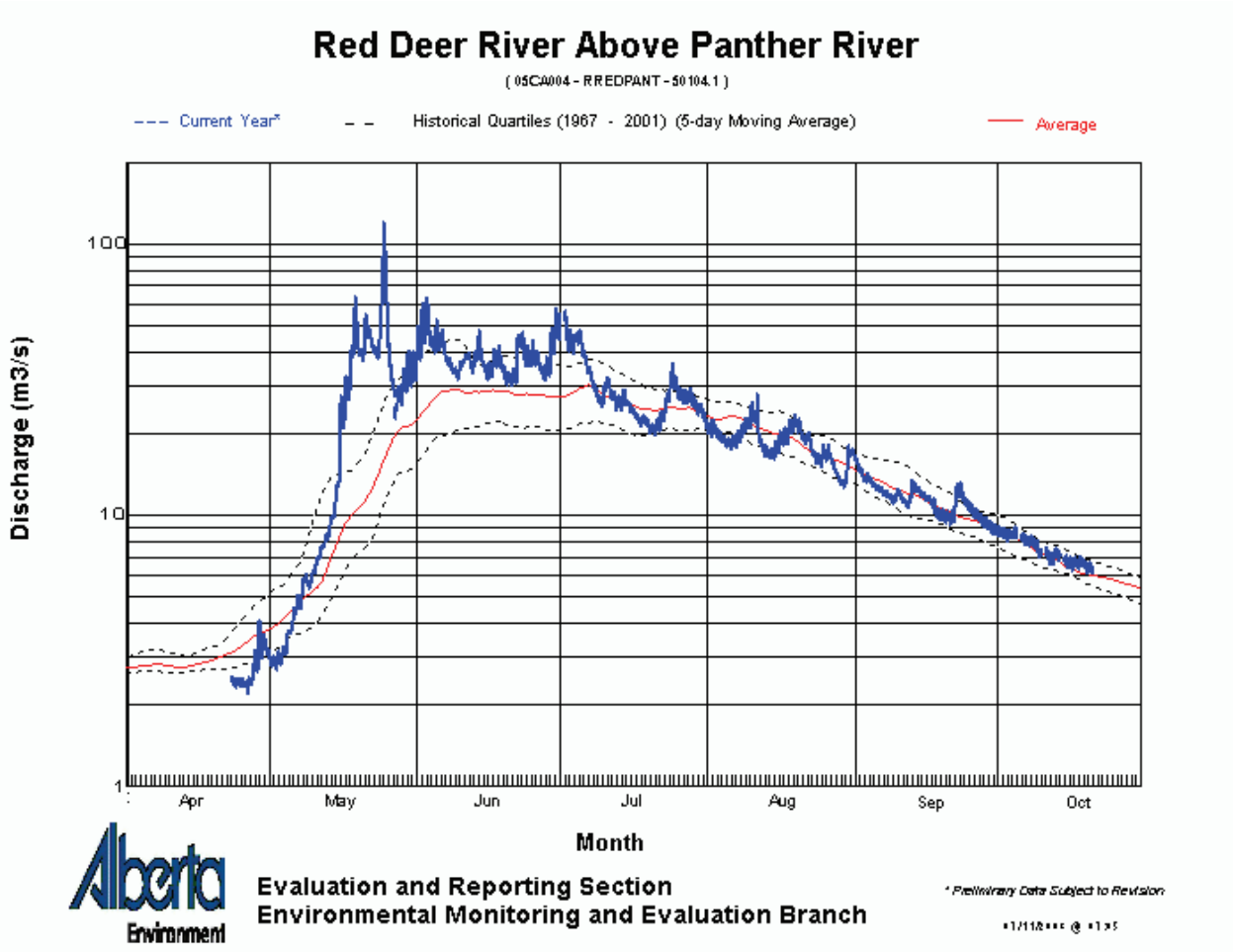


Figure 66. Discharge rates of the Red Deer River above the confluence with the Panther River (Government of Alberta, 2008c). "Current year" indicates water discharge rates in 2008.

