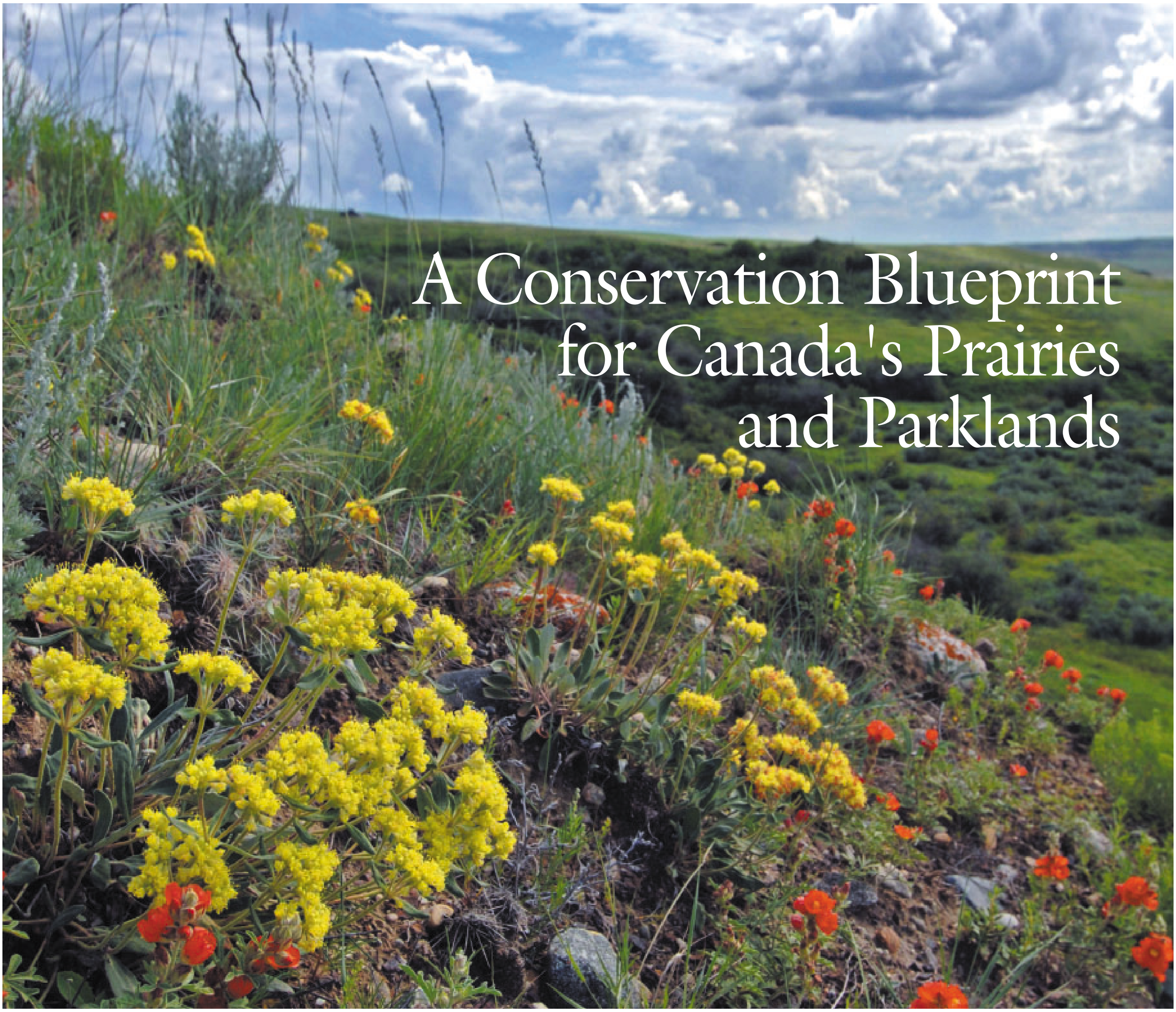
A Conservation Blueprint for Canada's Prairies and Parklands



J.L. Riley, S.E. Green and K.E. Brodribb

2007

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The Nature Conservancy of Canada (NCC) is a non-profit, non-advocacy organization that takes a business-like approach to land conservation and the preservation of Canada's biodiversity. Its plan of action involves partnerships and creative conservation solutions with individuals, corporations, community groups, conservation organizations and government agencies that share its passion. Since 1962, NCC and its supporters have protected more than 765,000 hectares (1.9 million acres) of ecologically significant land across Canada — mountains and valleys, coasts and lakes and rivers, and prairies, parklands, forests, wetlands and tundra — and all the species and ecosystems that these landscapes support.

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Contents

Summary

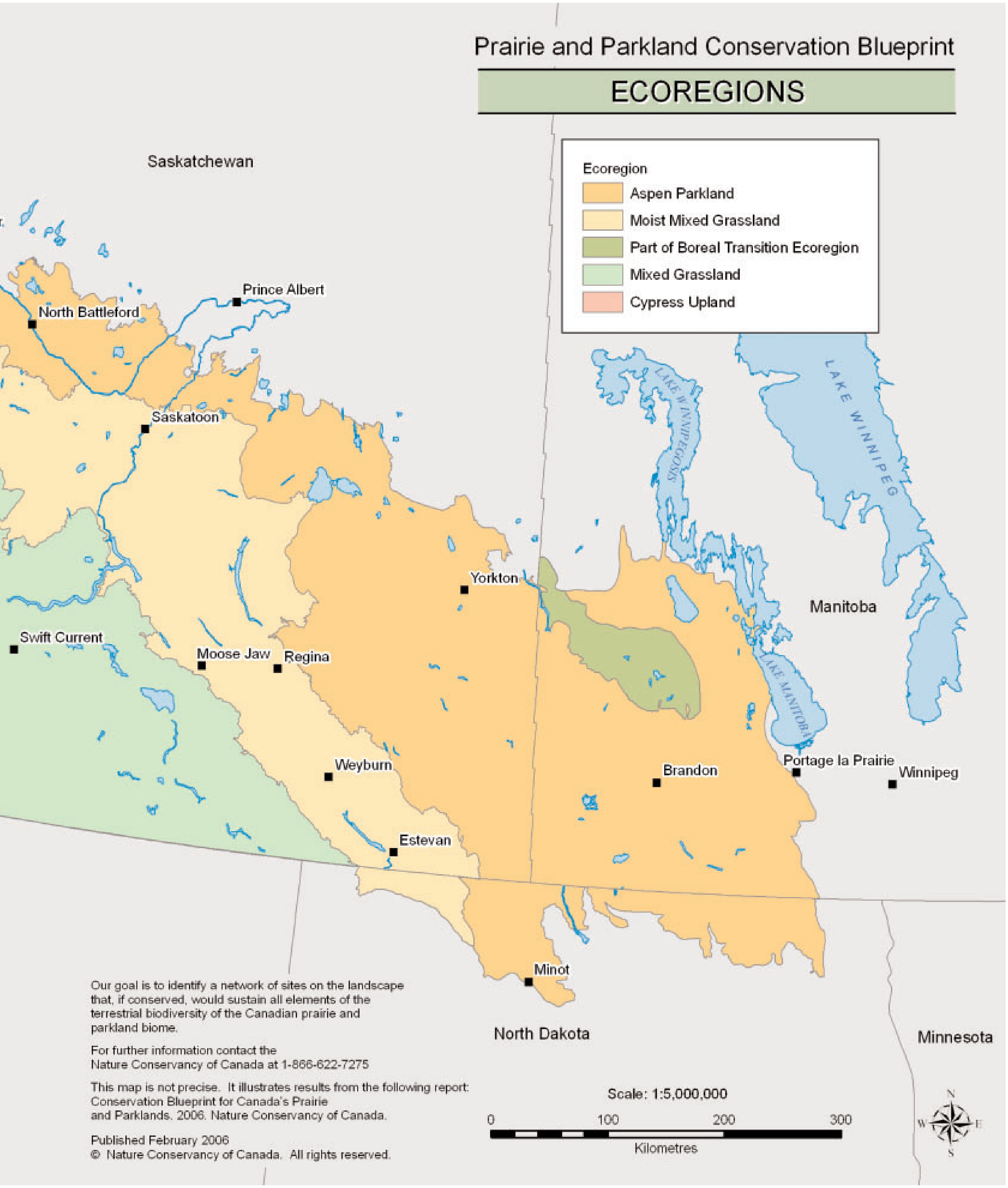
The prairies and parklands of Canada and the adjacent United States are the northern reach of North America's great plain, one of the Earth's great grassland biomes. The history of agricultural land conversion and wildlife removal in this biome is unparalleled among world grasslands, involving the virtual or literal elimination of many ecologically significant species like the Plains Bison, Buffalo Wolf, Plains Grizzly, Passenger Pigeon and Rocky Mountain Locust.

On the U.S. great plains to the south, two thirds of the land remains in natural cover, with one third under cultivation. The comparable figures for the Canadian prairies and parklands are the reverse — one third (34%) left in natural cover and two thirds under cultivation or development.

The region's historic disturbance regimes of heavy natural grazing, fire, drought, flood and insects have been stabilized in support of an alternate non-native grassland ecosystem based on agriculture. The vast majority of this conversion was completed from 1880 to 1930, after which a major drought enforced new lessons about land stewardship. Community pastures were established and tame pastures expanded. Land retirement and land conservation have become important tools in re-distributing crop agriculture to appropriate agricultural soils. At present, 21% of the land base is in public ownership (including waters), and 79% is in private ownership.

The region witnessed an early and active history of wildlife-conservation regulations and wildlife restoration, largely through government agencies. This work continues through Canada's most successful wetland and waterfowl conservation venture, the Prairie Habitat Joint Venture (PHJV), through which private-sector organizations are major partners. The PHJV is now diversifying its interests to all birds and to upland habitats, and is engaging private landowners and groups far beyond the original public-agency work in the region.

Figure 1. Study area: the Aspen Parkland, Moist Mixed Grassland, Mixed Grassland and Cypress Upland ecoregions.


Prairie and Parkland Conservation Blueprint
ECOREGIONS
Ecoregion
Aspen Parkland
Moist Mixed Grassland
Part of Boreal Transition Ecoregion
Mixed Grassland
Cypress Upland
Saskatchewan
Manitoba
North Dakota
Minnesota
Prince Albert
North Battleford
Saskatoon
Yorkton
Swift Current
Moose Jaw
Regina
Weyburn
Estevan
Minot
Brandon
Portage la Prairie
Winnipeg
LAKE WINNIPEGOSIS
LAKE WINNIPEG
LAKE MANITOBA
Our goal is to identify a network of sites on the landscape that, if conserved, would sustain all elements of the terrestrial biodiversity of the Canadian prairie and parkland biome.
For further information contact the Nature Conservancy of Canada at 1-866-622-7275
This map is not precise. It illustrates results from the following report: Conservation Blueprint for Canada's Prairie and Parklands. 2006. Nature Conservancy of Canada.
Published February 2006
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Scale: 1:5,000,000
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Whole-biome conservation planning has occurred across the region through the PHJV, the Prairie Conservation Action Plan, and the Endangered Spaces Campaign of World Wildlife Fund (Canada). These and other international trans-boundary assessments concur on the ecological importance of the biome and the shortfall in conservation efforts, for example in identifying and stewarding the lands that have their highest and best land use as conserved lands. This on a landscape with very few conserved lands, a maximum 7.1%, and where natural cover has been reduced to a third of its original extent.

Significant threats remain to this prairie and parkland biome. Farm-gate prices remain a key determinant of the intensity of agricultural pressure on the lands and waters of the region. The impacts of drought, groundwater depletion, climate change, trade shocks and new farm practices remain unpredictable and net farm income continues to decline.

This conservation blueprint contributes to a better documentation of the biological diversity of the four ecoregions comprising the prairie and parkland biome (Fig. 1). The study area includes parts of three provinces, two states and two countries. It documents existing conservation efforts, the biodiversity of the region (target species and ecological systems), conservation goals to be met to sustain those targets, and the places that best meet those goals.

This atlas and analysis of the biological diversity of the Canadian prairies and parklands is offered as a contribution to a shared understanding of the conservation geography of the region, to help frame the **identification of a suite of core biodiversity conservation areas, set within the supporting network of remaining natural cover.** Individuals, agencies, conservation practitioners and others may find the data useful, along with other data, in determining the set of **priority landscapes** that should be the focus of conservation efforts. A blueprint such as this can also be used to inform the types of long-term stewardship needed to conserve prairie and parkland landscapes, whether through passive management or by emulating disturbance regimes to maintain natural diversity and particular species and ecosystems.

This report summarizes an assessment of the biological diversity of four terrestrial ecoregions in the prairie, parkland and Cypress upland of Canada and the northern United States (Montana and North Dakota). In addition, two ecodistricts adjacent to and including Riding Mountain National Park were included because the Riding Mountain is effectively an island surrounded by aspen parkland and, now, agricultural land.

This conservation blueprint is a first attempt to identify and map conservation targets, map existing protected areas and conservation lands, analyze the current protection of particular target species and ecosystems, and identify the best areas required to meet shortfalls in achieving conservation goals set for those targets.

Classifying and mapping ecological systems was central to this project. These ecological systems were used as coarse-filter targets, and provided the framework for comparisons of different sites.

Detailed location information on rare and endangered species provided the fine-filter targets for the project. This information was assembled with the assistance of the provincial Conservation Data Centres and Natural Heritage Information Centres, and state Natural Heritage Programs. Mapping protected areas and other conservation lands helped us assess the ecological systems and species already conserved in these areas.

Specific examples of native ecosystems were identified as a result of the coarse-filter analysis. Other sites were added to the blueprint portfolio to address the under-representation of fine-filter targets.

Federal and provincial protected areas and other conservation lands cover just over 9% of the Canadian study area, of which this study has mapped 7.1%:

- 1.2% federal protected areas;
- 0.9% provincial protected areas;
- 2.5% federal conservation lands;
- 2.9% provincial conservation lands; and
- 1.9% PHJV lands.

(There is overlap in counting between PHJV lands and other categories.)

Regulated protected areas total 2.0% of the prairie and parkland biome. Other non-regulated conservation lands make up the bulk of lands for which there is some expression of conservation intent. By area, the key lands are the community pastures, national defence lands, agricultural lease lands with wildlife protection, and Prairie Habitat Joint Venture lands.

As it organizes itself on the landscape — and is organized by humans — biological diversity occupies a whole range of potential sites meeting different conservation goals, all of which deserve consideration in a conservation plan. These sites range from small to large in size, reflecting the various scales of biological diversity.

A. **Small sites** conserving fine- and mid-scale targets, with functionality in terms of the viability of target species and communities.

B. **Large sites** conserving coarse-scale targets such as large grassland ecological systems, with functionality in terms of specific targets but not with respect to landscape-scale biodiversity.

C. **Functional landscapes** that also conserve common or matrix communities and species at coarse, intermediate and fine scales, with a high degree of intactness across an area.

D. The **remaining natural cover** across the region as a whole, which provides a habitat network essential to sustaining species populations and environmental goods and services as a whole.

E. The **broader landscape** across which is delivered the full range of environmental goods and services, and within which there are sites where restoration of natural habitats or rehabilitation of supportive environmental conditions are important for maintaining or recovering particular species, habitats or ecological systems that have declined below levels needed for their persistence.

The tile maps at the end of the report illustrate blueprint outputs at the scale of **small sites** (A), **large sites** (B), and **natural cover** (D). The same maps, when considered in conjunction with other sources of information and expert opinion, provide much of the information needed by conservation planners to start mapping **functional landscapes** or "priority landscapes" for conservation attention (C), and to address the restoration and rehabilitation needs of the **broader landscape** (E). Results from the project are presented in a variety of ways in addition to the "tile maps", in order to illustrate a few of the ways such data may be used, for example as:

- Percent of ecodistricts remaining in natural cover;
- Percent of ecodistricts in protected area or conservation land;
- Percent of ecodistrict identified as required to meet the blueprint's conservation goals;
- Top scoring ecological systems by ecoregion, by study area, and by jurisdiction; and
- Ecodistricts with high concentrations of rare species.

Collectively, these results provide biome-wide context for higher-level conservation planning. At finer scales, the tile maps suggest options and opportunities for meeting the conservation challenges raised by the biome-wide analysis.

A particular challenge on highly fragmented and converted landscapes is the identification of strategies involving the restoration or rehabilitation of intervening or adjacent lands and waters. This is also best done at scales finer than the blueprint scale, but the blueprint provides useful contextual data for discussions of appropriate restoration goals (species, systems) in appropriate areas.

The blueprint identifies and maps 2.0% of the land base of the prairies and parklands as formally protected for conservation, and a further 5.2% in other conservation lands. Natural cover remains on 34% of the land base, and the blueprint identifies more than half of this (18% of the land base) as core biodiversity conservation areas. In total, this includes existing protected areas, other conservation lands, highest scoring ecological systems within each ecodistrict, and the occurrences of other biodiversity targets where they are not otherwise sufficiently included in other identified areas.

There is consensus that the region is experiencing more rapid climate change than occurred naturally in the past, with attendant increases in mean temperature and weather variability, and with decreases in precipitation and groundwater. The impact of this on biodiversity will become clearer over time, but a further consensus is likely to emerge that larger-than-present conservation of landscape-scale blocks of intact prairie, parkland and valleyland habitat is required as a minimum response to this additional challenge to our native biodiversity.

The blueprint describes a landscape that will support the conservation targets that it considered in its analysis. The appropriate recognition and conservation of those targets, through the conservation of the lands identified by the blueprint (at a minimum) would significantly ensure the long-term persistence of those targets and of the overall biological diversity of the region.

It remains a worthwhile and perpetual goal to assemble region-wide data that can support regional assessments of our collective achievements and needs in the field of biodiversity conservation. This first-iteration attempt is an encouragement to others to continue to partner in this difficult task, and to consider a deliberate organization of collective conservation planning.

To this end, priorities need to be set for developing region-wide classifications and mapping of native habitats and vegetation, of surficial geology and landform, of ecological systems, and of conservation targets. These efforts must have seamless, region-wide mapping layers as a goal if they are to support region-wide resource management and effective conservation planning. They will enhance the measurement of targets, goals and achievements, and support effective conservation efforts on the ground.

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Kara Brodribb: project manager and administration; methods design; report writing.

John Riley: program lead; methods design; primary author; report production.

Sarah Bretl: editing.

Judie Shore: design and page layout.

Colin Anderson: DVD development.

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(Organization affiliations listed are those at the time of assistance to the project.)

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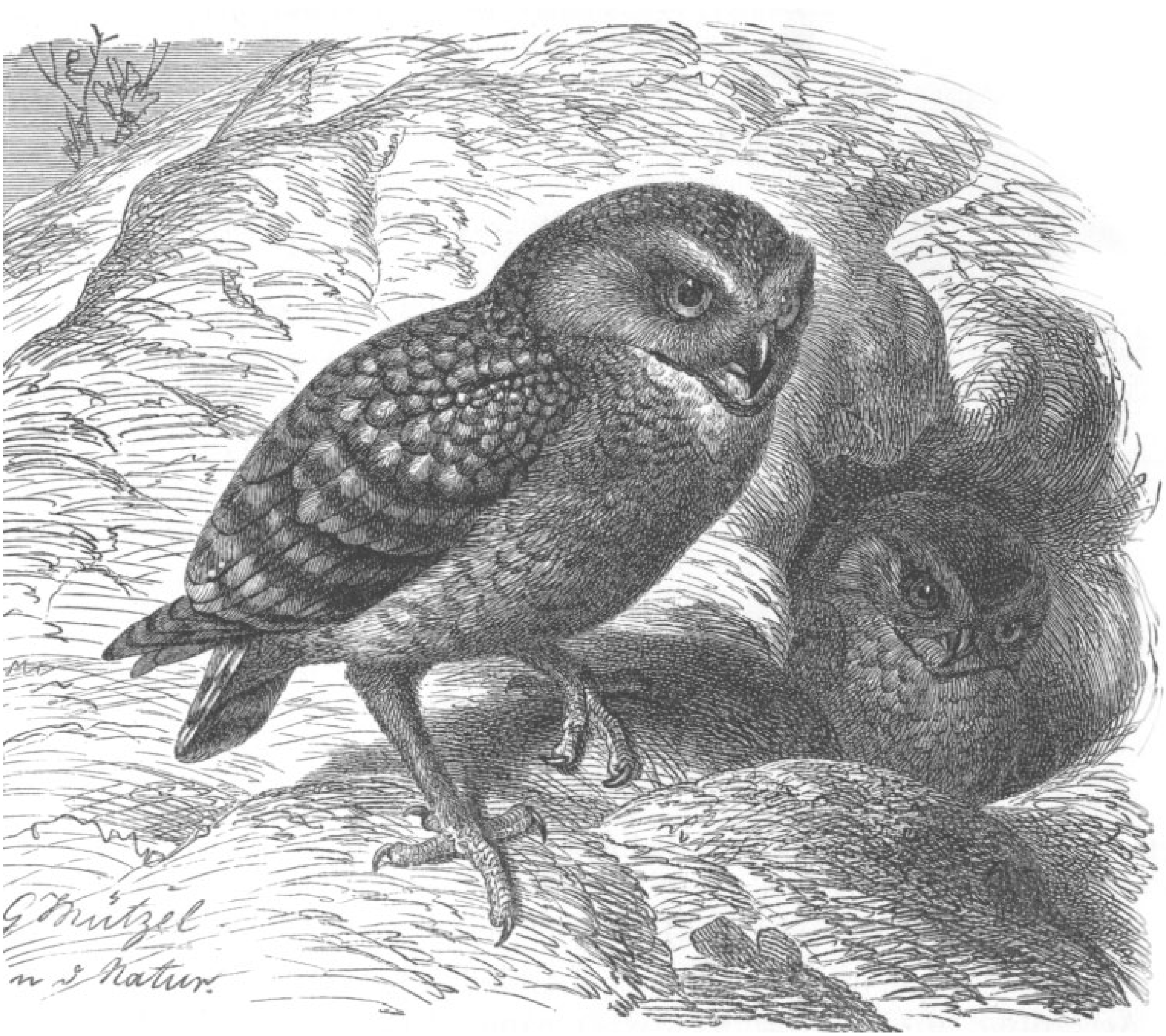
SECTION 1.0

Overview

Canada's prairies and parklands are part of North America's great plains, which represent collectively as much as 10% of the Earth's grasslands. This biome covers about 5% percent of Canada and, of its historic extent of native prairies and parklands, less than 34% now remains intact.



Grasslands cover between 41 and 56 million km^2 (31-43%) of the Earth's surface. Historically, they were one of the most productive and diverse terrestrial ecosystems, dominated by grass, forb and shrub vegetation, and maintained by grazing, fire, drought and extreme temperatures (WRI 2000). Canada's great prairie grasslands are also indissolvably nested with myriad wetlands and with aspen parkland on its cooler and more mesic sites.

This is a landscape that has now been totally re-shaped by modern human activities (Fig. 1). By 1881, the era of free-ranging Plains Bison was over and the railhead had reached Brandon, Manitoba. Farming was still restricted to small garden plots at fur trading posts, and a few milk cows had been brought by freighter canoe. The railhead reached Calgary two years later and branch lines reached Saskatoon and Edmonton by 1891. Farms started as linked networks along the railways and, by 1910, had filled the space between. The fastest rates of land conversion to crop, summer fallow and seeded pasture took place from 1900 (22,000km^2 total) to 1930 (243,000km^2 total). Canadian cattle ranching began on the open range in the 1870s. Domestic animals increased by 1921 to the equivalent of 4.4 million animal units and slowly stabilized around 5.8 million animal units by 1976. Cattle numbers grew most rapidly over that period, with hog numbers growing most rapidly since. For years, the erosion of organic matter from cropland soils was a major concern, and large acreages were converted to tame forage involving non-native perennial grasses, compounding the challenges to the remaining natural ecosystems (Coupland 1977).

The reduction of natural ecosystems in the region is not over. For example, *"From 1971 to 2001, Saskatchewan's natural pastures, wetlands and woodlands located on the prairies and parklands declined from almost 8,000,000ha to about 6,400,000ha"* (Saskatchewan Environment 2005).

The Canadian prairie and parkland biome supports almost 4 million people. This is almost four times the density of the population occupying the same biome in the United States. Most Canadians in this biome live in urban centres (81%), comparable with the rest of Canada, but notable in that urban land uses occupy less than 0.3% of the land. Accelerating emigration from rural to urban areas is the present trend, as is the shift away from traditional agricultural and resource employment.

The prairie and parkland region is now an overwhelmingly agricultural system. Fourteen field crops (grains, oilseeds and pulses) and even fewer forage crops occupy more than 95% of cultivated lands (GOC 1996). Irrigation and intensive modern farming practices are increasing productivity across the region and reducing inputs. The production of in-door domestic livestock is significantly changing cropping patterns, and beef remains the predominant outdoor livestock, much of it grazing on native grassland conserved for that purpose.

The agricultural economy of the region has been depressed, and may continue so for the foreseeable future (Gauthier *et al.* 2003). It is "boom and bust" economy with highly unpredictable year-to-year variation in farm income (*e.g.*, from 1961 to 1975, variation in net farm income was 86% in Saskatchewan, compared with 20% in Ontario; Gilson 1977). There has been a relative decline in net farm income across the three Canadian provinces resulting from declining commodity prices, higher input costs and trade reactions to pathogens (*e.g.*, bovine spongiform encephalopathy, anthrax). There is a general trend toward large agribusiness operations, with declining numbers of farms overall and of individual or family holdings, at the same time that the total area of farms is increasing.

Farming as the "principle" occupation is in decline and off-farm subsidization of farm operations is increasing. Government supports for agriculture vary hugely between the U.S., Mexico and Canada, but Canadian federal and provincial support of agriculture has declined since the 1960-1990 period. Drought relief is now a minor aspect of farm support although, even without climate change, long-lasting and intense droughts are said to be probable every 60-100 years. The dust bowl of the 1930s was one of the "mildest" in the past 2000 years while, at the same time, major flooding has occurred in cycles of 25, 50 and 300 years (Leavitt and Chen 2001).

Much of the flowing freshwater in the region comes from outside the biome. At the mouth of the Saskatchewan River, 87% of the flow is meltwater from the Rocky Mountains. However, high-elevation mountain glaciers are thinning and receding because of climate warming, and stream flows are dropping as a result. The flow levels in the major rivers of the western prairies are aleady reduced by 20–84% of their volumes in the early 20th cen-tury (Schindler 2002; Schindler and Donahue 2006). Agriculture is the largest industrial user of water, and the area in irrigation increased by 37% in the period 1981-1991 alone (GOC 1996). Increased salinization of some lakes has been noted, with a fourfold increase in dissolved solids in Big Quill Lake from 1925 to 1985, and 50% increases at Redberry and Manitou lakes over the same period (Hammer 1986).

Canada is the world's eighth largest oil and gas producer and exporter. It is the largest supplier of oil to the United States, with the majority (>2M bbl/d) flowing from Canada's western sedimentary basin — the prairie and parkland region. The U.S. imports 16% of all its natural gas and 95% of this comes from Canada, again almost all from this region. More than 20,000 oil and gas wells were drilled in Alberta in 2006, with more than 5,000 in Saskatchewan, almost all in the prairie and parkland region, and almost all associated with seismic and other exploration work, and with access development and product shipment. It is difficult to overstate the strategic economic importance or the ecological footprint of this activity today, overlaid as it is on an intensively worked agricultural land base.

From an ecological perspective, the pre-settlement landscape evolved in synchrony with harsh, episodic natural disturbance regimes, including some of the densest grazing populations in the world, fire, drought, flooding and insect plagues. The taming of these disturbance regimes through settlement was at a pace unparalleled in world grassland history. Now, the region faces a period of unparalleled weather variability and climate change.

There are key challenges in conserving the biological diversity of the prairies and parklands.

- What remains of the natural heritage of the biome?
- What constitutes the present and the likely future ecology of the prairie and parkland region?
- What part of remaining ecosystems should be identified as core biodiversity conservation areas?
- Does the biome's remaining natural cover persist at sufficient scale and proximity so that the long-term viability of its natural heritage is secure?
- Can priority landscapes be identified where conservation and restoration of native biological diversity can be advanced as the highest and best use of the land?

Many organizations, agencies and individuals are working to address these challenges. One of NCC's contributions to this work is a series of assessments of the biological diversity of ecoregions across southern Canada (Fig. 2). The goal has been to document, atlas and analyze the available information on the ecological systems, native species and remnant natural areas of these landscapes, to focus NCC and its partners in their direct, on-the-ground conservation activities.

1.1: Prairie and Parkland Ecoregions

The study area includes four ecological regions: **Aspen Parkland**, **Moist Mixed Grassland, Mixed Grassland**, and **Cypress Upland** (Figs. 1, 2). These are areas within which there are more or less homogeneous climate and landform, and biological diversity.

The **Aspen Parkland** extends across North Dakota, Manitoba, Saskatchewan and Alberta and covers 20,570,000 hectares. The **Moist Mixed Grassland** spans Alberta, Saskatchewan, North Dakota and Montana, for a total of 13,027,000ha. The Canadian portion of the **Mixed Grassland** in Alberta and Saskatchewan covers an additional 13,400,000ha. The **Cypress Upland** is a high-elevation outlier of upland conifer forest and grassland, in Alberta and Saskatchewan, 832,000ha surrounded by mixed grassland.

Two additional ecodistricts from the **Boreal Transition** ecoregion were added to the study area around Riding Mountain National Park in Manitoba (712,000ha), in order to include the full parkland area between Riding Mountain and Duck Mountain.

The study area does not include the Northern Tall Grass Prairie along the eastern edge of the biome, which was the subject of an earlier ecoregional assessment (TNC 1998; Chapman *et al.* 1998). In this project, NCC uses the above mentioned ecoregion names, based on the standard Canadian nomenclature (ESWG 1995). (Appendix C lists the different names of these ecoregions used by various agencies and authors.)

In the United States, the ecoregion that is contiguous with Canada's **Mixed Grassland** is called the Northern Great Plains Steppe, and an earlier ecoregional assessment was undertaken of that area (Fig. 2; TNC 1999). The present study re-assesses the Canadian portion of that ecoregion, using newly available data and upgraded methods.

(The original study was of the two "rainbow" ecoregions, the **Aspen Parkland** and **Moist Mixed Grassland**. As work progressed, it became apparent that there were significant benefits to achieving a consistent methodological coverage of the entire Canadian prairie and parkland biome. On this basis, the Canadian **Mixed Grassland** and **Cypress Upland** ecoregions were added to the study area.)

Figure 2. Ecoregions of southern Canada and the northern United States.

These ecoregions are further mapped into ecodistricts, areas within which there are similar landforms and physiography in particular, as well as similar soils, vegetation, water bodies and fauna (Fig. 10 and Appendix D maps). These are the geographic areas within which the comparative significance of their remaining natural areas was assessed and summarized in this study.

Overall, the study area includes the broad transition zone between the drier grasslands and deserts to the south of the region and the boreal forests and wetlands to the north. Together the study area totals some 48,543,000 hectares in size. As expected on a landscape of this size, a broad range of ecological systems are represented that support a wide diversity of organisms. Many of these ecological systems are unique to North America's great plains, and their conservation can only occur here.

The grassland, woodland, and wetland ecosystems of the prairie and parkland biome were dynamic. They were highly responsive to patterns of violent natural disturbance regimes, in which there were "tipping points" where woodlands or wetlands replaced grasslands over a period of wet years, and where grasslands took over the landscape following periods of drought, fire or heavy grazing. The landscape has been ecologically domesticated by land conversion and fencing over the past 150 years but these dynamics are still at play among natural ecosystems.

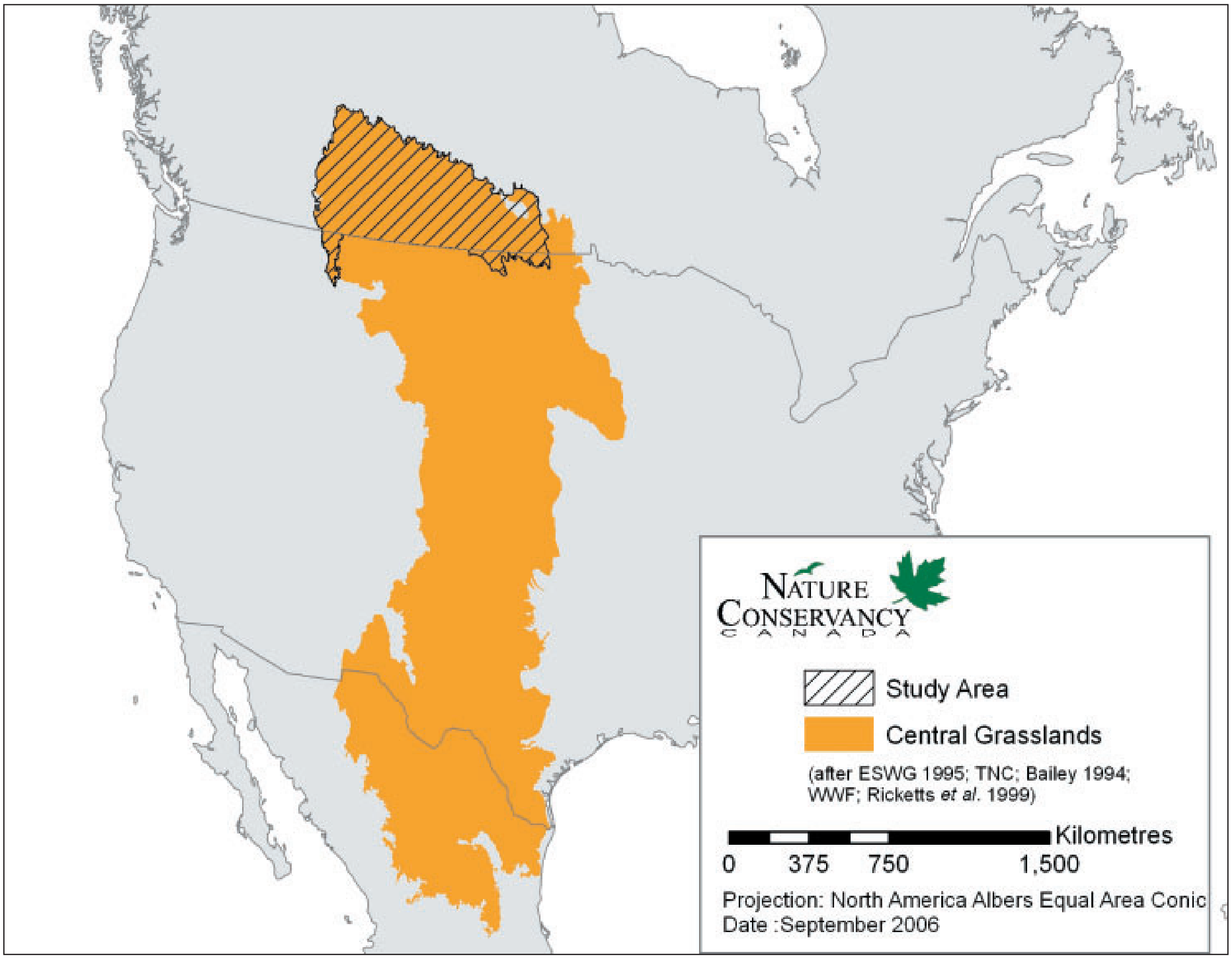


Figure 3. Study area in context of the North American grassland biome.

1.2: Conservation Planning and Action to Date

The prairies and parklands have been the subject of several significant efforts at whole-biome conservation planning: the Prairie Habitat Joint Venture, the Prairie Conservation Action Plan, the Endangered Spaces Campaign of World Wildlife Fund Canada (Hummel 1989, 1995), the Commission for Environmental Cooperation (CEC and TNC 2005), and others (Sampson and Knopf 1996).

Public agencies have developed biodiversity strategies for their jurisdictions, such as for Alberta (AEP 1995), Saskatchewan (GOS 2004), and Canada (AAC 1997). There have also been outstanding independent assessments of loss and threat (Thorpe and Godwin 1999, Hammermeister *et al.* 2001).

There have also been international assessments of the importance of the entire grassland biome (Fig. 3). These consistently describe the same shortfalls in conservation efforts across the biome, for example, to identify, map and formally conserve the lands that have their highest and best use as conserved lands. This on a landscape with so few conserved public lands (7.1% of the study area) and on a landscape so significantly converted from its original natural cover (34% natural cover remaining) (Table 5.1).

For example, the North American Commission for Environmental Cooperation identified these needs in its North American grassland conservation strategy:

- *To achieve complete identification, understanding and representation of biodiversity;*
- *To identify target species, high value habitats and natural corridors for wildlife;* and
- *To determine the biotic and abiotic requirements of native prairie species and communities* (Gauthier *et al.* 2003).

Another conclusion has been that information is difficult to locate and interpret on 1) the extent and distribution of conserved lands and waters, and 2) on the origins and goals of the many programs and projects that conserved them (*ibid.*) This project offers a reasonable approximation of the first of these — the extent and distribution of conservation lands – but only briefly addresses the second question — the many conservation programs and projects operating across the prairie and parkland region.

These conservation programs and projects involve private owners and lessees, municipalities, provincial and federal agencies, First Nations, and conservation organizations. In Canada, 79% of the biome is privately owned, with 21% owned by federal, provincial or state governments or First Nation peoples. These are comparable figures to ownership patterns on the great plains in the United States (84% private) and Mexico (94% private and communal) (*ibid.*) However, of the provincial and federal lands, probably a majority are leased to landowners for agricultural purposes. Another significant percentage is maintained as community pasture.

Information is also difficult to access on a number of positive trends that are occurring. In Canada, private landowners are increasingly aware of and encouraged to recognize the ecological value of land, water and wildlife through options such as stewardship agreements, conservation easements, and programs such as the North American Waterfowl Management Plan and the Prairie Farm Rehabilitation Administration (PFRA) Permanent Cover Program.

Standard agricultural practices are changing in ways that reduce wind and water erosion, loss of organic matter, and pesticide and fertilizer use. Application of insecticides, herbicides and fertilizers peaked in the 1980s, with appreciable declines since (GOC 1996). Cost is more of a determinant than conservation in most of these positive changes, which also include no-till and stubble operations.

At the same time, since the 1930s, cropland retirement programs have reduced agricultural land area, and improved the delivery of environmental benefits. Beginning in the 1930s, the PFRA Community Pasture Program returned 145,000ha of cultivated lands to permanent grass cover, and currently encompasses more than 900,000ha of rangeland. Between 1989 and 1994, the PFRA Permanent Cover Program assisted landowners in converting more than 518,000ha of marginal croplands to long-term forage (GOC 1996). These programs have helped focus cultivation on best agricultural soils, and grazing on native and rehabilitated grasslands.

By comparison, land retirement programs in the U.S. have been more aggressive. Since 1985, the U.S. Conservation Reserve Program and Wetlands Reserve Program retired more than 15,000,000ha, at least three-quarters on the central grasslands. These programs have shifted the pattern of croplands around locally, but overall land cover has remained relatively stable over the past seventy-five years on the U.S. great plains: two thirds of the land remains in natural cover, with one third in cultivated farming (Cunfer 2005). The comparable figures for the Canadian prairies and parklands are the opposite; one third (34%) remains in natural cover, with two thirds in agricultural cultivation or development.

National parks were established early in the region, first at Waterton on the montane edge of the region (1895), followed to the south by Glacier National Park (1910). These are spectacular landscapes on the eastern slopes of the Rocky Mountains, where grassland changes most abruptly to mountain range. Both conservation and recreation were motives in establishing these parks. The decline of the region's wildlife was a key motivation in establishing other parks, such as those to conserve Elk and Plains Bison: Elk Island (1906), Buffalo Park (1909) (now Canadian National Defence Camp Wainwright), and Riding Mountain (1930). Of note, no further national parks were established until Grasslands National Park in 1984, and none since.

The same impulse to conserve wildlife gave rise to the Canadian federal *Northwest Game Act* (1917), by which, for example, the possession and use of poison was prohibited, hunting and trapping were licensed, and the killing of female hoofed animals and young at foot was prohibited. Also in 1917, after much international discussion of shared threats and responsibilities, a migratory bird convention was adopted by Canada and the U.S., and embedded in the *Migratory Birds Convention Act,* which reduced and fixed seasons on migratory game birds.

Game and bird reserves were established early and by 1921 there were four in Manitoba (225,000ha), thirteen in Saskatchewan (>130,000ha), and ten in Alberta (>65,000ha) (Hewitt 1921). These began in 1887 with the regulation of a 1000ha area of islands and land adjoining the northern part of Last Mountain Lake, Saskatchewan for the protection of birds. This was the first area protected for wildlife in North America. Also established early were game reserves for Pronghorn Antelope, at the Wawaskesy (AB), Menissawok (SK) and Nemiskam (AB) National Antelope Parks (1914, 1915). These three were returned to the provinces in the 1930s and 1940s. As a result of these efforts, populations of game and fur-bearing wildlife stabilized and recovered.

Private land conservation also began early in the region. For example, numerous private sites for duck-hunting were established. Reuben Lloyd of Davidson, Saskatchewan, established a 15ha game preserve (Arm River Farms) before 1920.

At present, all Canadian jurisdictions have wildlife and fisheries legislation, as well as acts to establish parks, natural areas, protected places or ecological reserves. Most Canadian provincial jurisdictions have protected-area planning programs. Program delivery varies significantly between jurisdictions.

Non-game species have fared less well. Before the federal S*pecies at Risk Act* (2002), which conserves regulated species on federal lands, Manitoba was the only Canadian prairie jurisdiction to have endangered-species legislation (1990). It applies to all land tenures.

In Canada, the federal government is the largest holder of conservation property across the region. These properties include both regulated **"protected areas"** and less formally committed **"conservation lands"** that also make substantive contributions to the region's overall conservation efforts:

Canadian federal protected areas include: national parks, migratory bird sanctuaries, national wildlife areas (Table 3.2; 515,016ha).

Canadian federal conservation lands include: community pastures, and national defence lands (Table 3.2; 1,111,902ha).

Provincial protected areas include: provincial parks, natural areas, wildlife management areas, fish & wildlife development fund wildlife lands, heritage rangelands, ecological reserves and park reserves (Table 3.2; 391,081ha). Provincial parks are treated as protected although commercial resource extraction is permitted in some Manitoba and Alberta parks.

Provincial conservation lands include: provincial community pastures, provincial recreation areas, and Saskatchewan lease lands on which the Wildlife Habitat Protection Act (1984) conserves wildlife (Table 3.2; 1,297,798ha). Of these, the Saskatchewan lease lands occupy 1,058,225ha.

In total, this study mapped 3,463,529ha of existing federal, state and provincial protected areas and other conservation lands, 7.4% of the Canadian prairie and parkland study area (7.1% of whole Canada/U.S. study area).

Not included are the extensive land holdings of municipal regional parks (>100 in Saskatchewan), nor the lands owned, or with conservation easements or stewardship agreement through Ducks Unlimited Canada, NCC, Alberta Conservation Association and Saskatchewan Wildlife Federation. For example, since 2001, NCC has purchased 38,000ha of land and easement for conservation in the region as part of the Prairie Habitat Joint Venture (PHJV).

The PHJV reports that its government and non-government partners secured 862,000ha of conservation lands through fee simple, easement or stewardship agreement in the period 1986 to 2001. These would be mostly the work of Ducks Unlimited Canada. This in itself constitutes 1.9% of the Canadian prairies and parklands, an area almost equivalent to existing federal and provincial protected areas. (Map data were not available to the blueprint for these areas.) Finally, there is a significant variety of essential private-land holdings contributing to all aspects of conservation, both deliberately and through benign management.

The documented federal and provincial protected areas and other conservation lands cover just over 9% of the Canadian study area, of which this study has mapped 7.1%. Of these:

- 1.2% are federal protected areas;
- 0.9% are provincial protected areas;
- 2.5% are federal conservation lands;
- 2.9% are provincial conservation lands; and
- 1.9% are PHJV lands.

(There is overlap in counting between PHJV lands and other categories.)

Regulated protected areas total 2.0% of the prairie and parkland biome. It is the other non-regulated conservation lands that make up the bulk of lands for which there is overt conservation commitment. Specifically, the key lands are the community pastures, national defence lands, agricultural lease lands with wildlife protection, and PHJV lands.

It must be noted that such categories and statistics are problematic because on-the-ground stewardship is weak and under-resourced. Commercial resource extraction is occurring in some regulated protected areas. Migratory bird sanctuaries can be "temporary spots with restricted safeguards for certain birds and their nests…the general habitat in these areas is not afforded much protection" (Gauthier *et al.* 2003).

In the U.S. part of the study area (Montana and North Dakota), the following protected areas and conservation lands were considered:

U.S. federal protected areas include: national wildlife refuges, federal reservations, areas of critical environmental concern, national outstanding natural areas, power withdrawals, wilderness study areas, research natural areas (Table 3.2; 39,623ha, of which 82% is wildlife refuge).

U.S. federal conservation lands include: Bureau of Land Management holdings, national forests, military reservations, national wildlife refuges, wildlife management areas, game preserves, fish hatcheries (Table 3.2: 17,926ha).

State protected areas include: state parks, wildlife management areas (Table 3.2: 11,002ha, all but 452ha wildlife management areas).

State conservation lands include: state lands, state forests, state wildlife refuges, wildlife management areas, game preserves or fish hatcheries (Table 3.2: 82,097ha). Some of these state lands permit resource extraction and grazing, but conserve the land from conversion from natural habitat. Others are primarily managed for wildlife conservation.

Conservation Land-use Planning

The importance of region-wide assessments of the comparative conservation values of different ecological systems is that such assessments can provide the underpinnings for informed private and public stewardship of lands for which conservation is the best and highest use.

For example, in Manitoba, Manitoba Conservation is the lead agency in identifying areas of special interest (ASI), designed for possible future conservation. In Alberta, on public lands, Protective Notations (PNT) can be put in place by public agencies to identify lands that should be managed to achieve particular land use or conservation objectives. These or other areas may also be protected as Natural Areas under the Alberta Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act (2000).

These notations do not extend yet to private lands however, in Ontario, lands identified as significant natural areas during the 1980s were eventually considered provincially significant areas of natural and scientific interest (ANSIs) and the government committed in 1983 to, on public lands, "ensure that the land uses and activities, which occur, provide for the protection of identified values". On private lands, the commitment was "through cooperation with others, attempt to ensure that landowners are aware of significant features on their properties and seek the owners' cooperation in protecting such features". These sites subsequently became eligible for property-tax reductions under the Ontario *Conservation Land Act's* Tax Incentive program. In 1992, 1994 and 2005, land-use policies under the *Ontario Planning Act,* recognized these natural areas and promoted their protection from incompatible land-use decisions favouring development and site alteration.

This conservation blueprint maps and documents existing conserved lands and additional high-scoring ecological systems and rare-species habitats, all set within the broader network of remaining natural cover and potentially restored lands. Collectively, this constitutes a natural-heritage system that communities, organizations and landowners may recognize as potential conservation outcomes in their areas. In general, natural heritage systems are networks of conservation lands and waters linked, where possible, by natural or restored corridors. They include but are not limited to natural-heritage features, as well as significant hydrological features. Their objectives are the conservation of biological diversity, ecological functions and viable populations of native species and ecosystems (Riley *et al.* 2003).

Elsewhere, the mapping of such systems has been used to illustrate what a conserved landscape might look like, such as through the Massachusetts BioMap Project (www.mass.gov/dfwele/dfw/nhesp/nhbiomap. htm). In Ontario, natural-heritage systems are required elements of municipal official plans (Ontario Provincial Policy Statement under the *Planning Act*; Riley 1999). The Nature Conservancy of Canada has partnered with government and non-governmental agencies in mapping and documenting natural heritage systems, such as the southern Ontario *Big Picture 2002* project.

Conservation Blueprints

Ecoregional assessments help frame broad strategies to conserve biological diversity. They are being completed across all North America and elsewhere (Groves *et al.* 2000; Poiani *et al.* 2000; Gaston *et al.* 2002; Groves 2003; Redford *et al.* 2003; Tear *et al.* 2005).

NCC calls its ecoregional assessments "conservation blueprints" to emphasize the need for well-documented plans underlying NCC conservation activities (Fig.2). A conservation blueprint is an attempt to assemble, classify, map and analyze the available information on the biological diversity of a natural geographic region, in this case the four ecoregions that comprise the prairie and parkland biome of Canada and two areas of the U.S.

An atlas of biodiversity data has many applications. The application of particular interest here was **the identification and assessment of the places across the prairie and parkland biome that, if appropriately conserved, could sustain the essential biological diversity of the region.** This may or may not be achievable, but remains the challenge for conservation professionals.

The prairie and parkland conservation blueprint is the first computer-based, landscape-level analysis of the terrestrial biodiversity of this large study area. It analyzes results regardless of jurisdictions or land tenure. It documents and validates existing protected areas and conservation areas, and identifies additional sites of conservation importance.

Representation of the region's natural community types is central to this analysis. Identifying and conserving representative systems provides the means to preserve the widest variety of species in conditions that support them best. Some of these are widespread 'matrix' habitats. Other targets include occurrences of species that are rare throughout their ranges and require conservation where they occur.

In recent years, mapping of geology, vegetation, water features, species and habitats has been computerized in digital formats that allow the analysis of such data in new ways. A range of approaches has been used to map priority conservation areas on a variety of landscapes (Poiani *et al.* 2000; Bowker 2000). With the current ability to analyze multiple data layers in a GIS (geographic information system), it becomes possible to apply approaches that are increasingly replicable and more explicit about their assumptions and limitations. At the same time, these analyses are admittedly remote and deliberately contextual, and are no substitute for expert knowledge and in-field verification, which is needed in order to interpret and implement results on the ground (Zhou and Narumalani 2003).

As it organizes itself on the landscape — and is organized by humans – biological diversity can be thought of as occupying a whole range of potential sites meeting different conservation goals, which can be deliberately considered in a conservation plan. In geographic scale, these sites range from small to large in size, reflecting the various scales of biological diversity (Noss 1990).

A. **Small sites** conserving fine- and mid-scale targets, with functionality in terms of the viability of target species or communities;
B. **Large sites** conserving coarse-scale targets such as large grassland ecological systems, with functionality in terms of specific targets but not with respect to landscape-scale biodiversity;
C. **Functional landscapes** that also conserve common/matrix communities and species at coarse, intermediate and fine scales, with a high degree of intactness within a particular area;
D The **remaining natural cover** across the region as a whole, which provides a habitat network essential to sustaining species populations and environmental goods and services as a whole;
E. The **broader landscape**, across which is delivered the full range of regional environmental goods and services, and within which there are sites where restoration of natural habitats or rehabilitation of supportive environmental conditions are important for maintaining or recovering particular species, habitats or ecological systems that have declined below levels needed for their persistence.

The blueprint and, for example, the tile maps (Appendix D) that illustrate its results, focus on scales A (small sites), B (large sites) and D (natural cover) above. At the same time, it provides much of the contextual detail needed for conservation planners to take the next steps in defining functional landscapes or "priority landscapes" for conservation attention (C above), and to address the restoration and rehabilitation needs on those priority landscapes (E above).

A computer-based analysis like this relies on region-wide data sets to make region-wide comparisons. There are relatively few such data sets and a large part of the blueprint project consisted of knitting together new coverages. However, for many parts of the study area there are additional better-resolution data sets, and it is for this reason that the work of identifying priority conservation landscapes (C above) and of identifying on-the-ground conservation strategies is best approached at finer scales, with additional data and expert knowledge brought to bear.