Below the confluence with Burnt Timber Creek, water discharge rates range from 4-9 m^3/sec in the spring (April) to 40-60 m^3/sec in summer (June and July). In the fall, discharge rates decrease to 10-20 m^3/sec (Figure 67). Historical discharge rates at both measuring stations vary by up to 10 m^3/sec, particularly in the early summer months, but the variation is generally less than 1 m^3/sec during the remainder of the year. Water discharge rates in the Red Deer River were well above historical levels at both monitoring stations in the spring 2008, when they exceeded 100 m^3/sec above the confluence with the Panther River and 500 m^3/sec below Burnt Timber Creek (Figures 66, 67) (Government of Alberta, 2008c).

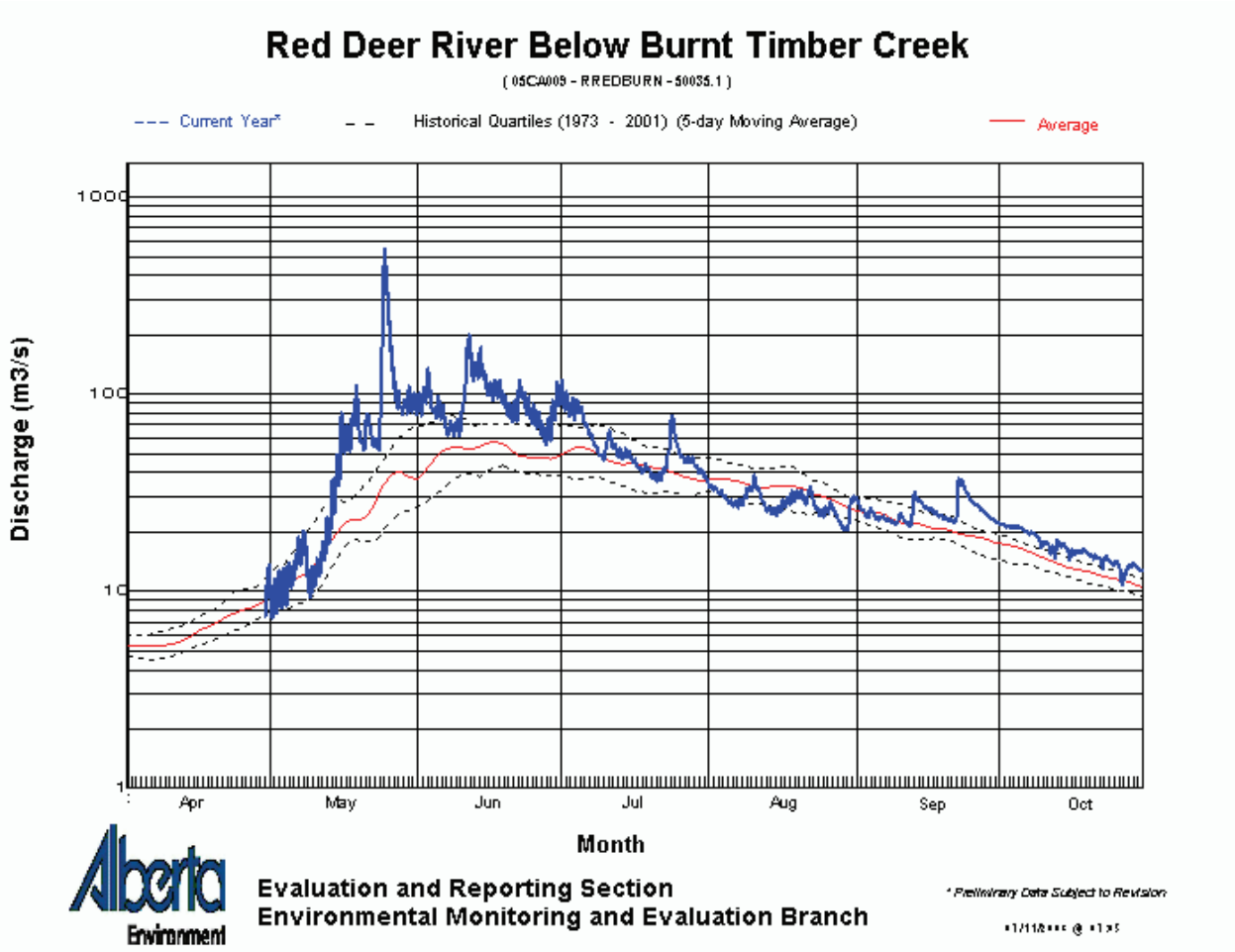


Figure 67. Discharge rates of the Red Deer River below the confluence with Burnt Timber Creek (Government of Alberta, 2008c). "Current year" indicates water discharge rates in 2008.