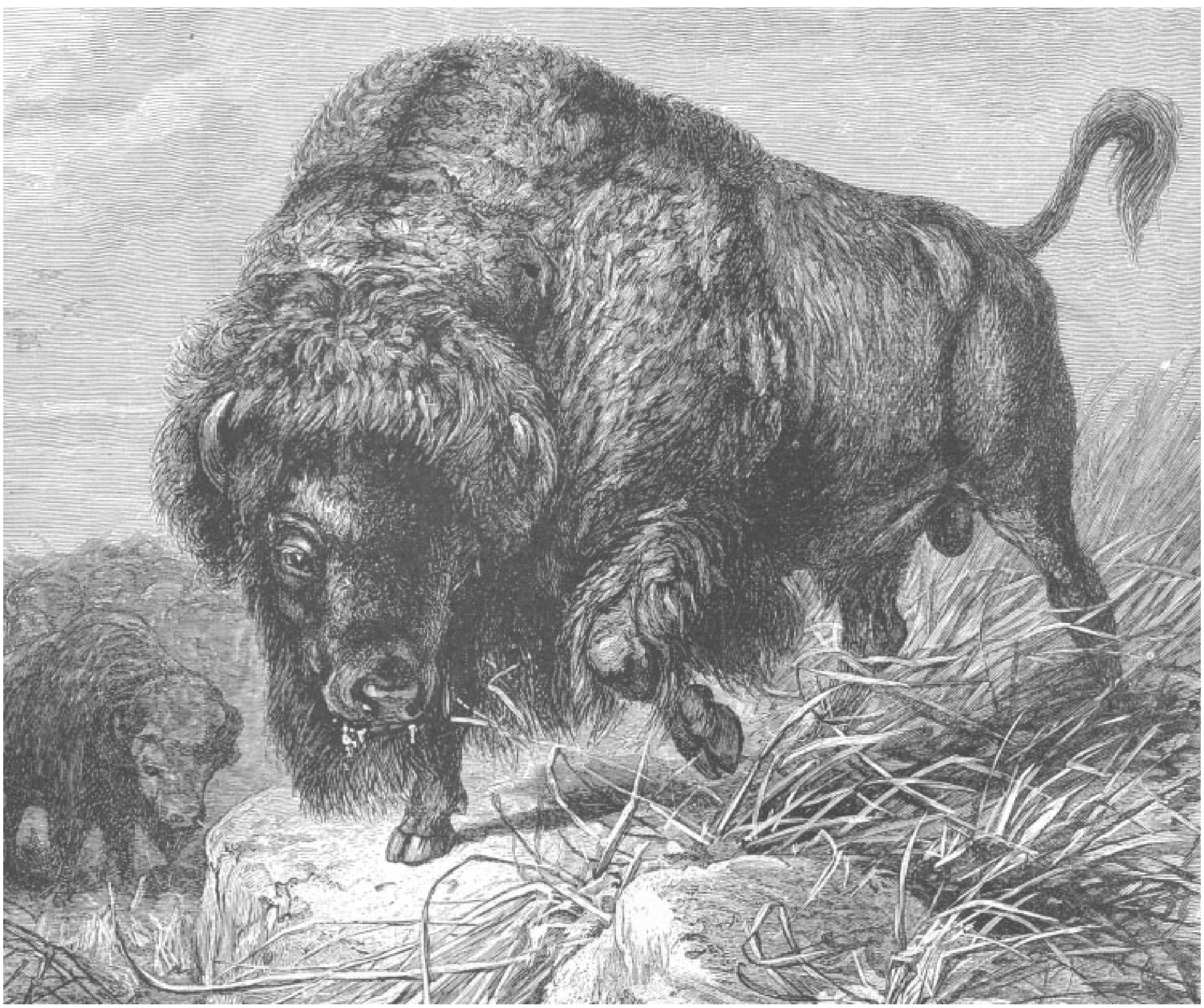
A particular challenge on highly fragmented and converted landscapes is the identification of strategies involving the restoration or rehabilitation of intervening or adjacent lands and waters. This is also best done at scales finer than the blueprint scale, but the blueprint provides useful contextual data for discussions of appropriate restoration goals (species, systems) in appropriate areas.

This general approach reflects the experience of NCC in trying to work at appropriate site scales, as well as the experience of others. For example, *Designing a Geography of Hope* (Groves *et al.* 2000) set out the concept of "multiple-scale" sites, and included a similar range of sites, conceptualized as functional sites set within functional landscapes, in turn nested within functional networks (Low *et al.* undated; Poiani *et al.* 2000).

SECTION 2.0

Ecological Context

This was the land of Plains Bison, Elk, Antelope, Wolf and Grizzly, in astonishing numbers. These became the lands of semi-industrial pemmican production, and then they became the bright future for generations of agricultural immigrants. More than 75% of Canada's cultivated lands occur in Alberta, Saskatchewan and Manitoba, almost entirely in this region of original prairies and parklands.



The buffalo were the unconscious caretakers of the grasslands. They thundered over vast patches of the landscapes, creating diverse plant communities according to the intensity and duration of their grazing in any given area, as well as the number of years since their last visit. For prairie creatures dependent on a narrow niche — say, short grasses with little cover and abundant badger and ground-squirrel holes – the habits of buffalo and the incidence of fire maintained a dynamic ecological patchiness that ensured a fullness of life over the whole of the prairie world.

Trevor Herriot, 2000.
River in a Dry Land

The prairie and parkland biome or ecozone of Canada and the adjacent United States is the northern tip of the vast temperate grassland plain at the heart of the North American continent (470,000 km^2; Fig. 3).

In the eighteenth century, European adventurers started to explore the region and began setting up fur trading posts. From the St. Lawrence, Great Lakes and Hudson Bay, they crossed almost impassable hurdles of rock and forest to reach the welcoming grasslands and aspen groves of the central continent. These lands offered long rivers and open trails for transport, luxuriant pasture for game, untouched waters full of waterfowl and lake fish, and unparalleled access to furbearers.

The traders and missionaries, and then surveyors, worked their way westward and southward, toward higher, drier lands where the aspen thinned and the prairies shifted to shorter grass species. This was the land of Plains Bison, Elk, Antelope, Wolf and Grizzly, in astonishing numbers. These became the lands of semi-industrial pemmican production, and then they became the bright future for generations of agricultural immigrants. More than 75% of Canada's cultivated lands occur in Alberta, Saskatchewan and Manitoba, almost entirely in this region of original prairies and parklands.

2.1: Geography, Landforms and Soils

The prairie landscape is bound by the boreal forest to the north, tallgrass prairie to the east, central shortgrass prairie to the south, and the Rocky Mountains to the west. Five major river systems — the Saskatchewan, Missouri, Assiniboine and Red rivers, and Lake Winnipeg – flow through these ecoregions (AAFC 2005) (Fig. 4). The close proximity to the mountains along the western edge of these ecoregions creates a unique mosaic of habitats that sustain terrestrial and aquatic biodiversity (WWF 2001).

The prairies and parklands descend more than 700m from the high-elevation Rocky Mountain foothills in the west, over two major bedrock steps (the Prairie and the Missouri Coteaus), to low-elevation, mid-continent lacustrine landscapes in the east. The landforms shaping the surface of the region are mainly glacial in origin, with the exception of the higher elevations of the Cypress

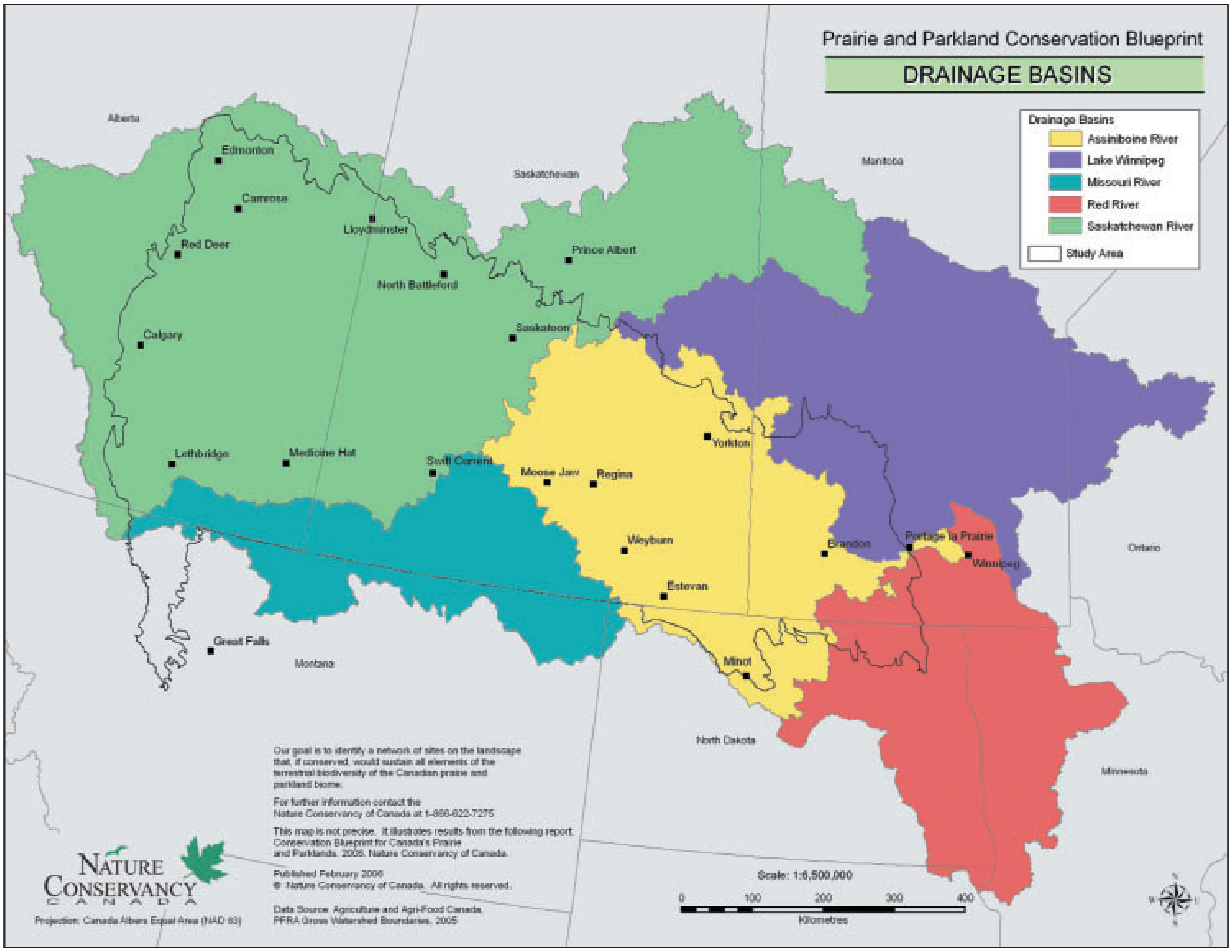


Figure 4. Major drainage basins of the study area.

Hills, Milk River Ridge and parts of Montana that lie above or beyond the maximum extent of the last continental ice sheet. Bedrock exposures exist in some areas where glacial deposits have been removed by erosion.

The vast majority of the terrain is poorly drained, relatively young glacial till, formed into higher upland moraine. Lowlands with poor natural drainage systems occupy the bottoms of large proglacial lakebeds. These landforms resulted directly from the action of the continental Laurentide ice sheet, or were created since the retreat of that glacier some 12,000 years ago. The predominant, thick, till ground moraines vary from level to hummocky and, depending on rainfall, wetlands fill the small depressions among them. In some areas, wind has blown sand deposits into dunes, while finer sediments or loess form gently undulating landforms.

The major rivers generally follow the valleys eroded by the vast meltwaters of the decaying ice sheet and are generally characterized by meanders, oxbow lakes and wide flood plains. Slumping and landslides in river valleys creates small changes to the local topography resulting in gradients of moisture and light which leads to a diversity of micro-habitats that support life on the prairies. Chernozemic "black" soils have developed on these landforms and form the highly productive soils so attractive for agriculture (Geological Survey of Canada 2001).

2.2: Climate

The climate across this vast region is fundamentally tied to its location in the interior of the North American continent. The Rocky Mountains to the west impede the moisture-bearing winds from the Pacific Ocean, but also funnel air masses north from the Gulf of Mexico. Cold northwestern air masses dominate for most of the year. This results in a continental climate, which is sub-humid to semiarid with short hot summers, long cold winters, low levels of precipitation, and high evaporation (ESWG 1995).

In the 1850s, Captain John Palliser travelled through what is now southwest Saskatchewan and southeast Alberta, recording it as the driest region of the prairies, and considered it unfit for agricultural conversion. This area was once referred to as Palliser's Triangle, where rainfall was as little as 250mm per year. This water deficit resulted in treeless grasslands, across which strong winds accelerated the evaporation of any surface waters (ESWG 1995). Drought occurs often in the region and varies in extent, intensity and duration. Affects on the biodiversity of the region vary in relation to these three variables.

Elsewhere in the biome, precipitation reaches its highest levels at 750mm per year towards the north and east (ESWG 1995). Spring is the wettest season.

There are long and cold winters, short and very warm summers, and regular cyclonic storms moving eastward. Mean winter temperatures range from -12.5^{0}C to -8^{0}C and mean summer temperatures average from 14^{0}C to 16^{0}C. Summer extremes of 40°C and winter extremes of -40°C occur. Severe cold in the winter of 1885-86 resulted in 85% mortality of cattle across large parts of the prairies (Dormaar and Barsh 2000), and particularly deep snow in southern Alberta in 1882-83 had a similar local result (Roe 1972).

Dry arctic air predominates in the winter but periodic *chinooks* (strong, warm and dry westerlies) blow in through the Rockies and cause spring-like conditions in southern Alberta and, to a lesser extent, southwest Saskatchewan. They reduce snow cover and remove moisture from an already dry region.

There is consensus that the region is experiencing more rapid climate change than occurred naturally in the past, with attendant increases in mean temperature and weather variability, and decreases in precipitation and groundwater (Leavitt and Chen 2001, Schindler 2002, Clark *et al.* 2002, Schindler and Donahue 2006, etc.) The implications of rapid climate change for the conservation of our native biological diversity will become clearer over the next several decades but it seems likely that a further precautionary consensus will emerge, stating that larger-than-present conservation of landscape-scale blocks of intact prairie, parkland and valleyland habitat is required as a minimum response to this challenge.

2.3: Vegetation

The south and west portion of the region is the **Mixed Grassland**, also known as the dry mixed-grass prairie. Here the grasslands are a mix of mid- and short-grasses; the former including Western Porcupine Grass (*Stipa curtiseta*), Northern Wheatgrass or Thickspike (*Elymus lanceolatus*), Plains Rough Fescue (*Festuca hallii,* to the west), Western Wheatgrass (*Pascopyrum smithii*) and Needle-and-Thread Grass (*Stipa comata*), and the latter including Blue Grama (*Bouteloua gracilis*). Sedges (*Carex* spp.) and Junegrass (*Koeleria macrantha*) are also part of this community, with the latter particularly so on clayey soils.

Typical forbs of these prairies include the Prairie Crocus (*Anemone* or *Pulsatilla patens*), Pussy-toes (*Antennaria* spp.), Locoweed (*Oxytropis* spp.), Golden Bean (*Thermopsis rhombifolia*), Three-flowered Avens (*Geum triflorum*), Gaillardia (*Gaillardia aristata*), Pasture Sage (*Artemisia frigida*), asters (*Aster* spp.), and goldenrods (*Solidago* spp.). Typical low growing shrubs include Western Snowberry (*Symphoricarpos occidentalis*) and rose (*Rosa* spp.) Other shrubs include the Silver Sagebrush (*Artemisia cana*) and other dry-land, drought-tolerant shrubs.

To the east, especially on the former bottom of proglacial Lake Agassiz, mesic tallgrass prairie once dominated, before being virtually eliminated. The tallgrass prairie is now thought to have extended westward into Saskatchewan, based on remnant insect faunas and soils (Hamilton 2005). As a general rule, as one moves north and east through the **Moist Mixed Grassland**, the frequency of taller shrubs increases, such as willows (*Salix* spp.), Buffaloberry (*Shepherdia canadensis*), hawthorn (*Crataegus* spp.), Saskatoon (*Amelanchier alnifolia*) and Chokecherry (*Prunus virginiana*). Along this same gradient of moisture, there is an increase in trees, particularly in Trembling Aspen (*Populus tremuloides*), Balsam Poplar (*Populus balsamifera*), Eastern Cottonwood

(*Populus deltoides*) and Bur Oak (*Quercus macrocarpa*, to the east). Typical mid-grasses of the **Moist Mixed Grassland** are the Northern and Western Wheatgrass and the Western Porcupine Grass and Green Needlegrass (*Stipa-viridula*).

The **Cypress Uplands** has a mix of grasslands and conifer forest. Logdepole Pine (*Pinus contorta* var. *latifolia)* is the most common tree, with White Spruce (*Picea glauca*) occupying cooler and moister sites. Grasslands of Plains Rough Fescue, Bluebunch Fescue (*Festuca idahoensis*) and Intermediate Oatgrass (*Danthonia intermedia*) can be found here and to the west. A few other "islands" of wooded upland also occur across the biome. These sites can be dominated by deciduous forests (Moose Mountain, Saskatchewan and Turtle Mountain, Manitoba/North Dakota) and by mixed conifer and deciduous forests (Spruce Woods, Manitoba).

In the northern part of the prairie ecozone grasslands, aspen stands, moist prairies and wetlands co-occur as a mixed parkland. This **Aspen Parkland** is a transitional ecosystem (or ecotone) between the boreal forest to the north and the grasslands to the south, and supports enhanced levels of species diversity in areas of habitat interspersion. In many areas, aspen will be on the north-facing pitches and moist depressions, with grassland on drier south-facing slopes and hilltops.

Parkland varies from large grasslands interspersed with small aspen stands to dense aspen woodlands with small grassland openings. This ecoregion also contains a large number of wetlands and their associated species. In the absence of pre-settlement disturbance regimes, aspen parkland takes over mesic grassland sites. For example, aspen incursion on the parkland region of southcentral Alberta expanded from 5 to 8 percent of total land area between 1907 and 1966 (Bailey and Wroe 1974).

The parklands have a rich shrub understorey consisting of species such as Beaked Hazel (*Corylus cornuta*), rose (*Rosa* spp.), Saskatoon, Snowberry (*Symphoricarpos albus*), Pin Cherry (*Prunus pensylvanica*) and Choke Cherry. The interspersed grasslands include fescue grasslands, dominated by Plains Rough Fescue, and other dominants such as Western Porcupine Grass, Northern Wheatgrass, Slender Wheatgrass (*Elymus trachycaulus*) and Junegrass. Common forbs are the Yarrow (*Achillea millefolium)*, asters and Prairie Crocus.

2.4: Wildlife

The prairies and parklands support a rich diversity of wildlife but only a very few areas such as on the foothill fringe at the Waterton front in Alberta and along the boreal-transition fringe near Riding Mountain include anything like the original guild of wildlife species from pre-settlement times. Even in these areas, wildlife do not occur in nearly the numbers originally noted by the first recorders in the area, whether it be the Bison, Elk, Wolf and Grizzly, or the *"infinite"* Lake Whitefish. Even the Prairie Dog was *"very common"* (Macoun 1882). Writing from the Milk River area, Anderson, surveyor of the 49th parallel, wrote, *We travelled thro' buffalo for about 3 days journey or 75 miles of the Boundary, and they were dotted all over the plain like bushes on a heath.* (Anderson 1874)

The speed of change in these wildlife populations was as dramatic as anywhere on Earth. The landscape has been changed so irrevocably by human endeavour that pre-settlement landscape conditions will never occur here again, although they may be replicated at limited scales, for a few biota.

By 1890, 99% of the wild mammal biomass of the prairie and parkland biome was eliminated (Geist 2007). Plains Bison were extirpated from the wild, as was its dependent predator, the Buffalo Wolf (*Canis lupus nubilis*). Pronghorn Antelope retreated to the high plains. Elk, which were second only to Bison in numbers and grazing impact, are represented by a few remnant herds restricted to forested hill country. Moose are nowhere near pre-settlement numbers. Mule Deer declined dramatically with settlement, replaced by White-tailed Deer that was new to the region from the east in the 1870s (Halls 1984). Mule Deer numbers have rebounded in Alberta and Saskatchewan, while White-tailed Deer remain plentiful and move ever further northward.

Grizzly Bear ranged across the entire region but now occurs only on the Rocky Mountain foothills, with rare, recent eastward occurrences in the Milk River valley. Cougar were extirpated from the parkland but are now observed again, rarely, across the region. Historic populations of Marten and Fisher in the parkland fringe, and Otter and Wolverine throughout, were effectively extirpated from the biome — the first three are now re-established on the parkland fringes. Swift Fox and Black-footed Ferret were extirpated but are now re-introduced.

"Multitudes of pelican, geese, ducks, avocets, phalaropes, water hens, and grebe, besides innumerable snipe and plover were everywhere in the marshes at [Last Mountain Lake]. This was early in July and experience tells me that not one-tenth was then seen of the bird life assembled in September and October."

John Macoun, 1882
Manitoba and the Great North-west

The Passenger Pigeon bred in Manitoba and Saskatchewan, and was extinguished. Sandhill Crane, Trumpeter Swan and Whooping Crane were extirpated from the region but persisted northward. The first two of these are now re-established on wetlands of the parkland area. After the demise of the Bison, Greater Prairie Chicken moved in briefly, but is now again no longer in the study area. Sage Grouse and Prairie Dog remain critically threatened.

The prairie and parkland biome remains the most important North American breeding areas for many waterfowl species due the large number of wetlands. The region is also home to many temperate grassland bird species that are experiencing significant population declines. Significant declines over a 31-year period include the following: Loggerhead Shrike (-10.1% per year), Sprague's Pipit (-7.1%), Horned Lark (-2.2%), Western Meadowlark (-2.0%), Bobolink (-1.7%) and Clay-coloured Sparrow (-1.2%) (Sauer *et al.* 1997).

Upland grassland birds have experienced the most pronounced decline of any birds in Canada (Downes 1994) or North America, based on Breeding Bird survey results for the period 1966-2004 (Sauer *et al.* 2005, Peterjohn and Sauer 1993). Of 32 species declining across North America over this period, 12 are used as conservation targets in this blueprint (Table 4.1). The average decline of the 12 over that period was 2.4% per year (*ibid.*) The majority of these species are short-distance, temperate migrants wintering no further south than the southern U.S. and northern Mexico (Blancher 2003). The causes of decline are many (McCracken 2005):

Changes in Habitat Supply and Quality

Obligate grassland species require grassland during migration, breeding and wintering. Across North America, mixed and shortgrass prairie is now at 20-30% of its former range (Gauthier *et al.* 2003). The area of cultivated grassland (tame pasture) in Canada decreased by 48% from 1951-2001, during which time the total land under cultivation increased by 14% (McCracken 2005). This is a shifting and increasingly non-native mosaic of native and tame grasslands, haylands and croplands.

Habitat Fragmentation

Range fragmentation affects most aspects of a bird's life, and grassland birds vary in their sensitivity to the size of remnant grassland patches. Even so, grasslands less than 10ha (especially if linear) are of little benefit to grassland species (*ibid.*) Suggestions about minimum required patch size vary from 100ha (Vickery *et al.* 1994) to 250ha (James 2000) to 1000ha (Herkert *et al.* 2003). In this analysis, grasslands parcels were not scored for size if they were less than 16ha in size or less than 180m wide, and scores increased to a maximum for patches more than 4096ha (Appendix B).

Natural Succession

Much of the prairie biome is witness to unidirectional natural succession to aspen parkland from former open grassland, reducing the extent of available grassland habitat. As well, abandoned farmland can succeed rapidly to shrub and wood.

Overgrazing

Intensive grazing results in the decline of grassland species such as Short-eared Owl and Baird's Sparrow (Bock *et al.* 1993), largely through loss of cover, structure and food, and invasion by exotics.

Predation

Grassland birds nest on the ground, with a few exceptions (Swainson's Hawk), and mammalian nest predators like Raccoon and Red Fox are increasing. Ground nesters are also impacted by haying too early, farm equipment, and farm chemicals (McCracken 2005). Both grassland and woodland ground nesters are declining disproportionately.

Change in Food Supply

Pre-settlement grasslands were rich insect ecosystems, and most grassland birds depend on insects during the breeding season. Agricultural practices have decreased insect numbers (Bird 1961). Small mammals have also declined and with them, Burrowing Owl and Northern Harrier.

Toxins

Agricultural pesticides are believed to have had widespread impacts, though incompletely understood or documented (McCracken 2005).

McCracken (2005) notes: No single management approach or conservation solution will benefit the entire suite of grassland bird species across large geographic regions.
However, he notes:

- Large habitat patches should be created or restored;
- Hay cutting should occur only after fledging, and hay should be regularly cut to prevent encroachment by woody plants;
- Crop residue should be kept on soil surfaces to support invertebrates and provide cover; and
- The frequency and types of field operations that impact nests and birds should be minimized.

2.5 Threats to Biological Diversity

In 1999, Thorpe and Godwin described the major threats to Saskatchewan's biodiversity as 1) habitat loss and alteration; 2) fragmentation; 3) exotic invasives; 4) pollution; 5) over harvesting; and 6) loss of genetic diversity. In this analysis, threats like habitat fragmentation and isolation could be considered at broad scales but data on the other threats were not available at scales permitting region-wide comparisons.

Over the last century, at least 70-75% of the landscape was converted from its native state to support agriculture (Gauthier and Wiken 2003), with agriculture of one kind or another now on well over 90% of the landbase. The remaining parcels of native habitat lie scattered in a sea of agriculture, with the largest intact areas in southeast Alberta and southwest Saskatchewan, and along major rivers.

The loss of connectivity between different ecological systems can affect organisms that have lower mobility and local dispersal mechanisms, and can lead to higher rates of predation (Wiens 1994, With and Crist 1995). Basically, areas with low capability for cropping (*i.e.*, poor agricultural soils) have more intact native cover, while areas with richer soils have been converted to cropland. Also impacting these habitats are agricultural practices such as overgrazing, early season haying (i.*e.*, during the peak breeding season of nesting birds), and improper livestock waste management.

A major regional land use is the extraction of oil, natural gas, coal and potash. These land uses occur in all soil types, with much of the current activity in the larger intact habitats of the **Mixed Grassland** ecoregion (Ricketts and Imhoff 2003). The extent of these activities is much less than agriculture but they have significant effects on some of the native species of these ecoregions, especially through linear development like roads and pipelines.

Another major land use is urban, residential and infrastructure development. Around Calgary and Edmonton, the two largest cities in these ecoregions, urban expansion and exurban cottage and rural development are growing threats to the native landscape. "Second home" development can be observed throughout the ecoregion. Development is occurring in many of the remaining native ecosystem dominated landscapes (*e.g.*, the foothills of Alberta and the Qu'Appelle Valley, Saskatchewan). Primarily rugged topography and limited agricultural potential have allowed some native cover to persist to date (Ricketts and Imhoff, 2003). In this case, the factors that make this land unsuitable for agriculture are the same factors that put the land at risk of development. Along with cottage and housing development, inappropriate recreational use (*e.g.*, off-road vehicles vehicles in sensitive environments) threaten the habitats of species at risk and other conservation targets that live in these sensitive environments.

There are clear patterns among the remaining large parcels of natural habitat. River valley slopes have not been conducive to either cropping or grazing, although considerable grazing occurs on many valley slopes. River valley bottomlands that are wide and well-soiled have been largely converted to cropland, while narrower bottomlands and bottomlands with poor soils have not. These valleys, especially where water access is possible (including dammed waters) are attractive for recreational second homes, which can in turn constrain further agricultural land conversion in these areas.

Other landforms with steep slopes and light or rocky soils, such as badlands, sand-hill areas, moraines and uplands, also have higher percentages of remaining natural habitat, and less likelihood of land conversion. Wetlands have not discouraged land conversion in many areas where drainage, ditching and tiling have been applied since settlement. However, overall, the speed of wetland conversion is now slowing, as the ecological and wildlife values of wetlands are better understood by farmers. Meanwhile, farm-gate prices continue to decline, also discouraging further land conversion.

The ecological functions of the landscape are important to the long-term survival of many of the conservation targets on the prairies. At broad scales, some ecological functions are closely tied to the size, position, connectivity and condition of remaining natural habitats on the landscape. Other functions, such as the pre-settlement disturbance regimes of fire, grazing, and flooding have been forever altered by humans, with significant impacts on biodiversity (Thorpe and Godwin 1999). Draining and filling wetlands to increase crop production has altered local and regional hydrology, and consequences for biodiversity (positive and negative) are inevitable.

Finally, human-induced climate change is altering drought cycles (Clark *et al.* 2002) and is predicted to cause clinal shifts in weather patterns and climate (Thorpe and Godwin 1999), and on vegetation (Henderson *et al.* 2003). These factors are likely to have long-term effects on biological diversity.

One of the more inexorable threats to native ecosystems is exotic invasive species. A few of the plants and animals that have not evolved in the prairie environment are guaranteed to 'out-compete' the native species. Non-native invasives such as Smooth Brome (*Bromus inermus*) and Crested Wheatgrass (*Agropyron cristatum*) were deliberately introduced to tame forace to address the loss of organic matter in cultivated soils and to increase productivity (Coupland 1977). Particularly virulent but more accidental noxious weeds include Leafy Spurge (*Euphorbia esula*), Yellow Toadflax (*Linaria vulgaris*), Downy Brome (*Bromus tectorum)*, and Purple Loosestrife (*Lythrum salicaria*).

2.6: Ecological History of the Region and its Implications for Conservation

The occupation and conversion of this region exceeded many of the ecological thresholds necessary to sustain the original native species and ecosystems of the region. This has been clear for many years even if seldom stated, and prairie rehabilitation programs, prairie conservation programs, and wetland and waterfowl conservation programs have been working for decades to sustain and restore the species and ecosystems of the region. History is not determinism, however, and new and better approaches are being applied to the conservation of prairie and parkland landscapes — that can shape a new and restored landscape going forward.

Conservation work needs to be grounded in an appreciation of the special stewardship needs of the natural systems that dominated the prairie and parkland in pre-settlement times. In other words, the abatement of apparent external threats, such as land conversion, linear resource developments, climate change, invasives, etc., are important but our land stewardship going forward must also reflect the ecological history of the region, which is entrained in the structure, composition and genetics of the prairies and parklands themself.

Ralph Bird (1961) outlined the major ecological factors that maintained a rich and dynamic prairie and parkland biome before European intervention. Essentially, it was a story of more or less unidirectional vegetational succession from grassland vegetation and pothole vegetation to aspen forest vegetation, interrupted and set back by major landscape disturbances that returned the forest to grassland (by fire, locusts, grazing) or wetland (by excess precipitation and flood).

Even over short periods of time, this succession — evidenced by the advance of aspen — has been remarkable. Compare the mapping of aspen parkland by Ernest Thompson Seton in 1905 with the mapping of aspen parkland by Ralph Bird in 1956 (Bird 1961). Even earlier, based on the observations of Henry Youle Hind (1850s), John Palliser (1860s) and John Macoun (1870s), this dominant trend in succession was clear, and there was recognition of the major dynamics of this landscape.

For example, travelling south and west, the amount of aspen diminishes until it occupies only small, isolated groves and is finally restricted to depressions and north- and east-facing slopes, where there is moisture. So central is the role of aspen that researchers now consider the "parkland" to be an ecotone that is very sharply demarked (at landscape scales and at the scale of individual aspen clones) into two distinct ecosystems, the grassland community and the aspen forest community.

Grazing and Vegetation Succession

Historically, it was the intensive influence of Bison — grazing, trampling and dry- and wet-wallowing — combined with fire, drought, flood and insect grazing that established the overall landscape mosaic of mostly sub-climax grassland and aspen stands. These disturbances also had the effect of ensuring the occurrence of native mineral soils, key habitats for some species — Sharp-tailed Grouse, for example, and plants such as Snowberry. Snowberry still

In 1801, Alexander Henry wrote of the easternmost edge of the region, in the Red River valley,

> "Here I climbed a high tree, and, as far as the eye could reach, the plains were covered with buffalo in every direction.... They formed one body, commencing about a half of a mile from camp, whence the plain was covered. They were moving southward slowly, and the meadow seemed as if in motion. ...The bare ground is more trampled by these [Bison] than the gate of a farmyard".

Bison were last seen in the Red River valley in 1819 and on the Souris in 1883.

responds positively to heavy overgrazing, but now by Cattle instead of Bison. Such open mineral soils were also revealed by Richardson's Ground Squirrel, Pocket Gopher, Badger, Fox and canids.

Bison, Elk and Antelope once occurred in large numbers throughout the prairies and parklands. Bison impacted areas in different ways, based on the movements of large herds. Grazing, trampling and wallows, combined with relatively stable Bison harvesting by aboriginals, tended to keep the landscape's vegetation in a relatively constant sub-climax state even though local areas may have either reached climax aspen forest or remained open mineral or wetland (Bird 1961). Locally, it was noted that, over large areas, *Buffalo had destroyed all the grass and our horses are starving…the vast quantity of dung gives this place the appearance of a cattle yard.* (Alexander Henry, *in* Coues 1897)

Also from Henry, a comment on grazing by Elk — *Very numerous here not long ago, as the tops of the oak … are all broken and twisted.*

Without such grazing, a rapid build up of organic debris and woody vegetation ensues. This in turn increases the severity of fires that can occur, with higher temperatures having greater likelihood of setting back the prairie-to-aspen succession for a longer period.

Fire and Drought

The limits of the wooded country are becoming less year by year, and from the almost universal prevalence of small aspen woods it appears that in former times the wooded country extended [south] beyond the Qu'Appelle, or three or four degrees of latitude south of its present limits.
(Hind 1860)

Fires, both natural and human in origin, raged in dry periods, particularly where moist years and a lack of disturbance had resulted in heavy fuel loadings. They were so frequent that they were seen as the cause of the lack of aspen south of the Qu'Appelle and Assiniboine, *If a portion of prairie escapes fire for two or three years the result is seen in the growth of willows and aspens, first in patches, then in large areas, which in a short time become united and cover the country; thus retarding evaporation and permitting the accumulation of vegetable matter in the soil. A fire comes, destroys the young forest growth and establishes a prairie once more. The extension of the prairie is evidently due to fires, and the fires are caused by Indians, chiefly for the purposes of telegraphic communication, or to divert buffalo from the course them may be taking. …From…the South Branch of the Saskatchewan to Red River all the prairies were burned last autumn, a vast conflagration extending from one thousand miles in length and several hundreds in breadth. The dry season had so withered the grass that whole country of the Saskatchewan was in flame* (Hind 1860). *Having frequently passed from south to north on the great prairie, I came to the conclusion that the prairie fires explained the absence of wood* (Macoun 1882). Particular note was taken of the disastrous and widespread fires in the eastern part of the study area in 1803 and 1804 (Henry, *in* Coues 1897) and in 1879 (Macoun 1882), and of major droughts periodically and subregionally, such as in central Saskatchewan in 1897 and 1938 (Bird 1961), and across the region in the 1860s and 1870s.

During the past 125 years, the frequency and extent of g*rassland fire has dramatically declined as a result of the systematic heavy grazing by large herds of domestic cattle and sheep which reduced the available levels of fine fuel and organized fire suppression efforts that succeeded in altering the natural fire regime. Wild fires resulting from natural ignition sources such as lightning influenced grasslands long before the arrival of humans. Native Americans later discovered that burning existing vegetation was one of the easiest methods for effectively modifying their environment and ignited fires for a variety of reasons, including hunting, habitat improvement, crop harvesting, pest reduction, warfare and clearing areas for home sites, crops and travel. The use of fire was so widespread in aboriginal cultures that treeless grassland are thought to be a product of repeated burning by these people.* (Brockway *et al.* 2002)

Drought in 1914 resulted in almost complete crop failure in many parts of Saskatchewan and Alberta, followed by plant rust in 1916 and a major regional drought from 1917 to 1921 (Gilson 1977). The rust-resistant Red Fife and Marquis wheats were key to the persistence of grain farming through to the 1930s, when even worse drought occurred. In 1936, *in southern Alberta, the C.P.R. used snowplows to clear the tracks of soil drifts ten feet high…Administration set the disaster area at over 60 million acres, of which 45 million acres were once prosperous and occupied farm land…The year 1938 began with rain and considerable promise… Then came hail, rust and grasshoppers… The worst grasshopper blizzard within the memory of man hit Regina on August 11.* (Gray 1966)

Locusts and Other Insects

Plagues of the leaf-eating Rocky Mountain Locust (*Melanoplus spretus*) occurred periodically for centuries, and there are ancient strata of these locusts in glaciers along the eastern Rocky Mountains (Bird 1961). They descended on the region in 1818 *when they destroyed nearly everything* (Hind 1860; Macoun 1882). In 1858, Hind recorded (1860), *On the second of July we observed the grasshoppers in full flight towards the north, the air as far as the eye could penetrate appeared to be filled with them. On subsequent days when crossing the great prairie from* [Antler River] *to Fort Ellice, the hosts of grasshoppers were beyond all calculation; they appeared to be infinite in number. …Those portions of the prairie which had been visited by the grasshoppers wore a curious appearance: the grass was cut uniformly to one inch from the ground, and the whole surface was covered with the small, round, green* [feces] *of these destructive invaders.*

Coincident with the dry period in the 1860s and 1870s was another prolonged outbreak of the same locust in 1857-1876. The last flight north of the 49th parallel was into Manitoba in 1901-02, when the last specimens of this now extinct species were collected. A co-dependence with Bison herds may have doomed them; grazing, trampling and dust wallows created favourable egg-laying sites (Bird 1961).

In the 1920s, the sheer biomass of other insects in prairie and parkland situations remained high (peaks of 6,000,000 per acre; Bird 1961), and many of these became major agricultural pests, since then increasingly controlled by pesticides. For example, outbreaks of other *Melanoplus* spp. occurred in 1898-1903, 1911-1912, 1919-1923 and 1938.

Floods and Wet Periods

Floods in the Red River and Assiniboine basins were recorded early and often, in 1776, 1790 and 1809 (Hind, 1860), and 1826 and 1852 (*ibid*.; Macoun 1882). *In 1852, the Indians represent the Qu'Appelle as filled with a mighty river throughout its entire length, flowing with a swift current from the lakelets at the Height of Land …to the Assiniboine, and as a mountain torrent through the short distance of 12 miles, which separated this from the South Branch of the Saskatchewan* (Hind 1860). Another major wet period occurred through the 1880s and 1890s. Settlement itself was compromised by these floods.

Wet periods check fires and enable aspen and shrub to advance. Floods can be widespread or local, and wetlands fill up and dry out on cyclical patterns. Lakes and potholes in the region contain water ranging from fresh to alkaline. Alkaline sloughs have few if any willows or aspen around them, while freshwater sloughs can be crowded around with willows and aspen. High waters shift the distinctive pothole-ring succession outward, knocking back willow and aspen, and 'freshen' the waters. Long dry periods have the opposite effect, and make pothole waters more alkaline through capillary evapotranspiration of subsurface salts (Walker and Coupland 1968).

Invasives

Invasive non-native species have had a defining influence on the ecology of the prairies and parklands. Some of the first invasives had immense impacts on the First Nations of the region. Smallpox repeatedly and totally devastated the aboriginal population of the region, such as in 1738-39, 1781-82, 1836-38 and 1870-71 (Roe 1972, and others). Horses were the transformative factor in wildlife harvesting and transportation. (The first horses in the study area were brought from the south to LaVerendrye's fort near Portage la Prairie in 1741; Kavanagh 1968). Later came the outright domestication of the entire biome with Eurasian — and a few domesticated North American — species.

The present occurrence, distribution and patterns of remnant natural habitats across the region have their origins in the original pre-settlement landscape, its wildlife and its disturbance regimes. The result was a dynamic and variable landscape based on sub-climax vegetation ecosystems heavily harvested and impacted by major landscape stressors. Two conservation challenges that arise are:

1) **What influence should such factors have on the selection of natural areas for conservation?**
2) **What influence should such factors have on the successful, long-term stewardship of conserved areas?**

> "…Much depends on the scale of what we are prepared to call 'land of the father'. Is it 160 acres square or is it a stretch of river valley, a range of hills, or a watershed? The flaw in our settler vision of philopatry is that we have been trying to impose a model of site tenacity that comes from another continent, that does not shape human culture against the demands and limitations of the local ecology."
>
> Trevor Herriot, 2000
> *River in a Dry Land*

2.7: Selection of Natural Areas

Disturbance regimes at the scales noted above will not occur again except to the degree that land conservation and stewardship can approximate those regimes. A number of relatively large natural-cover landscapes remain across the region, some the result of past conservation and some inviting future conservation, at scales appropriate to their ecosystems, ecological functions and original disturbance regimes.

While conservation of some lands and waters may be appropriate at the scale of individual species or natural features, prairie conservation research has long determined that volumetric approaches, at scale, are critical to long-term conservation. The best example of this has been the long-standing and successful conservation and restoration of wetlands and waterfowl habitat across the region (Riemer *et al.* 1995). This work has penetrated every part of the study area, and has made measurable difference to the conservation of target species and habitats.

The past ecological history of the region supports the view that this patient, long-term, volumetric conservation of prairie and parkland habitats needs to occur, with a focus on the identification of major opportunity areas with coincident values: 1) areas of high overall natural cover; 2) areas of natural cover of better-than-average condition; 3) areas encompassing the full range of representative vegetation-landform types (ecological system types); and 4) areas supporting both common and rare biodiversity targets (species and ecological systems).

The Conservation Blueprint project is an attempt to orchestrate data in support of assessing these kinds of areas in a standard manner across the whole prairie and parkland biome. The results and maps illustrate the project. However, there are elements of conservation planning on real landscapes that are not amenable to computer-based GIS solutions, due to difficulty in discriminating pattern, condition and diversity on the landscape. NCC recommends in its approach to conservation planning that the raw materials resulting from the blueprint analysis be reviewed by individuals and groups knowledgeable about particular ecodistricts or sub-regions. These individuals are encouraged to review the data and identify conservation action areas, or functional landscape sites that are the best prospects for re-establishing large, connected prairie and parkland landscapes.

On landbases that range upwards of 75% cultivated cropland, the re-establishment of natural cover between remnant native tracts may be necessary to the success of some conservation projects. NCC's goals in such situations are to either restore or replace functioning ecosystems. Replacement (or remediation) entails the re-establishment of functioning but largely non-native systems that fall within the existing land uses or character of an area but are, for various reasons, not the historic native ecosystems of an area. Establishing tame forage where cultivation is the current practice is one example.

Restoration is preferred but difficult, and includes efforts to repair or re-establish the structure, function, diversity and dynamics of a particular native ecosystem. NCC's efforts at prairie re-establishment at Old Man on His Back in Saskatchewan and the Tallgrass Prairie in Manitoba are examples of restoration efforts.

Success in conservation on the prairies and parklands will be measured using two types of metrics:

1) Quantitative metrics (area conserved, size of populations, connectivity of conserved lands); and
2) Qualitative metrics (species occurrences, habitat-type occurrences, range condition, riparian health, new species, re-introduced species, invasive species). These two measures are central to both site securement and site stewardship.

2.8: Stewardship of Lands

The management of grassland reserves requires careful consideration. …The role of fire, artificial clipping and other factors must also be considered in grassland reserves. [However] *the essential thing for the main reserves is to avoid overgrazing — either cumulative or during severe drought periods-— which would appreciably alter the virgin character of the grassland. The prime essential is…to ensure that grassland reserves will not be upset or materially altered at any time in the future. Once such reserves are destroyed or damaged they can probably never be restored and may not be replaced elsewhere.* (Coupland 1950)

It is not easy to manage an area and preserve it in an undisturbed, primitive condition. Fires, grazing and disturbance by dominant animals are a part of the environment. Removal of any of these factors upsets the natural balance. (Bird 1961)

A great deal had now been learned about prairie stewardship but the basic challenge remains; how to use disturbance regimes to maintain sub-climax vegetation succession, and how to avoid heavy, long-term overgrazing that sets back succession too drastically.

In the first instance, experimental design has advanced significantly, so as to avoid over-burning for example. However, burning can have real impacts on rare insect species that are remnant in small tracts and as a result are less able to re-establish after fire. *A range of burning dates and frequencies should be reintroduced or maintained in fescue prairie to create a mosaic of plant communities in various stages of recovery after burning. A mosaic will increase the structural and compositional diversity in remnant fescue prairies.* (Gross 2005) The "rests" between disturbances — and their duration and timing — can be as important as disturbance itself.

In the second instance, over-grazing can result in a severely reduced prospect for recovery of original conditions due to the absence of sufficient proximal seed sources on highly fragmented landscapes. A mosaic of grazing regimes across a landscape is more desirable than uniform grazing. A mosaic of heavy to light grazing regimes will best provide the vegetative composition and structure that can serve diverse wildlife populations.

NCC is experimenting with both burn regimes and grazing regimes in tallgrass prairie in Manitoba, and needs additional experience and expertise to apply such tools elsewhere. It is critical to consider the extreme variability of pre-settlement disturbance regimes across the region. Studies are confirming practical experience: *Lower species diversity was found in undisturbed and lightly grazed as well as in highly disturbed plot. Intermediate levels of disturbance had reduced dominance of [fescue] and increased abundance of most other species; this gave the highest species diversity.* (Vujnovic *et al.* 2002)

We gave this little tributary of the South Saskatchewan the name Sage Creek. Although the country throughout was arid and sterile, still muddy swamps very frequently occur, in which are to be found fowl in great abundance. Buffalo were also here in great numbers, as well as their constant attendants the wolves, ever ready to attack a worn-out or wounded straggler, or some stray calf. The grass in this arid soil, always so scanty, was now actually swept away by the buffalo, who, assisted by the locusts, had left the country as bare as if it had been overrun by fire; even at the edge of Sage Creek we could obtain but very little grass for our horses. (Palliser 1862)

> Within one human lifetime, the prairies have passed from wilderness to become the most altered habitat in this country and one of the most disturbed, ecologically simplified and overexploited regions in the world.
>
> Adrian Forsyth. 1983. *The End of Emptiness*

2.9: Summary

- The history of wildlife removal from this biome is unparalleled among world grasslands. That history included the virtual elimination of the once spectacularly abundant Plains Bison, Elk and Pronghorn Antelope from the biome, and the extinction of the Buffalo Wolf, Plains Grizzly, Passenger Pigeon and Rocky Mountain Grasshopper from the region. Each of these was an ecologically significant species.

- The biome's historic ecology was based on extreme disturbance regimes of heavy grazing, fire, drought, flood and insect infestations. Rapid agricultural conversion and stabilization established an alternate grassland ecology and economy, based on non-native species, new material and energy inputs, and controlled disturbance regimes.

- The history of land conversion over the past 125 years is also unparalleled among world grasslands, resulting in more than 65% land conversion to agricultural cropland and grazing of the remainder by non-native ungulates. The vast majority of this conversion was completed from 1880 to 1935, at which time the mid-1930s drought taught some strict lessons about land stewardship. Communal pastures were established as an ecologically sustainable approach to grazing, which has helped support conservation of native grassland at scales appropriate for wide-ranging species and ecological processes operating at landscape scales. As well, land retirement and land conservation have become important tools in re-distributing crop agriculture to appropriate agricultural soils.

- The region witnessed an early and strong implementation of wildlife conservation regulations and wildlife restoration efforts by government agencies, primarily to prevent imminent regional extirpations. This work continues through Canada's most successful wetland and waterfowl conservation venture, the Prairie Habitat Joint Venture (PHJV), which is expanding its interests to all birds and to upland habitats. The PHJV has also engaged private landowners and organizations far beyond the original public-sector focus the region.

- Significant threats remain. Farm-gate prices continue to be a major determinant of the intensity of agricultural pressure on the land base. This, and the impacts of drought, groundwater depletion, climate change and inadvertent misadventures in trade or farm practice, will inevitably continue to affect the ecology and economy of the region.

- There is consensus that the region is experiencing more rapid climate change than occurred naturally in the past, with attendant increases in mean temperature and weather variability, and with decreases in precipitation and groundwater availability. The impact of this on biodiversity will become clearer over time, but it seems likely that a further precautionary consensus will emerge, stating that larger-than-present conservation of landscape-scale blocks of intact prairie, parkland and valleyland habitat is required as a minimum response to challenge.

- There have been good efforts at whole-biome conservation planning in Canada, such as the PHJV, the Prairie Conservation Action Plan and the Endangered Spaces Campaign of World Wildlife Fund (Canada) (Hummel 1989, 1995). Even public agencies are organized on appropriate regional lines, such as the Canadian Wildlife Service. There are international trans-boundary assessments of the importance of the biome. All these efforts repeatedly describe the same shortfall in efforts across the biome, for example, to identify and conserve the lands having the highest and best land use as conserved lands. This is especially urgent on a landscape with so few conserved lands (maximum 9.0%), which is already reduced to 34% natural cover overall.

- The Commission for Environmental Cooperation identified key needs in its North American grassland conservation strategy:
  - *To complete identification, understanding and representation of biodiversity;*
  - T*o identify target species, high value habitats and natural corridors for wildlife*; and
  - *To determine the biotic and abiotic requirements of native prairie species and communities* (Gauthier *et al.* 2003).

  To which it is critical to add:
  To identify, conserve and restore the lands and waters needed for all the elements of native biological diversity to persist at viable scales and population levels across the entire biome.

- This conservation blueprint contributes to a better documentation of the biological diversity of the four ecoregions comprising the prairie and parkland biome. The project has worked across three provinces, two states and two countries. It documents existing conservation efforts, the biodiversity of the region (target species and all ecological systems), minimum conservation goals to be met to sustain that biodiversity, and the places that best meet those goals.

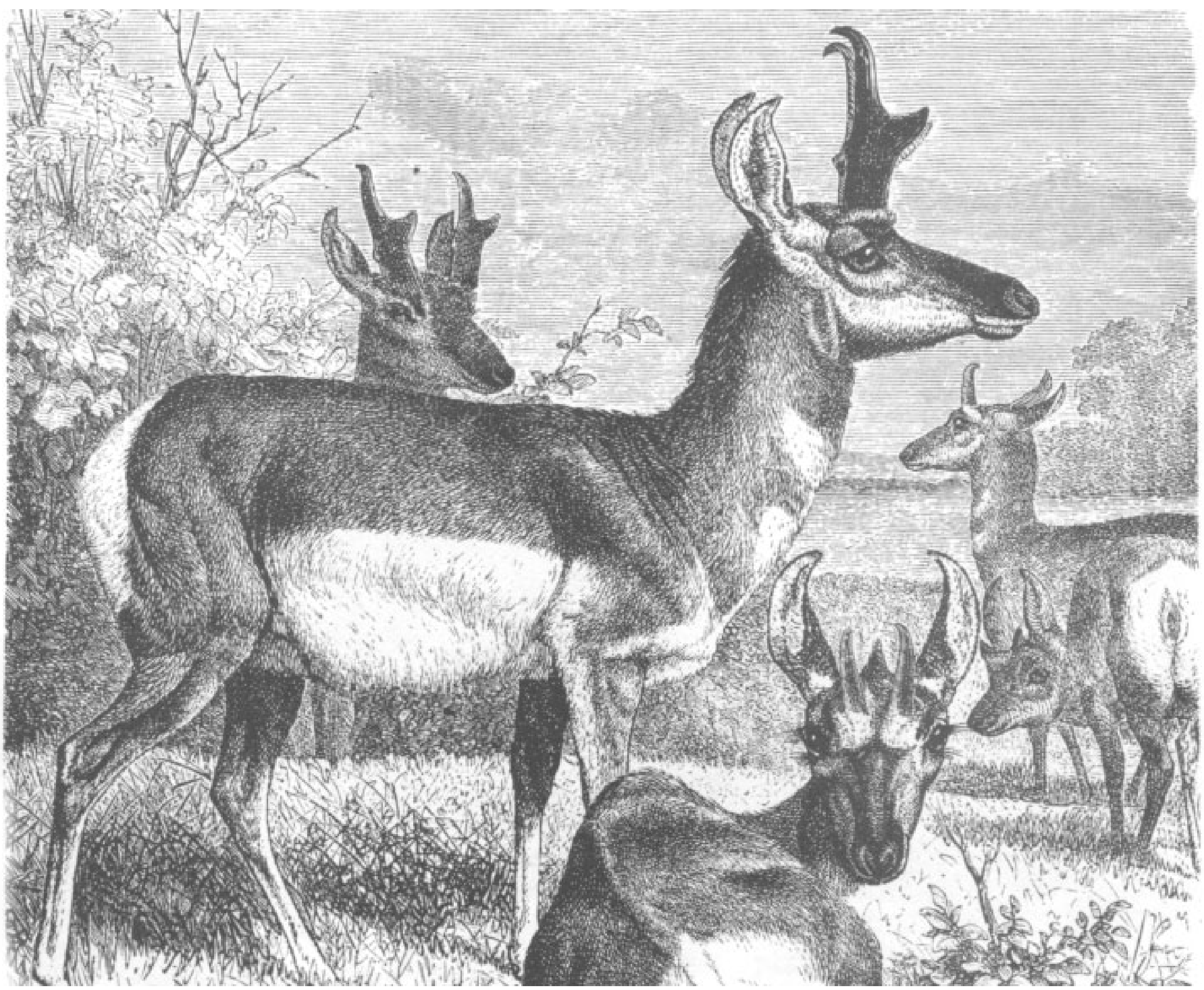
- This atlas and analysis of the biological diversity of the Canadian prairies and parklands is offered as a contribution to a shared understanding of the conservation geography of the region, to help frame **the identification of a suite of core biodiversity conservation areas, set within the supporting network of remaining natural cover.** Individuals, agencies, conservation practitioners and others may find the data useful, along with other data, in determining the set of **priority landscapes** that should be the focus of conservation efforts.