4.1.4.2 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 Panther River subwatershed.

4.1.4.3 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.

The entire subwatershed contributes to the annual stream flow, i.e., there are no non-contributing drainage areas in the Panther River subwatershed (AAFC-PFRA, 2008). The steep slopes prevalent in the

Rocky Mountains (Figure 68) facilitate high run-off rates and eliminate areas that may not contribute to drainage within the subwatershed.

4.1.4.4 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 Panther River subwatershed, 86 surface water licenses have been issued (Figure 69). They are located primarily in the eastern areas of subwatershed. No groundwater diversion licenses have been issued anywhere in the subwatershed (AAFC-PFRA, 2008).

4.1.4.5 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 Panther River subwatershed has about 27 freshwater springs, of which nearly half are located in the vicinity of the confluence of Burnt Timber Creek and the Red Deer River. About ten freshwater springs are located either on the Panther River mainstem or on its tributaries (AAFC-PFRA, 2008).

The northeast area of the Panther River subwatershed falls within Clearwater County, for which a groundwater assessment has been conducted by HCL (2004). The assessment indicated that most of the area south of the Red Deer River is a groundwater recharge area (i.e., water moves from the surface into groundwater reservoirs), whereas most of the area north of the Red Deer River is a discharge area (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 (2004).

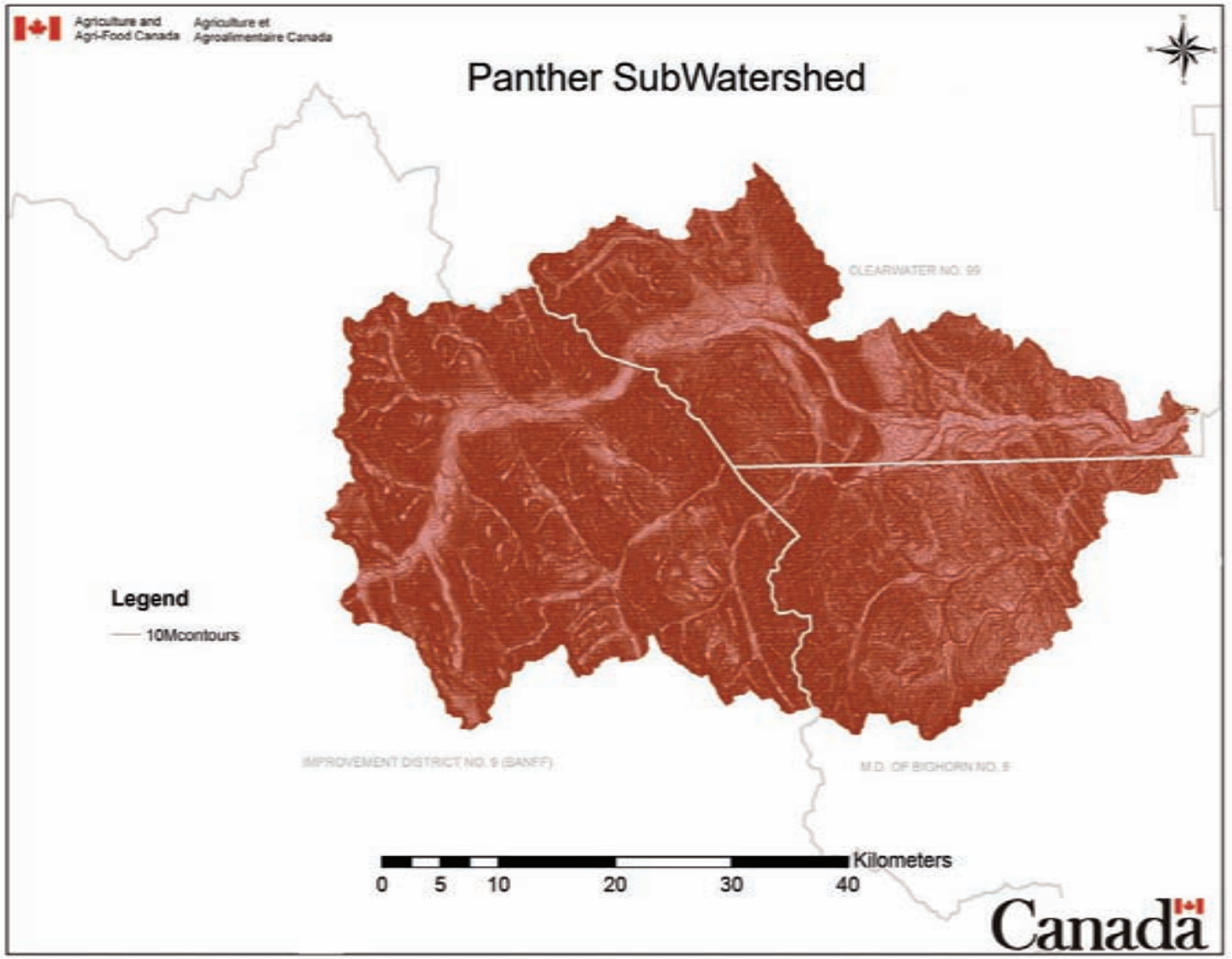


Figure 68. Topography (10-m contour intervals) of the Panther River subwatershed (AAFC-PFRA, 2008).

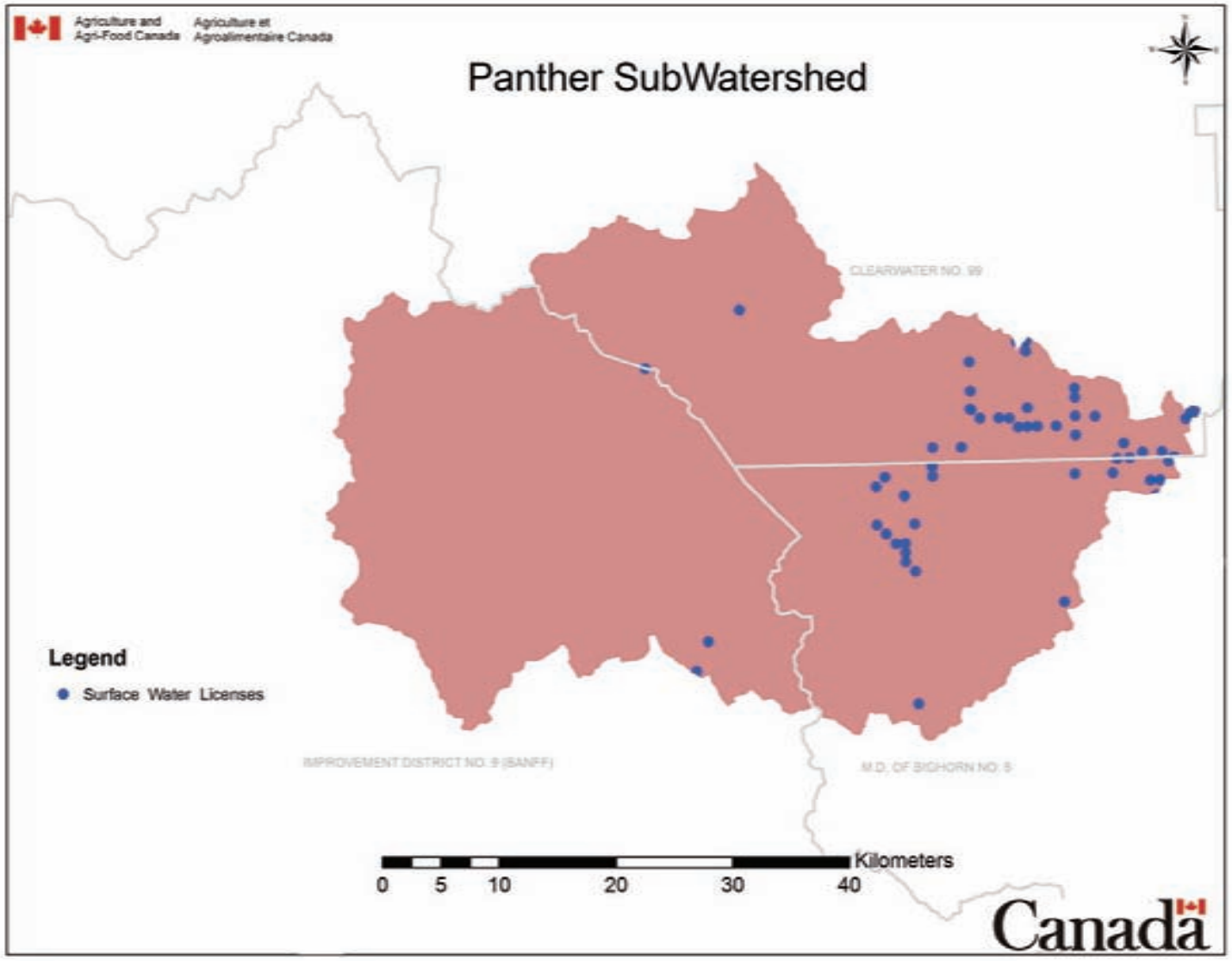


Figure 69. Surface water licenses in the Panther River subwatershed (AAFC-PFRA, 2008).

4.1.5 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.

4.1.5.1 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 Panther River subwatershed.

4.1.5.2 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 Panther River subwatershed.

4.1.5.3 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.

The majority of the Panther River subwatershed is covered by coniferous forests (50%) or exposed land (33%). There are no wetlands or annual or perennial croplands in the subwatershed (Figure 70, Table 32). The age structure of forest stands in this subwatershed has been altered due to timber harvesting activities, i.e., forest stands tend to be younger than in non-harvested forest stands.

Table 32. Land cover in the Panther River subwatershed (AAFC-PFRA, 2008). The most prominent land cover types are highlighted.

Land cover type	Area (ha)	Proportion of subwatershed area (%)
Waterbodies	513	0.22
Exposed land	75,003	32.60
Developed land	219	0.10
Shrubland	13,859	6.02
Grassland	20,150	8.76
Coniferous forests	115,779	50.32
Deciduous forests	114	0.05
Mixed forests	101	0.04
No data	4,347	1.89
Total	**230,087**	

There are no provincially, nationally or internationally designated Ecologically Significant Areas in the Panther River subwatershed (Alberta Environmental Protection, 1997).

4.1.5.4 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 Panther River subwatershed is home to three species of special concern, i.e., native species, sub-species or ecologically significant units that warrant special attention to ensure their conservation. These are the monarch butterfly (*D. plexippus*), Western Toad (*B. boreas*) and yellow rail (*C. noveboracensis*). There are no endangered or threatened species in the subwatershed. Detailed descriptions of these species are provided in Section 3.1.3.7.