- Data such as these can also be used to inform the kind of long-term stewardship needed for conserved prairie and parkland landscapes, whether through passive management or the emulation of disturbance regimes that is needed to maintain natural diversity and particular species and ecosystems. Successful conservation strategies will work to entrench a viable balance between conserved natural cover and converted, developed lands.

SECTION 3.0

Protected Areas and Conservation Lands

The blueprint project has deliberately included as many potential conservation-related lands as possible. Some may argue that provincial parks whose primary objective is recreation but permit resource extraction should not be included, or that some public lands that have been included as conservation lands may treat conservation as secondary to grazing. Some would argue that there are no true wilderness areas remaining in these ecoregions. In a landscape as highly altered as this, nearly the entire landscape is under some form of management and, yet, conservation is progressing.



There is digital mapping for most but not all types of protected areas and conservation lands in the prairie and parkland region. This project distinguishes between protected areas and conservation lands. Regulated protected areas have biodiversity conservation as their overt mandate but this study also includes less formal conservation lands that also significantly contribute to biodiversity conservation.

The protected areas (PA) and conservation lands (CL) are under two main types of tenure; private (freehold, deeded) and public (Crown, State, federal). Only public PA and CL were considered in this study. Table 3.1 summarizes this land tenure of each ecoregion. Table 3.2 lists the protected areas and conservation lands that were included in this project, and indicates their ownership. 79% of the lands and waters of these ecoregions are privately owned and managed. About 2.0% of the study area is protected area and about 5.2% conservation land.

The **Aspen Parkland** and **Moist Mixed Grassland** are predominantly privately owned and managed (87% and 83% respectively). Of the total land base of each of these ecoregions 4.2% is regulated public protected area or other conservation land. The **Mixed Grassland** and **Cypress Upland** have fewer private lands (66% and 52% respectively). In the **Mixed Grassland**, 12.1% of the total land base is protected area or conservation land, and in the **Cypress Upland** the extent is 14.9%. These are modest levels of land conservation. The portion of the **Boreal Transition** included in this study 52% public land, and more than 43% is protected area (Riding Mountain Park).

The great bulk of native grasslands in central North America (about 85%) occur in the United States but protected grasslands are reported to be as low as 1.61% of the U.S. portion of the biome (CEC and TNC 2005). The Canadian prairie and parkland biome represents 16% of the overall North American biome, and past estimates of protected areas in the Canadian portion have varied from 3.5% (Gauthier and Wiken 2001) to 14.95% (CEC and TNC 2005). The Strategic Plan for North American Cooperation in the Conservation of Biodiversity (*ibid.*) identifies 55 grassland priority conservation areas (GPCAs), 15 in Canada, for a total of 11.7% of entire area of the Canadian prairie and parkland biome. Perhaps 2/3 of the lands in these GPCAs remains in native grassland, in which case these GPCAs cover about 4% of remaining Canadian native prairies and parklands.

3.1: Federal Lands

3.1.1 Canada

Some federal lands in Canada have wildlife conservation and ecological integrity as required elements of their management (Table 3.2). These protected areas include national parks (12.7% of total PA/CL lands), national wildlife areas (1.4%) and migratory bird sanctuaries (1.5%). Other federal lands, such as federal pastures, are managed for agriculture (livestock grazing) and with proper management provide significant habitat for wildlife. These are treated as conservation lands in this study, and make up 24.2% of total PA/CL lands in Canada. In this analysis, federal Department of Defence lands are also treated as conservation lands (9.3% of total PA/CL lands). These areas are often located on non-arable lands including rare habitats (*e.g.*, sand dunes) and populations of rare species. First Nations lands, comprising 2.3% of the study area, were not identified as either protected areas or other conservation lands because of lack of data, despite their likelihood of containing areas of both.

These lands are categorized by International Union for Conservation of Nature (IUCN) and Gap Analysis Program (GAP) status (Table 3.2):

- IUCN classes of protected areas, *i.e.*, area of land and/or sea especially dedicated to the protection and maintenance of biological diversity…and managed through legal or other effective means;
- GAP status, *i.e.*, areas identified to provide an assessment of the management status for certain elements of biodiversity (vegetation communities and animal species etc.

3.1.2 United States

Federal lands are classified based on their management, which determines their GAP code and therefore their importance to conserving biodiversity (see glossary for GAP codes). Table 3.2 lists the federal lands included in the study in the Montana and North Dakota portions of the study area. The most significant of these lands are the National Wildlife Refuges (22.1% of total PA/CL area in U.S.), followed by Bureau of Land Management holdings (6.2%).

Table 3.1. Summary of land tenure and protected areas (PA) and other conservation lands (CL) in each ecoregion

Ecoregion	Public/Crown Lands and Major Water Bodies	Private Lands	Regulated Protected Areas (PA)	Other Conservation Lands (CL)
Aspen Parkland	13%	87%	1.5%	2.7%
Moist Mixed Grassland	17%	83%	0.8%	3.4%
Mixed Grassland	34%	66%	1.5%	10.6%
Cypress Upland	48%	52%	4.7%	10.2%
Portion of Boreal Transition	52%	48%	43.7%	0.1%
Total	**21%**	**79%**	**2.0%**	**5.2%**

Table 3.2. Protected areas (PA) and conservation lands (CL) according to type and area, included in study

Type of Protected Area (PA) other Conservation Land (CL)	PA or CL	IUCN Code	GAP Code	Area (ha)	% of total PA/CL by country	% of land base
CANADA						
Department of National Defence (F)*	CL	n/a	3	309,352	9.33%	0.6%
Ecological Reserve (F, AB)	PA	I	1	10,557	0.32%	0.0%
Fish and Wildlife Development Lands (SK)	PA	IV	2	50,176	1.51%	0.1%
Heritage Rangelands (AB)	PA	VI	2	1,123	0.03%	0.0%
Migratory Bird Sanctuary (F)	PA	IV	2	50,037	1.51%	0.1%
National Park (F)	PA	II	1	419,721	12.66%	0.9%
National Wildlife Area (F)	PA	IV	2	45,258	1.37%	0.1%
Natural Area (AB)	PA	II	1	93,641	2.82%	0.2%
Park Reserve (MB)	PA	II	1	132	0.00%	0.0%
Agriculture and Agri-Food Canada – Federal Community Pasture (F)	CL	n/a	3	802,550	24.21%	1.7%
Provincial Community Pasture (AB, SK, MB)	CL			223,750	6.75%	0.5%
Provincial Park (AB incl. Wildland Park, SK, MB incl. Heritage Park)	PA/CL	II,IV	1,2	169,777	5.12%	0.3%
Provincial Recreation Area (AB, SK)	CL			15,480	0.47%	0.0%
Wildlife Habitat Protection Act protecting (SK) – (Crown agriculture-lease lands)	CL/PA	n/a/,VI	2,3	1,058,225	31.92%	2.2%
Wildlife Management Area (MB)	PA			65,676	1.98%	0.1%
UNITED STATES						
Area of Critical Environmental Concern (F, in MT)	PA	III	1 & 2	3,368	2.3%	0.0%
BLM Holding (F, in MT)	CL	VI	3	9,200	6.2%	0.0%
Large park (city, cy. or private) (ND)	PA	VI	2	95	0.1%	0.0%
National Forest (F, in MT)	CL	VI	3	1,171	0.8%	0.0%
National Outstanding Natural Area (F, in MT)	PA	VI	1	2	0.0%	0.0%
National Wildlife Refuge (F, in MT, ND)	PA	IV	1,2	32,585	22.1%	0.1%
Power Withdrawal (F, in MT)	CL	n/a	3	251	0.2%	0.0%
Research Natural Area (F, in MT)	PA	I	1	3	0.0%	0.0%
Wilderness Study Area (F, in MT)	PA	II	2	63	0.0%	0.0%
Military Reservation (F, in MT, ND)	CL	n/a	3	1,973	1.3%	0.0%
Misc Federal Reservation (F, in ND)	PA	II	1	351	0.2%	0.0%
NWR, WMA, Game Preserve/Fish Hatchery (F, in ND)	CL	n/a	3	5,582	3.8%	0.0%
State Forest (ND)	CL	VI	3	4,797	3.2%	0.0%
State Lands (MT)	CL	n/a	3	74,117	50.2%	0.2%
State Park (MT, ND)	PA	II	2	452	0.3%	0.0%
State Wildlife Refuge, Wildlife Management Area Game Preserve or Fish Hatchery (ND)	CL	n/a	3	3,183	2.2%	0.0%
Wildlife Management Area (MT)	PA	VI	2	10,550	7.1%	0.0%

* F = Canadian and U.S. federal public lands; AB = Alberta, SK = Saskatchewan, MB = Manitoba provincial public lands; MT = Montana, ND = North Dakota state public lands.

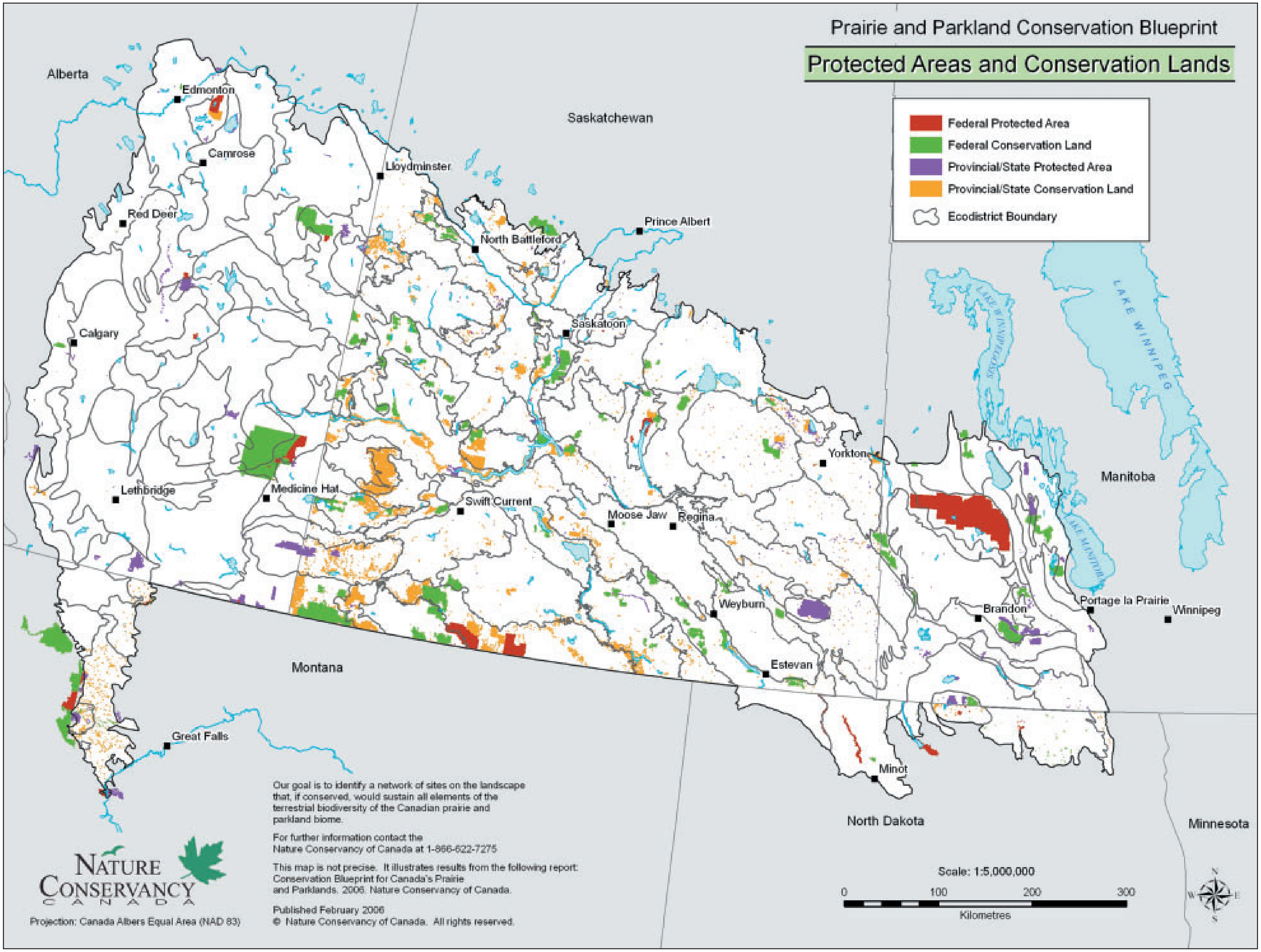
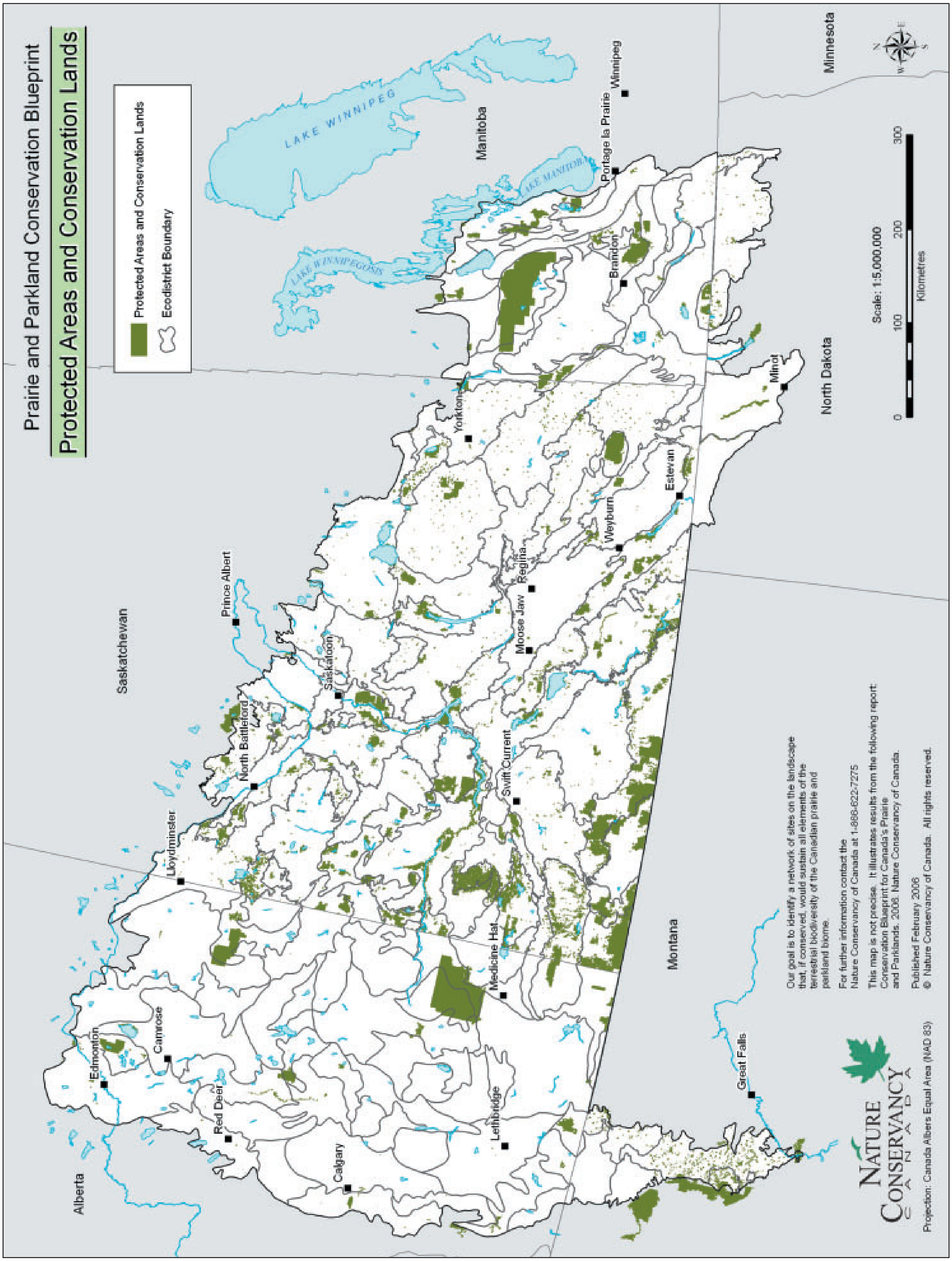


Figure 5. Protected areas and conservation lands.

Figure 6. Composite protected areas and conservation lands, by ecodistrict.



3.2: Provincial and State Lands

3.2.1 Provincial Lands – Canada

Provincial protected areas include provincial parks, natural areas, wildlife management areas, fish and wildlife development fund wildlife lands, heritage rangelands, ecological reserves, and park reserves (Table 3.2; 391,081ha). Of these, provincial parks make the greatest contribution to regulated biodiversity conservation (5.1% of total PA/CL lands). These parks are considered protected in this study but commercial resource extraction is permitted in some Manitoba and Alberta parks.

Provincial conservation lands include provincial community pastures, provincial recreation areas, and Saskatchewan lease lands on which the *Wildlife Habitat Protection Act (*1984) protects wildlife (Table 3.2; 1,297,455ha). Of these, the Saskatchewan lease lands occupy 1,058,225ha (31.9% of total PA/CL lands). Provincial community pastures cover 6.7% of total protected areas and conservation lands in the Canadian part of the study area.

3.2.2 State Lands – United States

State protected areas include state parks and wildlife management areas (Table 3.2: 11,002ha), almost all of which are Montana wildlife management lands. State conservation lands, as included in this study, are state lands (50% of total PA/CL in the U.S. study area), by far the largest set of lands with permanent protection from land conversion. Other lands include state forests, state wildlife refuges, wildlife management areas, game preserves or fish hatcheries, for a total of 82,097ha.

3.3: Private Lands

The Prairie Habitat Joint Venture (PHJV) reports that its government and non-government partners secured 862,000 hectares of conservation lands through fee simple, easement or stewardship agreement in the period 1986 to 2001. The large majority of these would be private lands secured by non-government partners, predominantly Ducks Unlimited Canada. NCC has secured 38,000 hectares of land and easement for conservation in the region as part of the PHJV. Taken together, this constitutes 1.9% of the Canadian prairies and parklands, an area almost equivalent to existing regulated federal and provincial protected areas. Mapping of these lands was not available to the study.

Over and above this, it is important to note that there are a tremendous but undocumented number of private landowners pursuing essential private-land conservation over large land holdings, both deliberately and through benign management and appropriate agricultural practices. These efforts are providing major ecological goods and services across the prairies and parklands, as a public service that is insufficiently recognized. For example, to take a single example, the McIntyre Ranch in southcentral Alberta supports the finest remaining fescue prairie in North America, under active grazing (McGillivray and Steinhilber 1996). The extent of this single private conservation effort rivals that of entire conservation agencies and non-government organizations in the region.

To conclude, the documented federal and provincial protected areas and other conservation lands cover just over 9% of the Canadian study area, of which this study has mapped 7.1%. Of these:

- 1.2% are federal protected areas;
- 0.9% are provincial protected areas;
- 2.5% are federal conservation lands;
- 2.9% are provincial conservation lands; and
- 1.9% are PHJV lands.

(There is overlap in counting between PHJV lands and other categories.)

3.4: Designations

A variety of programs have been developed to identify or designate lands important to the conservation of wildlife and their habitats. The first of these was the International Biological Program, which documented significant natural areas through the period 1967 to 1975.

Other designations have been used to distinguish between international, national, and regionally significant sites. Examples include the Important Bird Areas program (IBA; www.ibacanada.com), Western Hemispheric Shorebird Reserve Network (WHISRN; www.pnr-rpn.ec.gc.ca-/nature/whp/whsrn /index.en.html), UNESCO World Heritage Site program (www.templetons.com/brad/-unesco), and Ramsar Wetland program (www.ramsar-.org), all of which are represented across the study area.

Other designations have been assigned provincially, and are used to rank candidate sites for securement as new protected areas. Examples include Manitoba's Areas of Special Interest (ASI; www.gov.mb.ca/iedm/mrd/geo/-exp-sup/min-ai.html) and Alberta's Environmentally Significant Areas (ESAs;www.cd.gov.ab.ca/preserving/-parks/anhic/esa.asp).

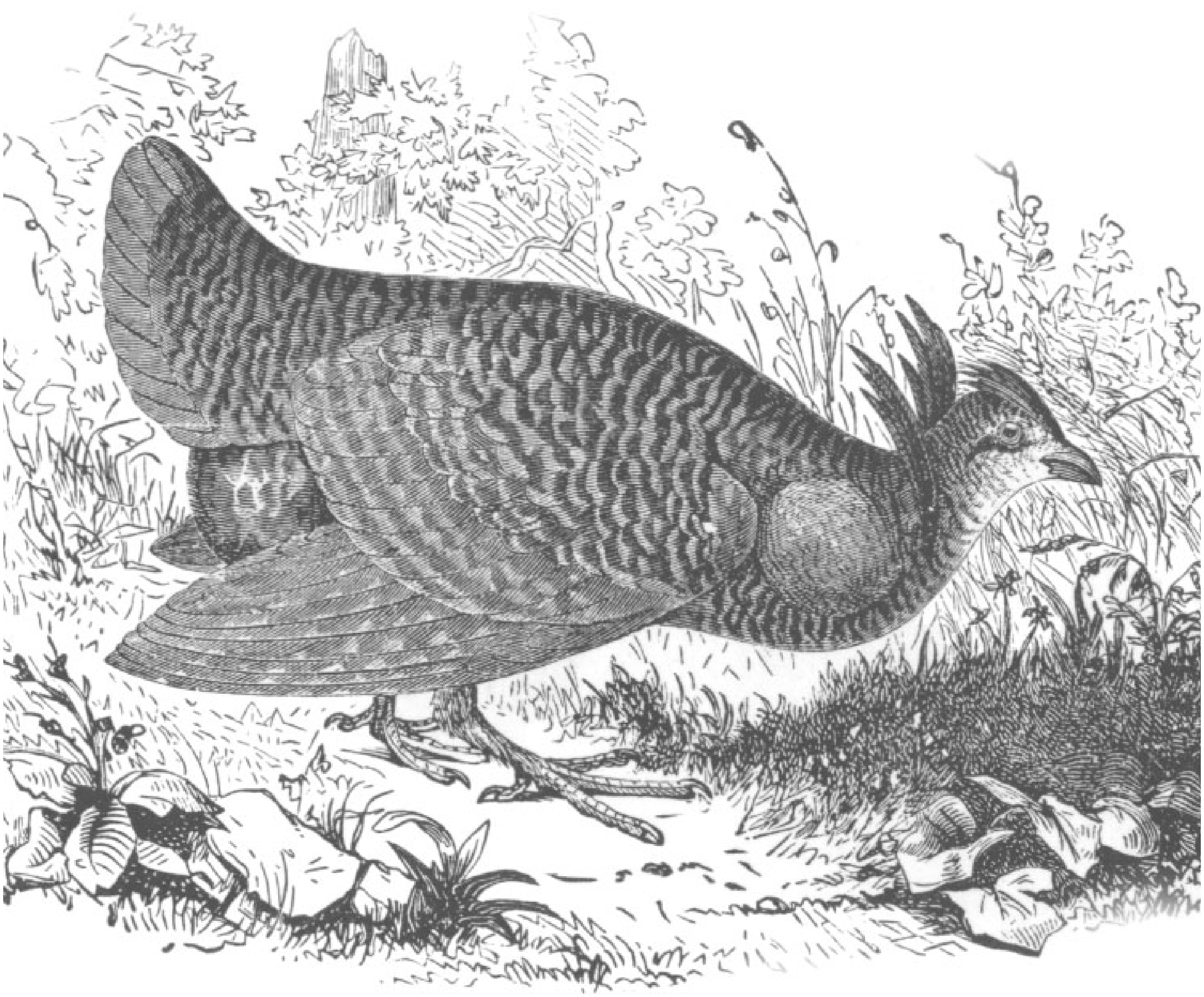
Many of these areas cover large tracts of lands and are generalized across the landscape. None yet are applied consistently enough across the whole study area to provide precisely-mapped areas for addition to the blueprint analysis. However, these are exactly the type of regional studies and treatments that have been important to other ecoregional assessments.

Private lands and conservation designations were not included in this study. In ongoing conservation planning at finer scales, these areas will be useful in conjunction with the blueprint for identification of priority landscapes for conservation action.

SECTION 4.0

Methods

The hypothesis that these methods test that it is possible to identify and assess the places across the prairie and parkland biome that, if appropriately conserved, could sustain the essential biological diversity of the region. This may or may not be possible but should be considered the measure of the techniques applied in this study.



This type of regional study bases itself on available mapped data which, in the case of this region, required assembly and "cross-walking" of many data sets across jurisdictional boundaries, as well as the development of new classifications of ecological systems and new attempts at setting conservation goals for targeted species and ecosystems. The absence of regional data on the condition, diversity and ecological functions of landscape features also requires the development of "surrogate" approaches to such questions. As a discussed in section 4.5, these methods are highly perfectible, representing a first-iteration analysis of this broad region.

All data were analyzed regardless of administrative jurisdiction or land tenure. Species and ecosystems rarely pay attention to jurisdiction or land tenure, and neither should conservation planning.

The study identifies the contribution of an inclusive suite of existing, regulated protected areas and other conservation lands (Figs. 5 and 6).

In general, the method was the coarse-filter/fine-filter approach to conservation planning (Groves *et al.* 2000), following these steps.

1. Biodiversity targets were identified, including species and habitat types at risk, and all ecological system types, which were considered to provide the appropriate range of habitats required by not-at-risk species.
2. Conservation goals were established for target species, habitat types and ecological systems, based on estimated needs for range-wide distribution and replication of populations and ecological systems.
3. Ecological systems were classified and mapped across the study area, and each system polygon was scored based on a range of values. The highest scoring polygons were selected based on replication goals set for each ecodistrict of the region (*coarse-filter analysis).*
4. Existing protected areas and conservation lands were classified, mapped and included in the blueprint portfolio.
5. Additional habitat polygons were added to ensure that conservation goals were satisfied for each species target (*fine-filter analysis*).
6. Output maps of these areas were overlaid on maps of existing features, to illustrate the full range of **sites** that can conserve fine-, mid- and large-scale targets, and the distribution of **remaining natural cover** across the region as a whole, to suggest the type of habitat network that is already in place and that could sustain species populations and environmental goods and services as a whole.

Next steps beyond the scope of this study are: the identification of **functional landscapes** or priority conservation landscapes that could achieve a higher degree of intactness; and the kinds of rehabilitation or restoration work needed across even **broader landscapes** to sustain the delivery of the full range of environmental goods and services and deal with longer-term issues of ecological persistence of species, habitats and systems.

The resulting portfolio consists of sites required to conserve viable examples of all native ecological systems and species in the prairie-parkland ecoregions. Data for these ecoregional assessments were analyzed using geographic information system (GIS) software and expert-driven model parameters (Appendix B).

The following section outlines the procedures taken to assemble data and establish biodiversity targets and conservation goals, and the technical methods followed in the coarse-filter and fine-filter analyses.

4.1: Ecological Systems – Coarse-filter Targets (details in Appendices A and B)

Knowing "what" kinds of habitat (or vegetation types) occur "where" is central to the assessment of biological diversity across a landscape. Region-wide classifications are not in place for wildlife habitats or vegetation and, as a result, there is no consistent mapping of this key aspect of biodiversity across the region. Mapping of vegetation polygons would be invaluable as the base for comparing habitats across large geographic areas.

However, even where such classifications are in place, such as the U.S. National Vegetation Classification (Grossman *et al.* 1998; Anderson *et al.* 1998), it is rare that there is mapping of these units across landscapes, and where they are mapped, the map units are often too many and too small to be the basis for reasonable comparative assessments.

As a result, intermediate-scale classifications have been developed that integrate both biological and landform features into "ecological systems". These have been used because they are mappable and communicable at more appropriate scales (Comer 2003). Assessment methods that seek to represent ecological systems have been demonstrated to be more effective in identifying sites that support large-scale ecological processes and characteristic biodiversity than conservation strategies that focus on individual species or groups of species (Kintsch and Urban 2002; Groves 2003).

The ecological systems developed for this project are unique combinations of landform and vegetation types (Appendix A). Vegetation communities vary with their underlying landform geology (Fig. 8), so abiotic (landform) data were combined with native land-cover data (Fig. 7) to create an ecological systems layer (Fig. 9). These ecological systems were used as the coarse-filter biodiversity targets in this study. By identifying and conserving representative examples of the best remaining ecological systems, the major assumption is that the majority of the region's species (biodiversity) that rely on these systems will be conserved as well.

To deal with edge effects where the study area grades into adjacent biomes, mapping of ecological systems was also done for a 30km buffer (where data existed) into the adjacent ecoregions. This allowed the project to delineate the important ecosystem polygons in the ecotones between ecoregions, in the cases where those polygons extended beyond the precise boundaries of the study area.

The distribution of these ecological systems across the wider landscape was the second major consideration. Oliver and others (2004) corroborate that ecological (or land) systems can function as effective surrogates for biological diversity within an appropriate geographic distance or range for that system. Where some ecological system types are distributed farther apart on the landscape, biota of these ecological systems exhibited less similarity (*ibid.*) For assessing representation, the *ecological system* was considered to be the surrogate for the characteristic biota of an area. The *ecodistrict* was considered to be the ecological land unit most suitable as the unit within which ecological systems were similar enough for comparison (Fig. 10).

The Canadian ecological land units used for this purpose were those of the Canadian Ecological Stratification Working Group (ESWG 1995). An *ecodistrict* is an area of relatively homogeneous landform, climate, soil, within which vegetation, wildlife and habitat respond consistently. The comparable U.S. units are the US EPA's Level IV units (subsections; Omernick 1995). Each jurisdiction has detailed descriptions and mapping of these ecological units (Montana – Woods *et al.* 2002; Alberta – Strong 1992; Saskatchewan – Acton *et al.* 1998; Manitoba – Smith *et al.* 1998; North Dakota – Bryce *et al.* 1996). Representation goals for coarse- and fine-filter biodiversity targets in the blueprint were stratified by ecodistrict (Fig. 10) to meet standard goals (see sections 4.2.1 and 4.3.1).

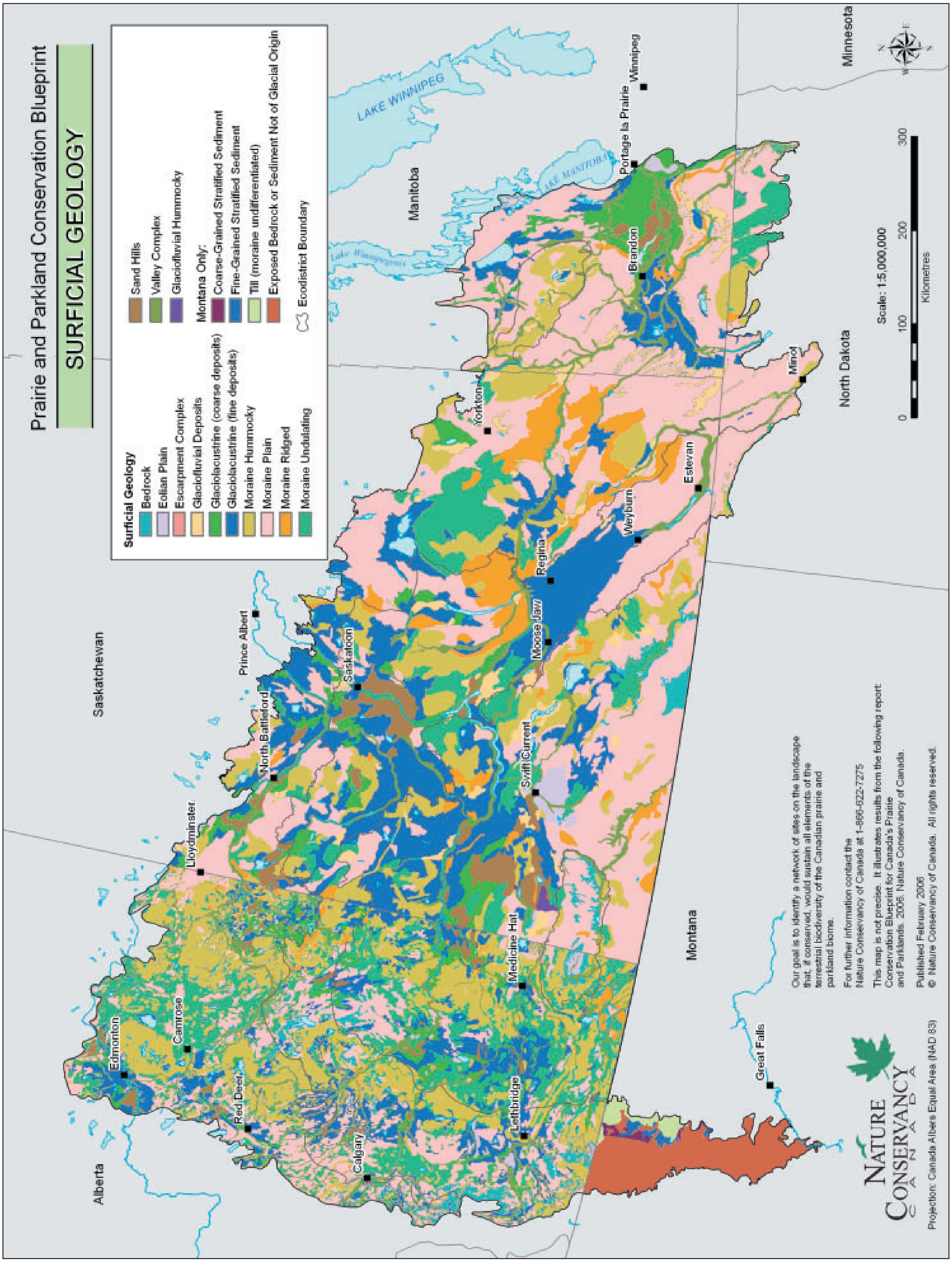
(Some of the initial ecodistrict and ecoregion boundaries did not connect across the international boundary. Interested parties met in Calgary in 2000 to match ecoregional boundaries across jurisdictional boundaries, with subsequent adjustments to line up the boundaries of ecodistricts. Some of the U.S. ecodistrict units did not match with their ecoregion boundaries, in which case they were clipped to TNC ecoregion boundaries.)

4.2: Coarse-filter Biodiversity Analysis

A coarse-filter analysis is a landscape-level approach to conservation area design that focuses on selecting the best representative (*i.e.*, highest scoring) examples of equivalent landscape units across broad areas, in this case, of ecological system types, across ecodistricts. The assumption is that, by selecting the best examples of each ecological system type across a region, a very large majority of that region's biodiversity will be represented in those areas. Methods were developed to assess which sites represent the best remaining natural (native) areas. To determine this, four criteria were applied, which will be discussed in more detail in the next section.

Polygons of each ecological-system type were compared with each other by calculating a specific numeric score for each polygon. This score was based on values assigned to each polygon, each value representing a particular ecological criteria. Each scored 'value' was based on a specific mapped 'value grid'.

Figure 7. Surficial geology in the prairie and parkland ecoregions (sources in App. A).



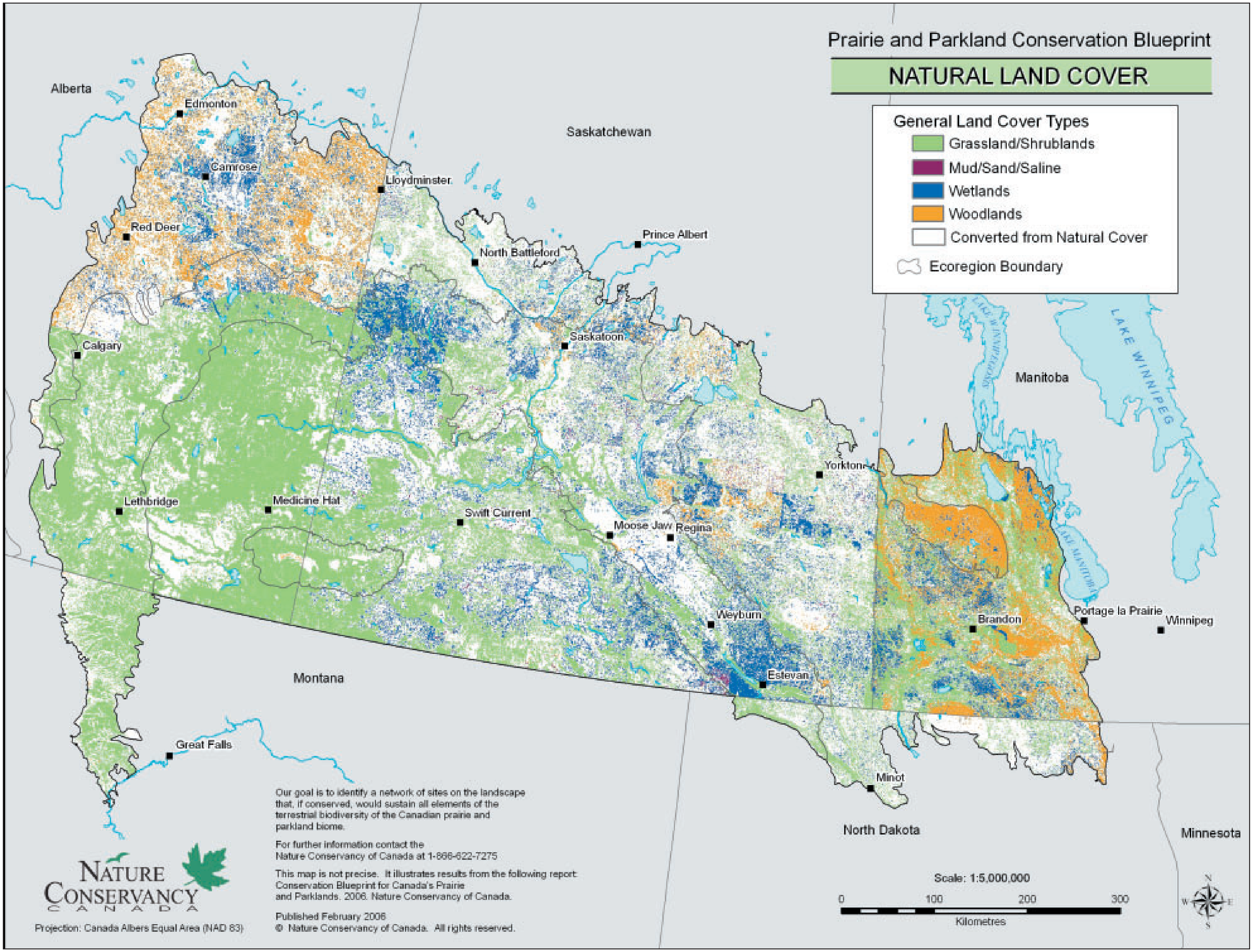
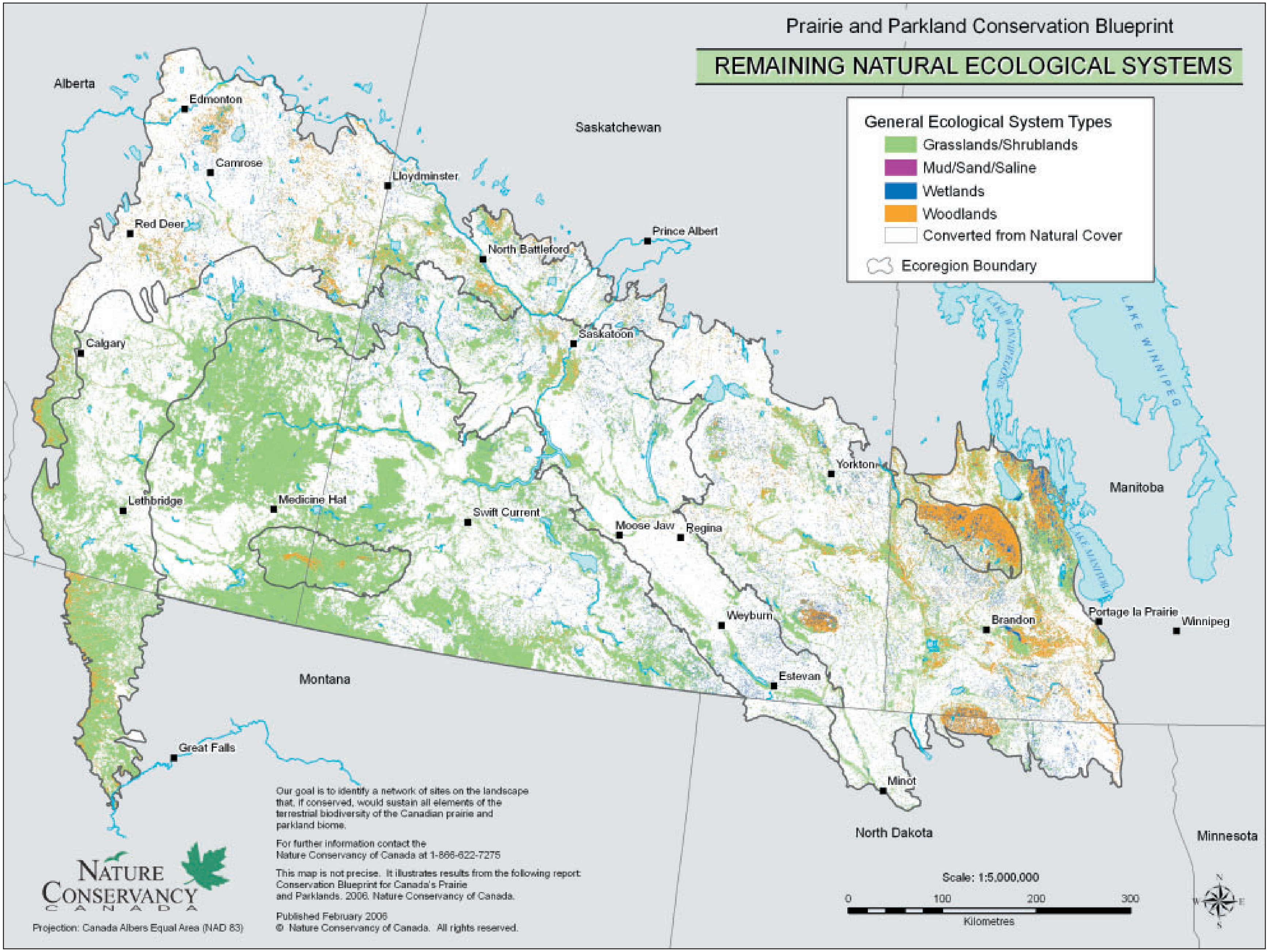


Figure 8. Generalized natural cover remaining across the prairie and parkland ecoregions (sources in App. A).

Figure 9. Generalized ecological systems of the prairie and parkland ecoregions (sources and types in App. A).



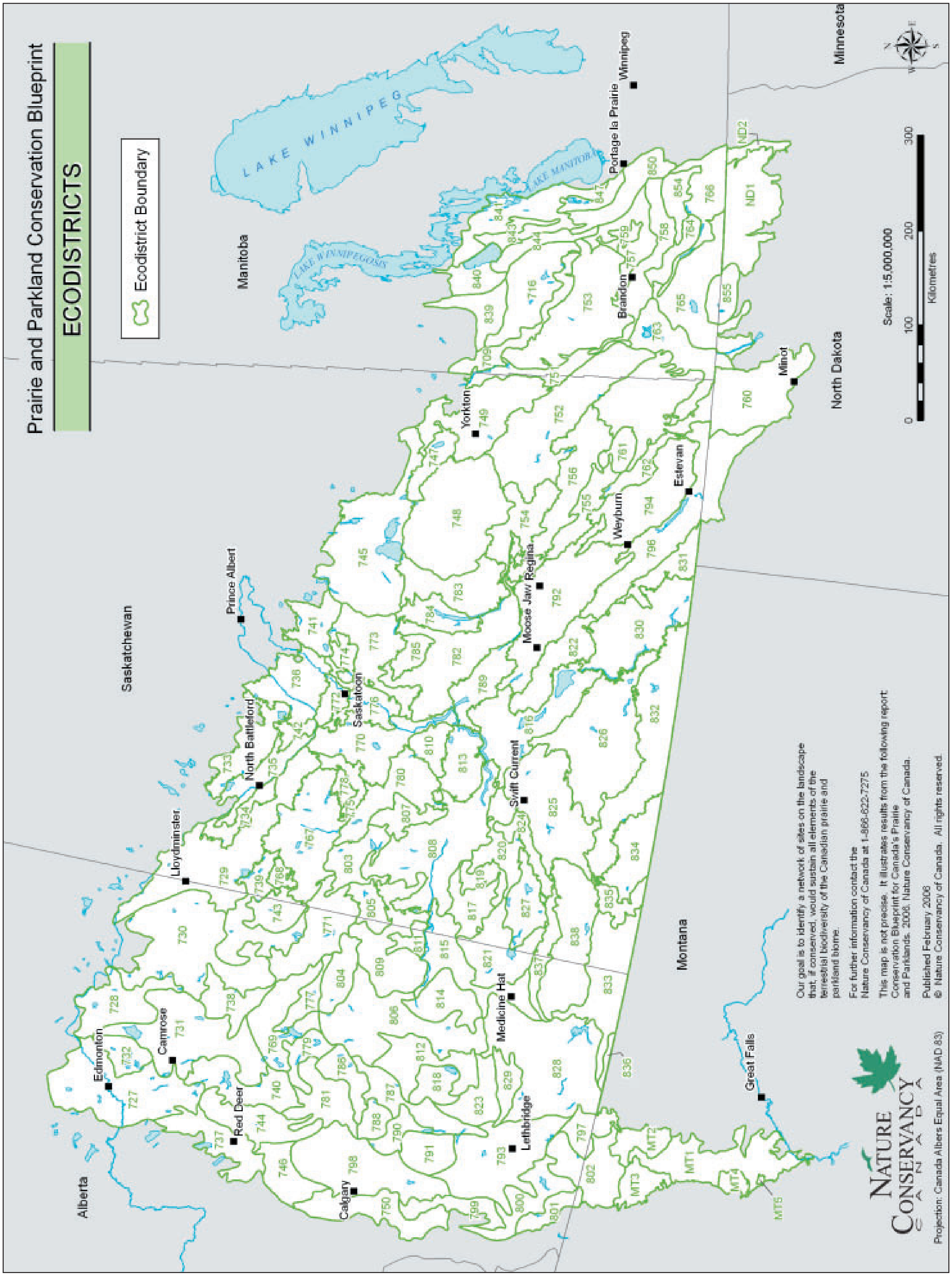


Figure 10. Ecodistricts of the prairie and parkland ecoregions (names in App. C).

The value grids of the coarse-filter analysis were GIS-derived data layers, or map layers, which acted as surrogate values for assessing particular ecological criteria:

- **Condition**
- **Diversity**
- **Ecological Function**
- **Special Features**

Each 30-metre pixel on the landscape was assigned a score from each grid. These grid scores were then numerically combined for each criterion, and the scores were calculated for each pixel to create a new layer of value scores representing each criterion. The pixel values within each intact ecological system polygon were averaged to generate a single score for each polygon, or patch.

Technically, the "value" layers used in the coarse-filter analysis are GIS-created rasters all with a 30-metre cell size. These layers either represent continuous information such as road density or discrete information such as ecological-system size. In cases, where the information is continuous, values for the ecological systems were calculated as the average value per polygon. Discrete values were assigned directly to the ecological system polygon.

All the criteria grids were added together to establish a final score for each ecological system polygon. This final total score is termed the polygon's 'conservation value' relative to other patches of the same ecological-system type. The polygons with the highest scores were selected to represent core biodiversity conservation areas among all other polygons of the same ecological-system type.

Due to the ecological differences between major ecological-system types in the study area, separate analyses (using separate scoring approaches) were used to assess five broad categories of ecological systems: **grasslands/shrublands; woodlands; large wetlands; small wetlands; and mud/-sand/saline** (Appendix B).

By classifying the ecological systems into one of these five categories, different variables and weights could be used to score each general type of ecological system. Within each type, ecological systems were scored using the same criteria of condition, diversity, ecological function, and special features, but with different scores.

Wetlands were analyzed following two methods, one for large wetlands (>20.25ha) and another for smaller wetlands. This was done to avoid placing a bias on either the large wetlands or small wetlands within areas of high wetland density, when they each sustain different and important suites of biodiversity features. As a result, both large wetlands and complexes of smaller wetlands are represented in the blueprint.

Small wetlands were analyzed as wetland complexes rather than as individual wetlands. To map these complexes, wetland density was first calculated using of all the wetlands (large and small) that met the minimum size requirements (0.36ha). Using the kernel wetland density calculation, wetland density polygons (WDP) were created from those areas with wetland densities of 3.48 wetlands/km^2 or greater. Once all calculations were completed and the top two scoring WDPs for each ecodistrict were identified, all wetlands that intersected with the WDP were selected. The WDP score was assigned to the selected wetlands and then the individual wetlands were added to the blueprint.

Ecological system polygons below certain size thresholds were not considered in this analysis because a review of the literature and expert opinion suggested patches below certain thresholds were not worth considering as regional conservation priorities in this coarse scale of analysis. Only patches that met minimum size requirements were analyzed. (Habitat patches smaller than these thresholds were considered in the fine-filter analysis.)

For the **Aspen Parkland, Moist Mixed Grassland** and the portion of **Boreal Transition** ecoregions the minimum sizes were: 16ha for grasslands/shrublands, 0.81ha for woodlands, 20.25ha for large wetlands and 0.36ha for mud/sand/saline and small wetlands. The minimum size requirements for the **Mixed Grassland** and **Cypress Upland** were: 16 ha for grasslands/shrublands and woodlands, 20.25ha for large wetlands and 0.36ha for mud/-sand/saline and small wetlands.

To provide an example, it has been stated that grasslands less than 10ha (especially if linear) are of little benefit to grassland bird species (McCracken 2005). Suggestions of minimum patch size for grassland birds range from 100ha (Vickery *et al.* 1994) to 250ha (James 2000) to 1000ha (Herkert *et al.* 2003). In this analysis, grasslands parcels were not scored at all for size if they were less than 16ha in size or less than 180m wide, and scores increased to a maximum for patches more than 4096ha in size.

Scoring was also varied by ecoregion. All grassland types in the **Aspen Parkland** were valued on the same manner . Likewise all woodland types in the **Aspen Parkland** were scored using the same scoring system. For all four ecoregions, the GIS layers were the same, but the assigned scores differed. Scores for the eco-logical systems and the ecoregions that they occur in are found in Appendix B.

The rule-based GIS project identified 'top-scoring' ecological systems (or landform-vegetation types) on the landscape. The top-scoring systems are those worth ground-truthing and considering in conservation strategies. This analysis did not target a particular percentage of the landscape for each remaining system type, which could have been an alternative approach. The 'top-scoring' approach works well where the landscape is highly fragmented and there is a large degree of variance in the ecological integrity of the remaining natural areas.