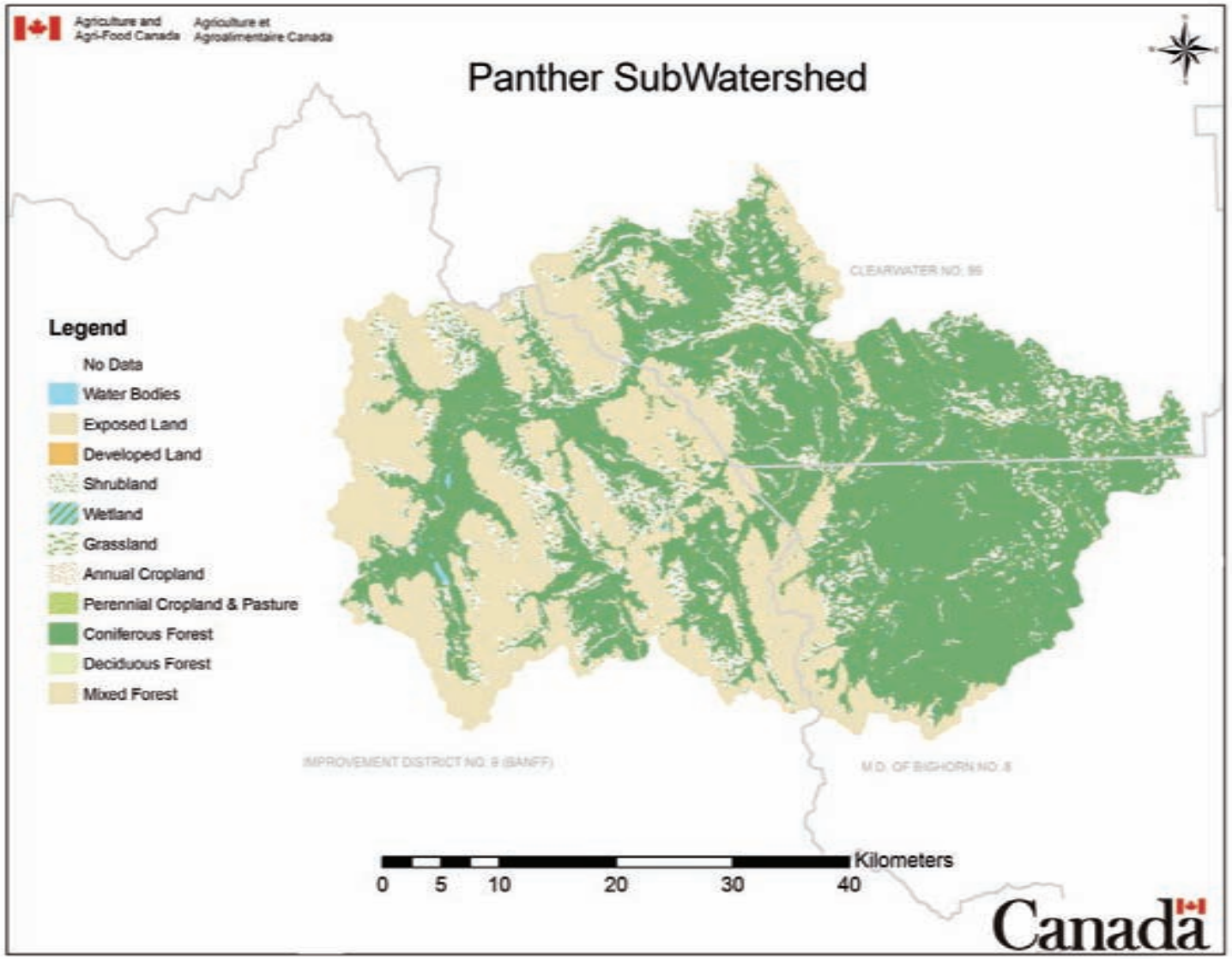


Figure 70. Land cover in the Panther River subwatershed (AAFC-PFRA, 2008).

4.1.6 Subwatershed Assessment

The Panther River subwatershed is the western-most subwatershed of the Red Deer River watershed. It is located in the Alpine, Subalpine, Upper and Lower Foothills Subregions, which contributes to its high biogeophysical diversity. Data on land use, water quality and quantity and flora and fauna are limited due to the subwatershed's remoteness and general inaccessibility. The subwatershed is characterized by low livestock and agricultural intensity. There are no communities located in the subwatershed; however, resource exploration and extraction activities have resulted in a network of linear developments, which consist primarily of cutlines. In addition, there are 57 active oil/gas/water wells in the subwatershed. There is a scarcity of information on water quality, although existing data indicate TN and TP concentrations above CCME PAL guidelines. No bacteria, parasite and pesticide data were located for any waterbody in the subwatershed. An abundance of streams and creeks in the subwatershed and the often high relief of the landscape contribute to high stream discharge rates, particularly following the spring freshet, when discharge rates frequently exceed 100 m^3/sec. No biodiversity assessment data were located for this coniferous forest and exposed lands-dominated subwatershed, although three SARA species of special concern inhabit this rugged and mountainous terrain.

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 Panther River subwatershed receives a rating of "good" for the condition indicators and a rating of "low" for the risk indicators (Tables 33, 34). Overall, this subwatershed receives a ranking of "A". 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.

Table 33. Condition and risk indicator summary for the Panther River subwatershed. Gray logos indicate data gaps.

Condition Indicators


Risk Indicators


Table 34. Condition and risk assessments of the Panther River subwatershed.

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