The following section describes each 'value grid' (or cost grid), including the inputs, outputs, scores and rationale for using that value as a surrogate for a particular ecological criterion. Appendix B lists each layer and its scores.

Condition

The ecological 'condition' of any area is challenging to assess on the ground, and numerous approaches to such assessments, including those for range or riparian conditions, are in use. Assessing condition remotely is more difficult. In this project we assessed the intactness of the adjacent native cover as a surrogate value for condition, by measuring the amount of natural cover immediately adjacent. Secondly, the density of roads in each ecological system polygon was assessed as a measure of disturbance. The model was weighted to select ecological systems with a high degree of natural cover and a low density of roads.

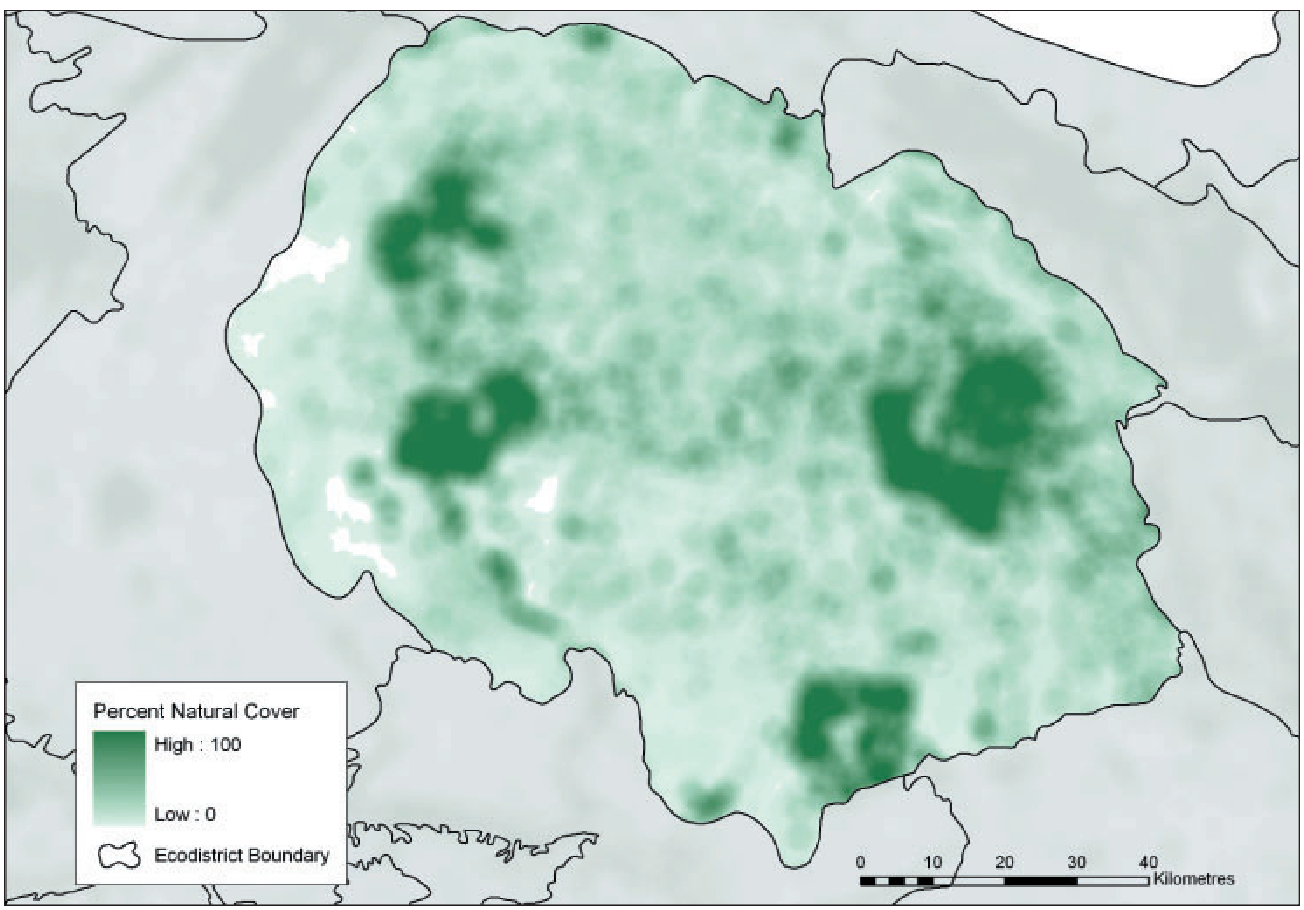
The condition criteria contributed 15% of the total score for all ecological systems, except for small wetlands (where they contributed 35% of total score) (Appendix B).

Percentage Natural Cover in 2km Radius

This measure of conservation value related directly to the degree of natural connectivity or isolation that a vegetation patch experiences. The amount of natural cover in an area influences many ecosystem processes, such as dispersal, in that more isolated patches are less likely to be recolonized after an extirpation event (MacArthur and Wilson 1967; White *et al.* 1996).

Parameter	Grassland	Woodlands	Small Wetlands	Large Wetlands	Mud/Sand/ Saline
% Natural Cover	✓	✓	✓	•	•
Road Density	✓	✓	✓	•	•

Figure 11. Percent natural cover within a 2 kilometre radius (Touchwood Hills Upland ecodistrict 748).



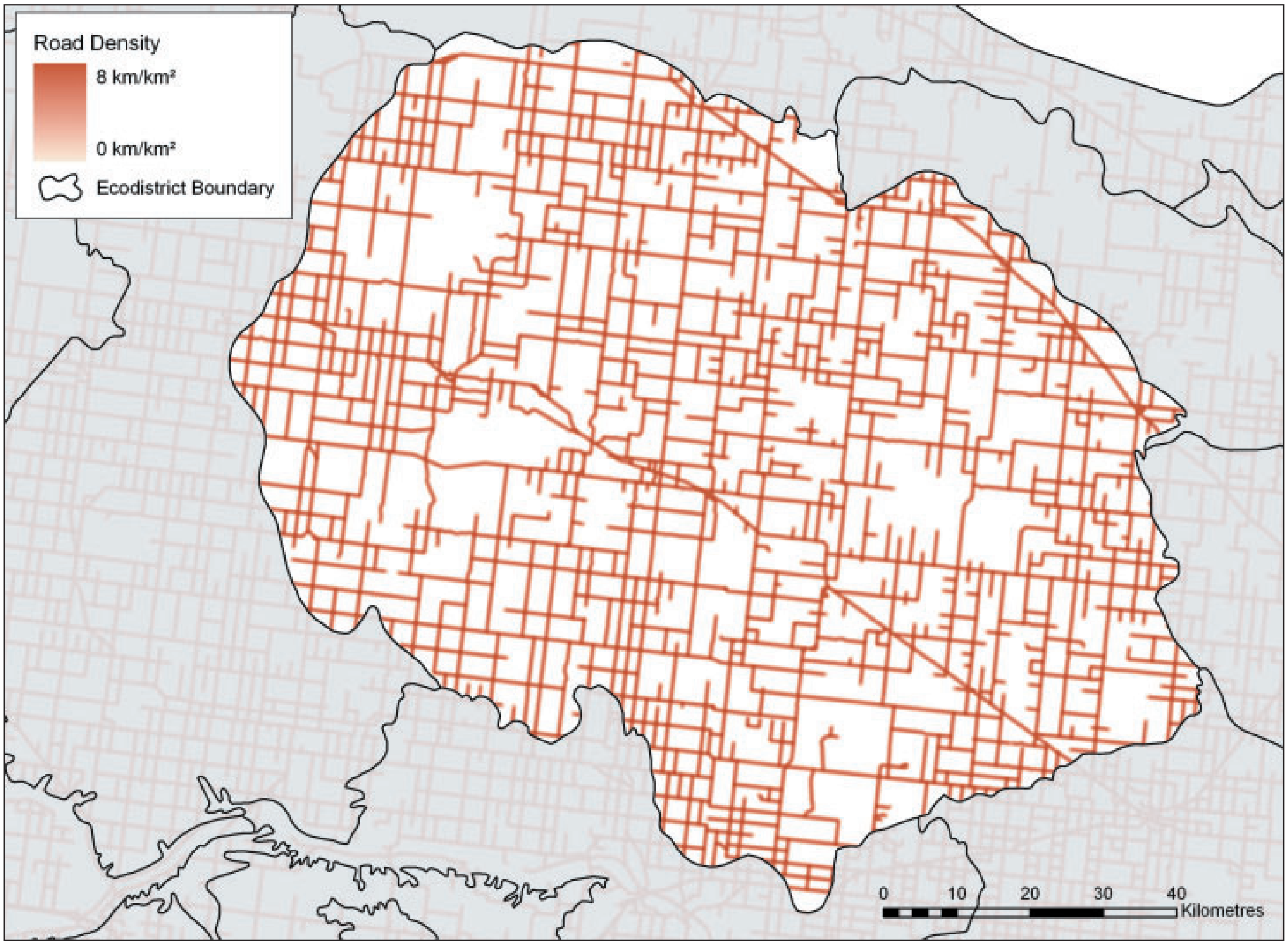


Figure 12. Road density (Touchwood Hills Upland ecodistrict 748).

The percentage natural cover was generated from land-cover data sets (see tile maps in Appendix D for mapping of natural cover). The amount of native land cover within a 2km radius of each 30m land cover pixel was calculated (Fig. 11) and scored. Natural land cover was considered to be the composite of all grasslands/shrublands, woodlands, wetlands and mud/sand/saline systems.

Finally, the average pixel value within each ecological system polygon was assigned to the polygon. The higher the degree of natural land cover in the surrounding landscape, the more points the ecological system received (Appendix B).

Road Density

Road density was calculated as the number of kilometres of linear road features per square kilometre. This was done in GIS using 'kernel density' with a 500-metre search radius.

The road data that were used to generate this layer came from several different sources. In Montana and North Dakota, all roads in the TIGER files (1:100,000) were used. In the **Aspen Parkland** and **Moist Mixed Grassland** ecoregions the National Topographic Series (NTS) 1:250,000 roads were used (highways, main and secondary roads). Roads for the **Mixed Grassland** and **Cypress Upland** ecoregions came from the Statistics Canada Road Network File (multiple sources and scales).

Road density was calculated as the average density of roads per ecological system polygon, up to a maximum of 8 km/km^2 (Fig. 12).

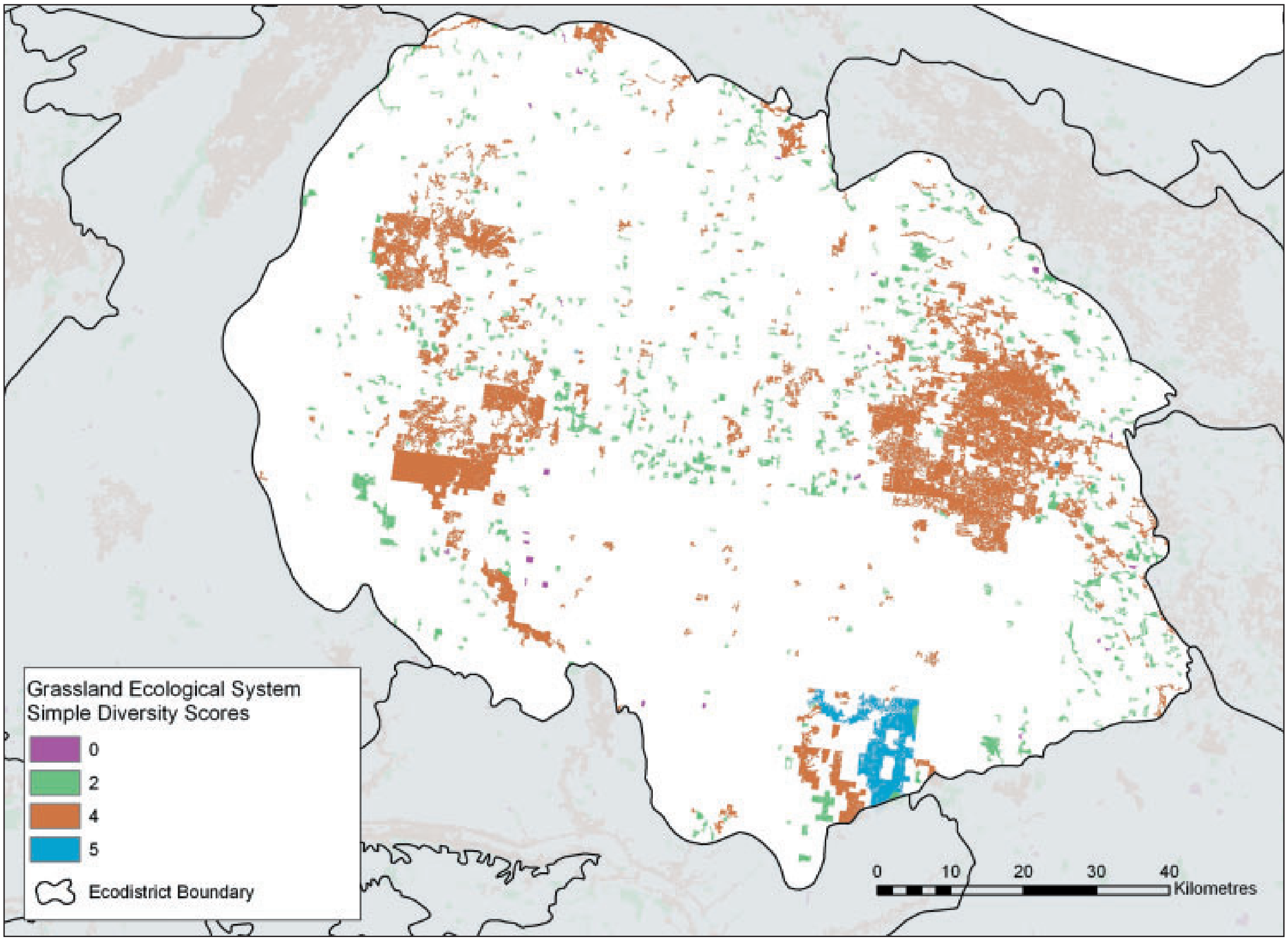


Figure 13. Diversity scring for grassland ecosysytems (Touchwood Hills Upland ecodistrict 748).

Diversity

Diversity was assessed as the number and range of ecological systems neighbouring an individual ecological system polygon, with high numbers scored more highly than low numbers. This was a surrogate measure of higher biological diversity.

The method for calculating diversity differed between ecoregions. In the **Aspen Parkland** and **Moist Mixed Grassland,** diversity was calculated on a per-pixel basis and then the maximum pixel value for each ecological system polygon was used. The neighbourhood statistic was calculated using GIS based on a grid that contained all ecological system types. The neighbourhood was a two-by-two pixel window and the variety was calculated. The variety was greater where many unique patches touched. This calculation did not measure the number of unique neighbours that an ecological system had, rather it provided higher scores to ecological systems that touched several different ecological systems in one spot. The polygons that were part of clusters of unique ecological systems scored highest.

Parameter	Grassland	Woodlands	Small Wetlands	Large Wetlands	Mud/Sand/ Saline
Simple Diversity	•	•	•	•	•

In the **Mixed Grassland** and **Cypress Upland**, diversity was calculated by buffering each ecological system polygon by a very small distance (1 metre). Then a spatial join was done and the number of unique neighbours that each ecological system was adjacent to was counted. This count (minus one, to account for the ecological system itself) was the basis of the diversity value and the scores were generated according to this number; the more unique polygons that the ecological system touched, the more diverse it was considered to be (Fig. 13).

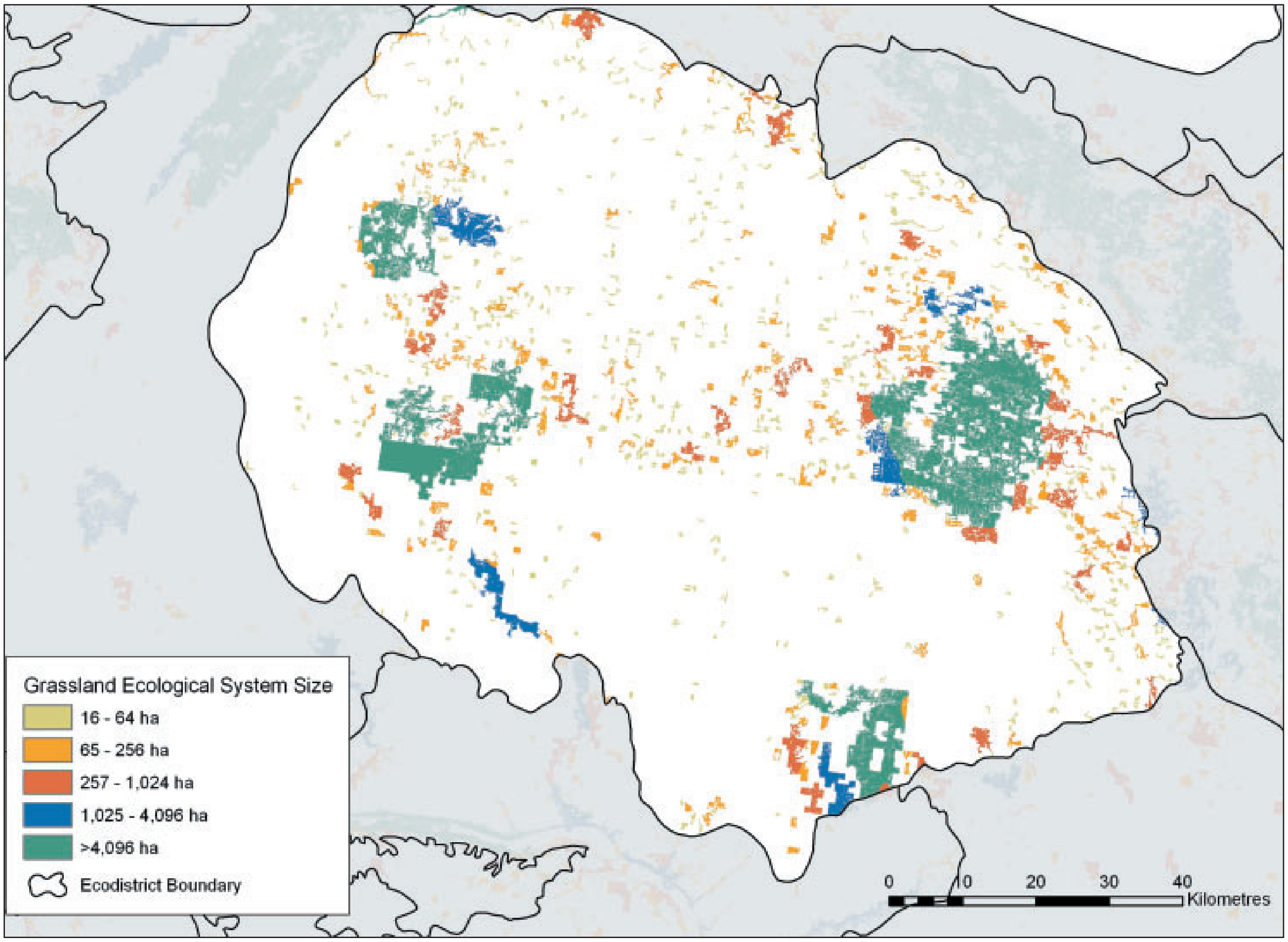


Figure 14. Site size; larger grassland ecosystems were scored higher (Touchwood Hills Upland ecodistrict 748).

Ecolgical Function

Ecological considerations of size, shape, and connectivity to other natural cover were assessed. Larger sites, sites with lower edge-to-area ratios, and sites connected to other natural cover on the landscape were scored as reflecting higher biological diversity. Depending on ecological system type, ecological function was scored as 40% to 50% of the total score (Appendix B).

Site Size

Scores were assigned to each ecological system polygon based on the total area, with the larger polygons receiving higher scores. In assessing small wetlands, the size of the wetland complex was used rather than the size of the individual component wetlands. Size scoring is outlined in Appendix B.

Parameter	Grassland	Woodlands	Small Wetlands	Large Wetlands/MSS
Size	•	•	•	•
Shape	•	•		
Connectivity	•	•		
Wetland Density			•	

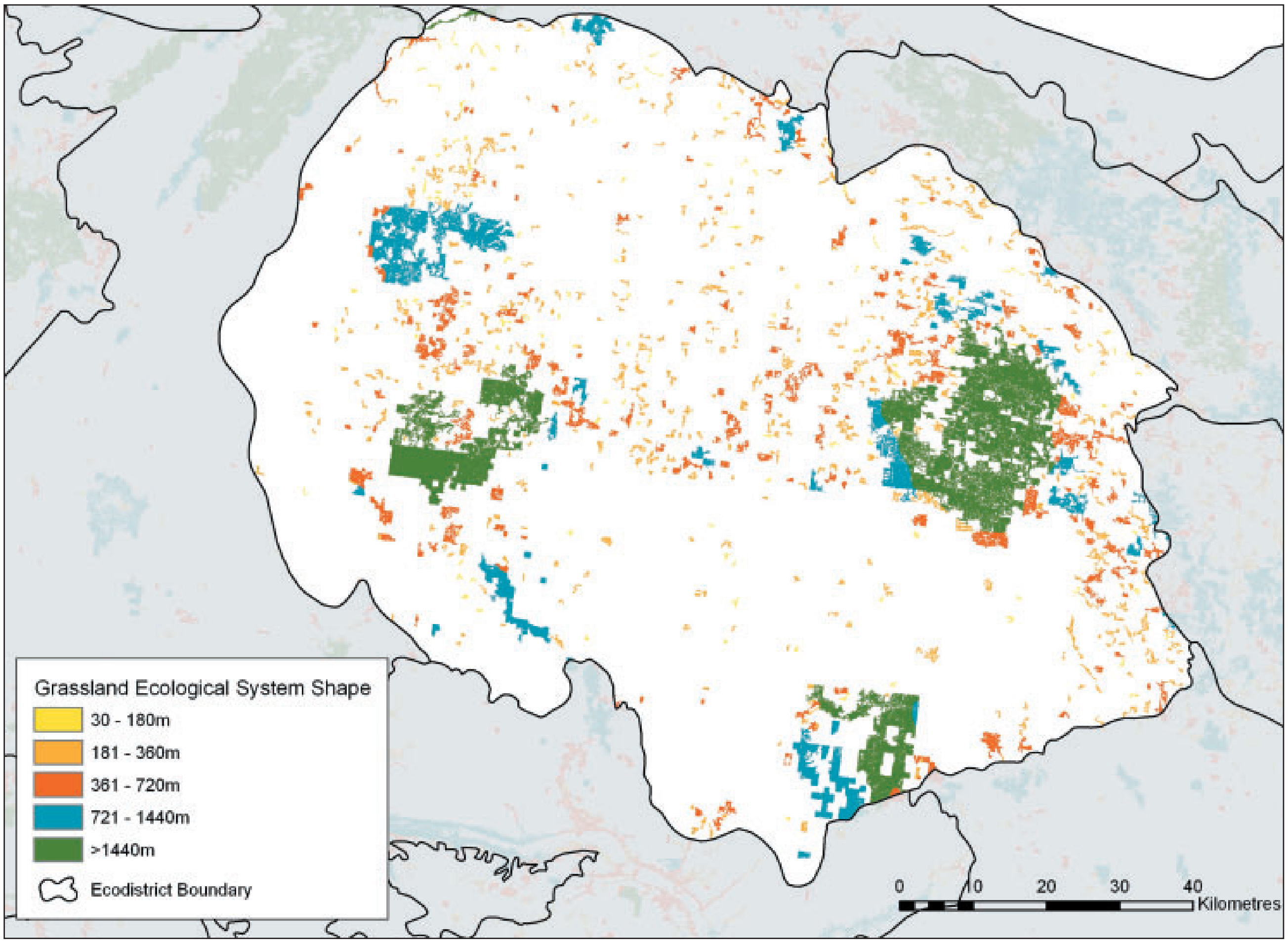


Figure 15. Site shape (Touchwood Hills Upland ecodistrict 748).

Shape (Minimum Habitat Area)

In evaluating the conservation value of almost all terrestrial ecological systems, linear shaped patches are generally considered less significant than blocky patches of the same size. In this study, shape was considered to be proportional to the minimum habitat area that could fit into a polygon. This was measured by the diameter (in metres) of the largest circle that could be drawn within a patch, essentially measuring for sites with lower edge-to-area ratios (Fig. 15). Site shape was only calculated for grasslands/shrublands and woodland ecological system polygons.

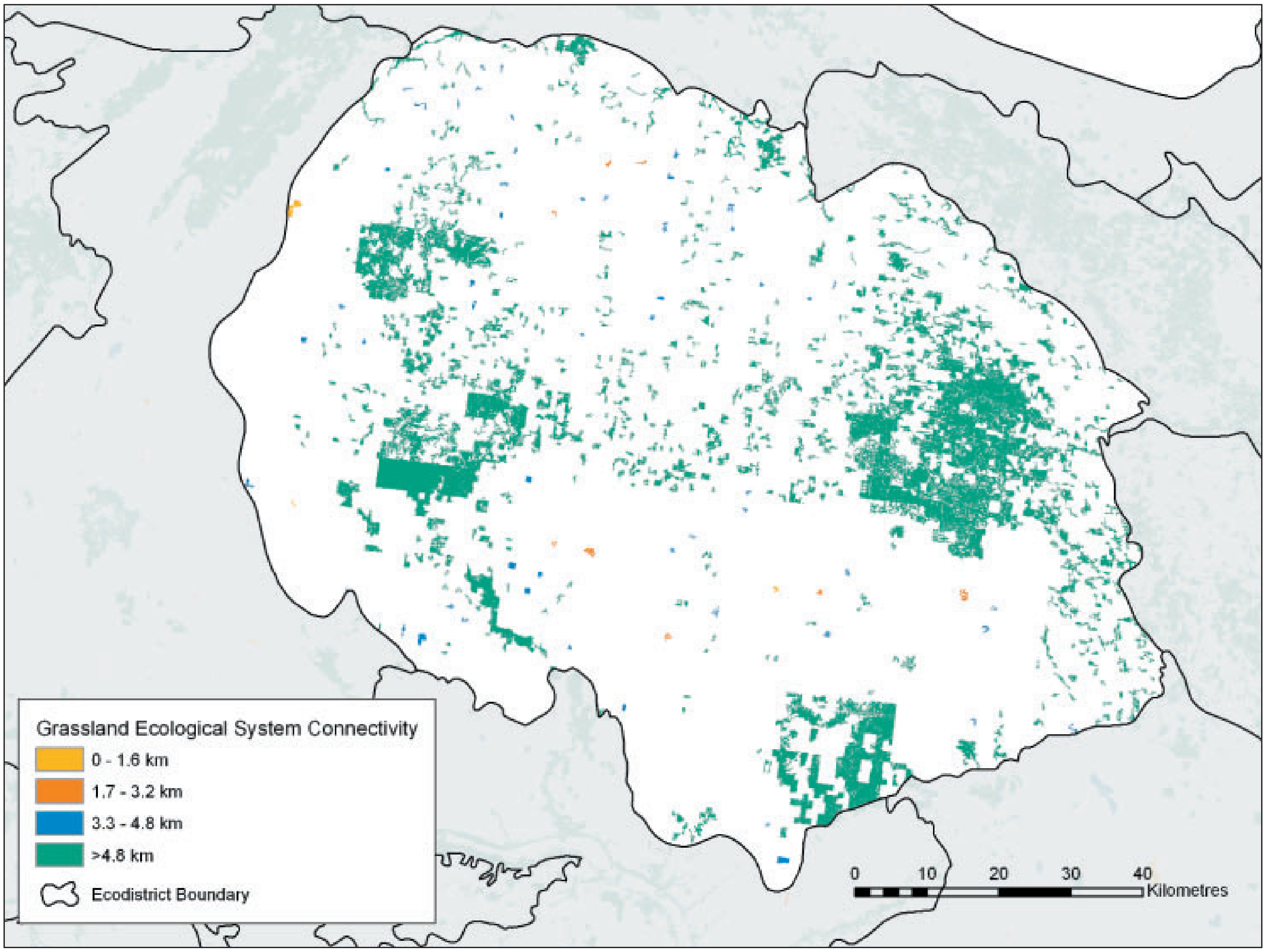


Figure 16. Connectivity values for grassland ecosystem patches (Touchwood Hills Upland ecodistrict 748).

Connectivity

The connectivity measure was used to score a site's potential to support the movement of organisms between ecosystem patches. The connectivity of sites was calculated as the distance from the patch edge to the next closest patch edge. Connectivity was only calculated for grassland/shrubland and woodland ecological systems. For grassland/shrubland patches connectivity was evaluated as the connectivity to other grassland/shrubland patches. Similarly, connectivity between woodland patches was evaluated between other woodland patches.

Connectivity scores were assigned based on the distance between the next closest patch. The shorter the distance, or the more connected the patches were, the higher the score (Fig. 16).

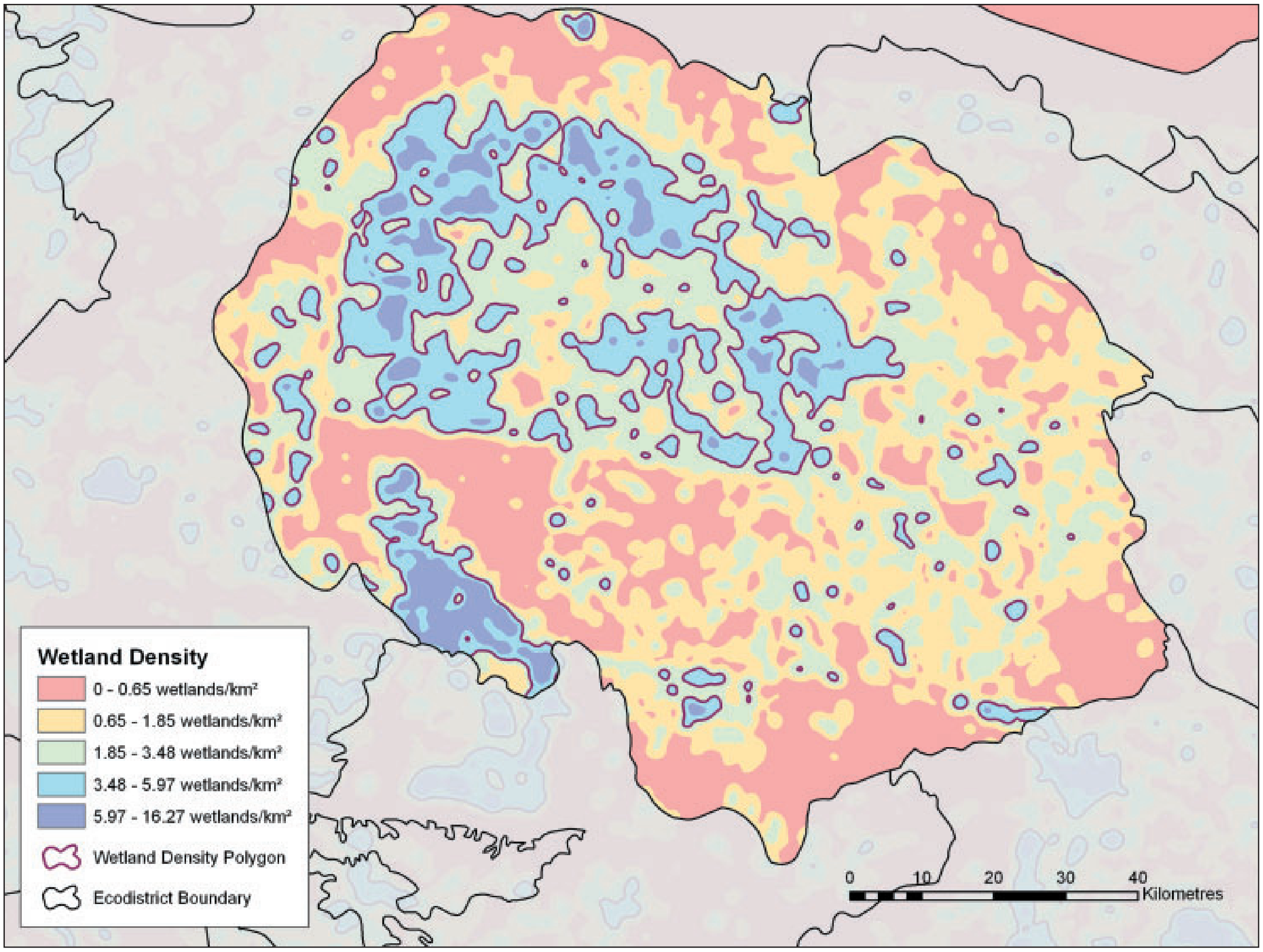


Figure 17. Wetland density (Touchwood Hills Upland ecodistrict 748).

Wetland Density

Across the region, there is considerable variation in the density of surface waters, with many areas having continentally-high densities of ponds supporting very high levels of waterfowl and related biological diversity. Other areas are notable for their lack of surface waters.

Wetland density was measured by selecting all wetlands that were 0.36 hectares or larger, and subjecting those wetlands to a kernel density calculation that was run with a 2km radius. (Fig. 17). The values, in wetlands per unit area, were assessed for natural breaks in the values, and the two highest density units, 3.48-5.97 and 5.97-16.27 wetlands/km^2 were scored, the less dense wetlands not being scored. The wetland density calculation was only calculated for the 'small wetland' ecological systems, as explained below.

Wetland Density Polygon

The area of wetlands in the top two natural breaks in wetland density data (above) were used to both map and score areas of significant concentrations of small wetlands. Any wetlands that fell into a high wetland density polygon were classified as part of 'small wetland' ecological systems. Any wetland falling outside of a high density area or not meeting the size criteria for a large wetland was not evaluated for inclusion in the conservation blueprint.

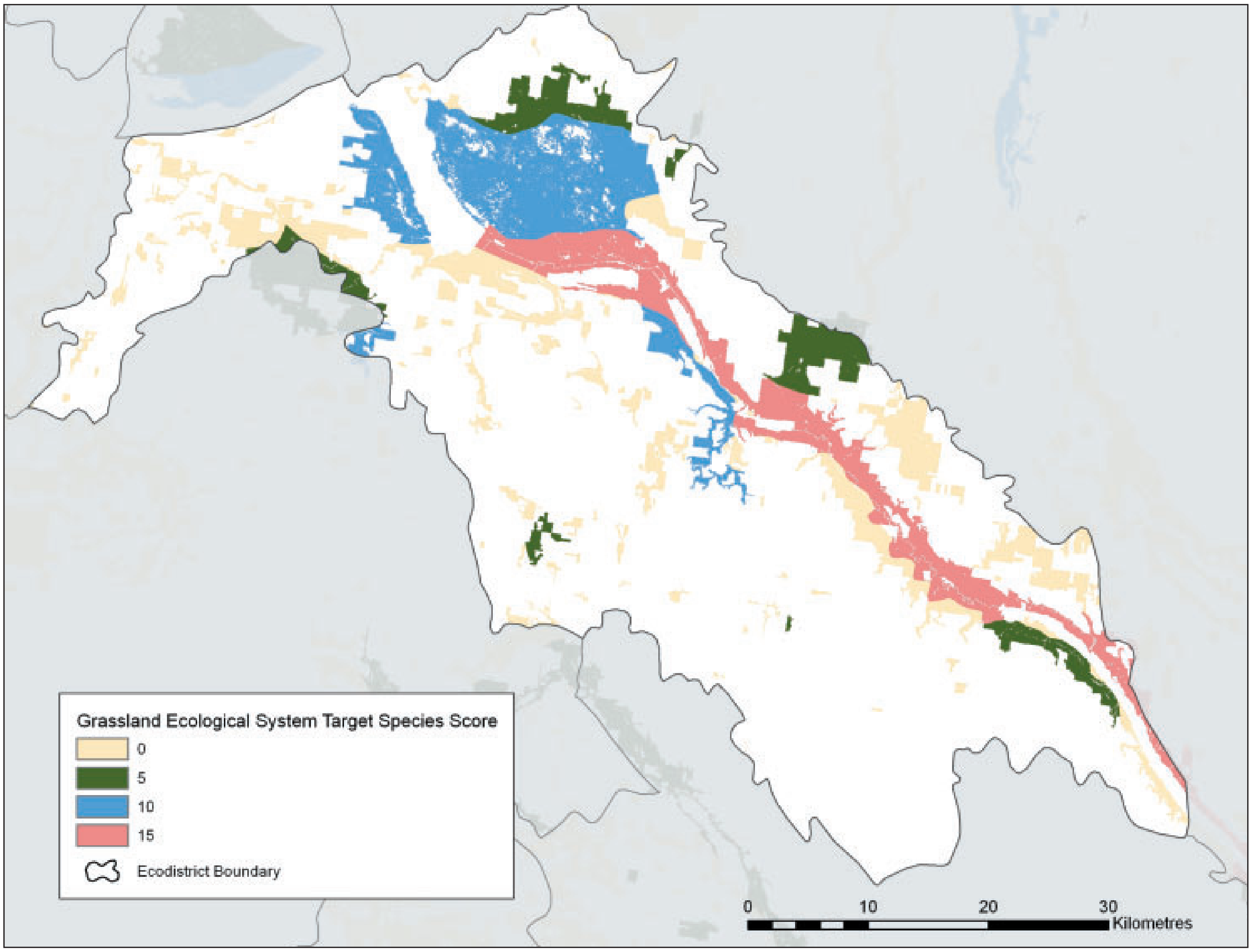


Figure 18. Scoring for presence of target species (Eyebrow Plain ecodistrict 789).

Special Features

Special features criteria included in this study were *i)* the presence of target species; *ii*) the presence of additional features of conservation concern; and *iii*) the distance to protected areas and conservation lands (Appendix B).

Parameter	Grassland	Woodlands	Small Wetlands	Large Wetlands/MSS
Presence of primary target species	•	•	•	•
Presence of additional species of conservation concern	•	•	•	•
Distance to Protected Area	•	•	•	•

Presence of Target Species

Scores were assigned based on the count of primary target species present in an ecological system polygon (Fig. 18; Table 4.1). Specifically, the target locations were considered to be unique element occurrences (EOs) of species tracked by the provincial Conservation Data Centers (CDCs) and shared with the project. Only EOs with relatively recent last observed observation dates were used. For plant species these were records that had been observed in the last forty years. For animal species a cutoff of twenty years was used.

In the **Aspen Parkland**, **Moist Mixed Grassland** and **Boreal Transition** ecoregions the primary target species listed in Table 4.1a were used to generate this layer. In the **Mixed Grassland** and **Cypress Upland** ecoregions all species tracked by the CDCs that had S1-S3 rankings or were COSEWIC listed species were scored as special features (Tables 4.1a, b and c).

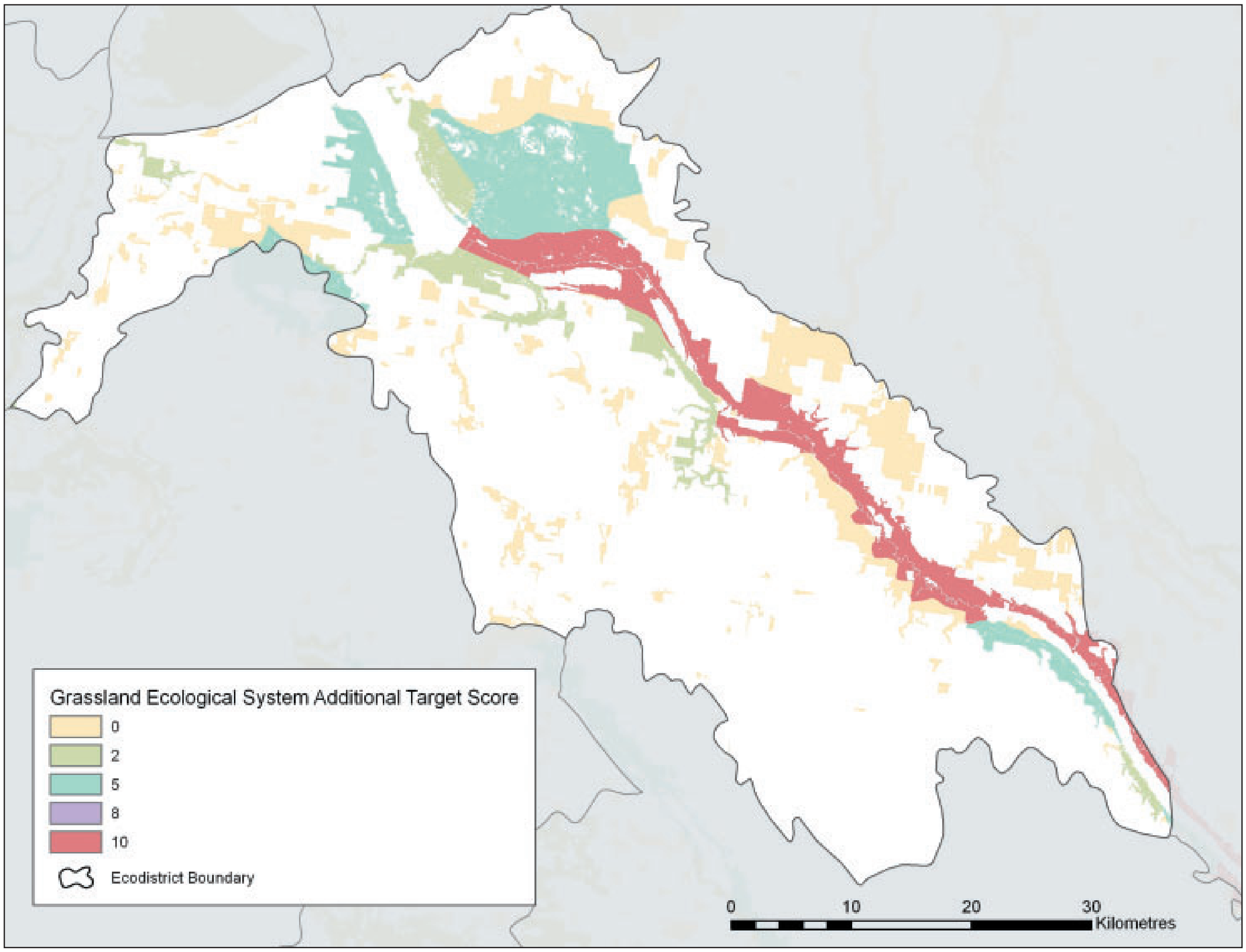


Figure 19. Scoring for additional features of conservation concern (Eyebrow Plain ecodistrict 789).

Presence of Additional Features of Conservation Concern

Scores for species of conservation concern that were not addressed in the preceding analysis were assigned based on the total within each ecological system polygon (Fig. 19; Tables 4.1b, c). These additional target species were all of the species tracked by the CDCs that were not considered to be in primary target species (*i.e.*, if they were not already assessed in the target species scoring). The same selection criteria with respect to observation dates for element occurrence records were applied. The additional target locations included the documented occurrences of rare community types, migratory bird concentration sites and snake hibernacula. (See Appendix B for details on scoring).

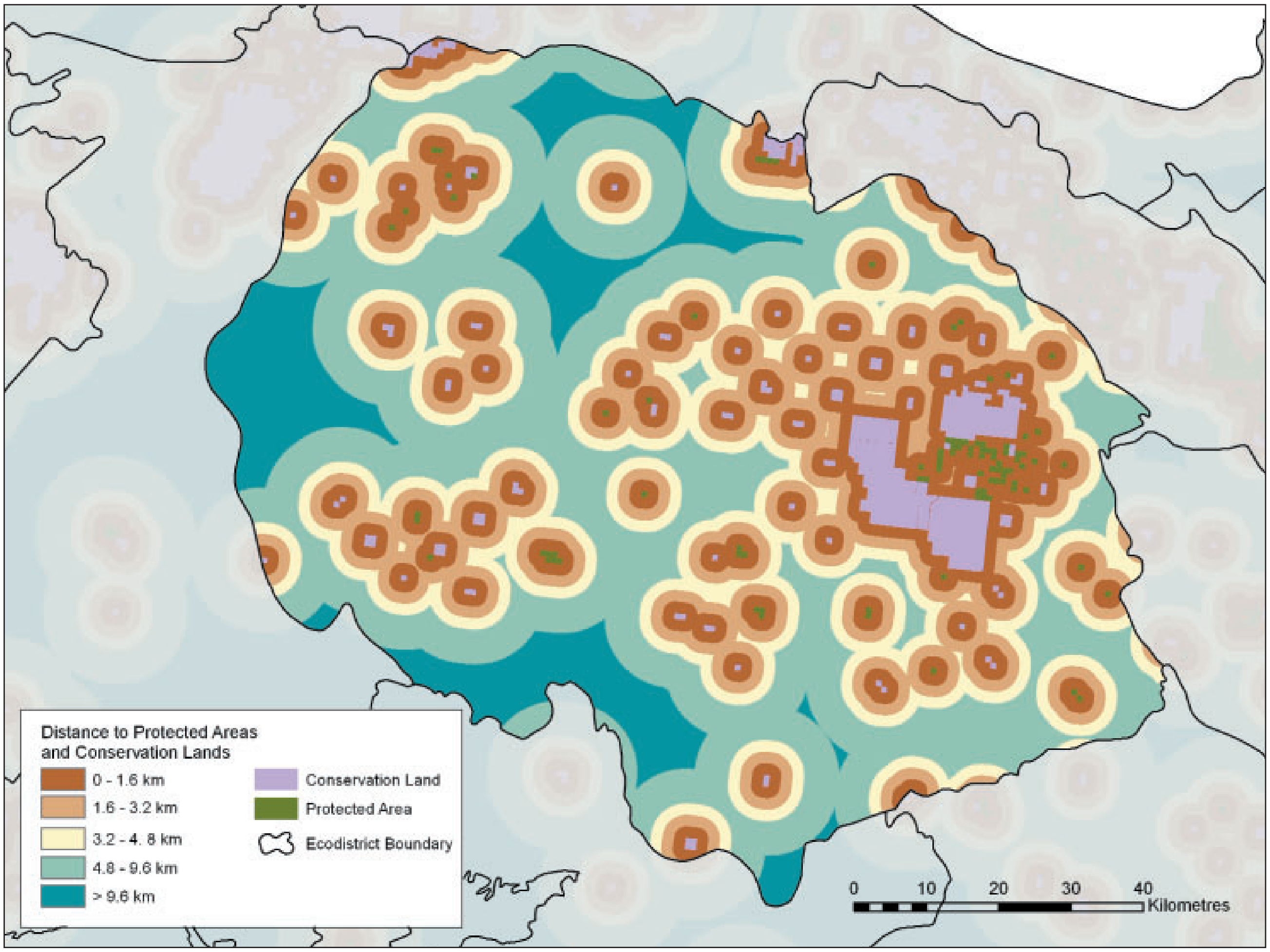


Figure 20. Distance to protected areas and conservation lands (Touchwood Hills Upland ecodistrict 748)

Distance to Protected Areas and Conservation Lands

In different parts of the region, at different scales, there are regulated protected areas and other less formally protected conservation lands. In some instances these areas may imply no additional biodiversity values on adjacent lands but, in other cases, proximity to such sites means that there is additional presence and movement of wildlife, as well as opportunity for exchange or extension of propagules from those conserved areas.

On this basis, sites closer to protected areas and conservation lands were given higher scores (Figure 20).

All protected areas and conservation lands were given the same weighting and value, regardless of the degree of protection afforded to biodiversity values at the site or the shape or size of the conserved site.

4.2.1: Coarse-filter Conservation Goals

The identification of priority areas for conservation was done on an ecodistrict basis. Ecodistricts are subdivisions of ecoregions. They are areas of more or less homogeneous vegetation, fauna, geology and soil, but primarily of consistent physiography and landforms (Marshall and Schut 1999).

The mapping of Canadian ecodistricts was derived from Agriculture and Agri-Food Canada (see ESWG 1995; sis.agr.gc.ca/cansis/nsdb/ecostrat/intro.html). For the United States, the terminology for landscape units differ, with the equivalent units generally being termed subsections (generally equivalent to USEPA Level IV units (Omernik 1995) (Appendix C).

For each ecodistrict, the two top-scoring ecological system polygons of each system type were selected as the core biodiversity conservation areas. This level of stratification was chosen to provide minimum replication of representative systems at the district scale, and hence minimum replication at the ecoregional scale. They represent sites important to the conservation of regional biological diversity at the coarser ecosystem scale.

These sites have been selected solely through GIS analysis. The conservation blueprint is based on the best available data and a working consensus that developed around the scoring parameters. The sites need to be validated to ensure that the results are accurate and the biodiversity targets are viable.

To provide coarser regional context, several analyses were also performed to assess the top scoring ecological systems by ecoregion, by study area, and by jurisdiction (see Results section).

(Some of the initial ecodistrict and ecoregion boundaries did not meet at international boundaries. Interested parties met in Calgary in 2000 to match ecoregional boundaries across jurisdictional boundaries, with subsequent adjustments to establish the same level of continuity with regard to ecodistrict boundaries. Some of the U.S. ecodistrict units did not match with their ecoregion boundaries, in which case they were clipped to the TNC ecoregions boundaries. The ecodistricts used in this study are listed in Appendix C and mapped on Figure 10.)

4.3: Fine-filter Biodiversity Analysis

The purpose of the coarse-filter analysis was to assess the representation of ecological systems, assuming that their conservation will reasonably sustain the typical common species and habitats occurring in them. A fine-filter analysis was conducted to address the representation of rare species and features, for which specific location information is known and which may otherwise not be included in the blueprint.

Numerous fine-filter targets were considered (Table 4.1):

- Globally imperilled species (G1-G3G4);
- Disjunct species;
- Species at risk (*Canadian Species at Risk Act* and COSEWIC; *U.S. Endangered Species Act*); and
- Other species and communities of conservation concern tracked by CDCs and Natural Heritage Programs.

These were further divided into **primary** and **secondary** target species (Tables 4.1a, b) by the project's core science team. The inclusion in the blueprint of occurrences of **primary targets** was ensured by applying specific representation goals for those targets (Table 4.4).

Secondary targets were considered to be important, but more widespread and not critically imperilled. These targets were considered in the scoring of coarse-filter analysis.

A third set of targets species, communities and features (Table 4.1c) were termed **other features of conservation concern,** and these were again used in the coarse-filter scoring.

Data for fine-filter biodiversity targets were provided by provincial and state conservation data centres, natural heritage information centres, and natural heritage programs.

Table 4.1a. Primary Species Targets

Common Name	Scientific Name	COSEWIC Status	Global Rank	Justification	Goal per ecodistrict	Aspen Parkland	Moist Mixed Grassland	Mixed Grassland	Cypress Upland	References
Plants										
Prairie Dunewort or Plain's Grape-fern	*Botrychium campestre*		G3G4	Grank	2	Peripheral	Widespread	Peripheral		
Pale Moonwort	*Botrychium pallidum*		G2G3	Grank	All	Widespread	Widespread	Widespread	Widespread	
Buffalograss	*Buchloe dactyloides*	T	G4G5	SAR	2	Peripheral	Peripheral			
Smooth Arid Goosefoot	*Chenopodium subglabrum*	SC	G3G4	GRank; SAR	2			Widespread		
Tiny Cryptanthe	*Cryptantha minima*	E	G5	GRank; SAR	All			Disjunct		ASRD 2004
Small White Lady's Slipper	*Cypripedium candidum*	T	G4	SAR	All	Disjunct				
Hairy Prairie Clover	*Dalea villosa var. villosa*	T	G5T5	SAR	2	Peripheral	Disjunct	Disjunct		
Slender Mouse-ear-cress	*Halimolobos virgata*	T	G4	SAR	2		Disjunct	Disjunct	Disjunct	
Western Blue Flag	*Iris missouriensis*	SC	G5	SAR	All		Peripheral			ASRD/ACA 2005a
Western Spiderwort or Prairie Spiderwort	*Tradescantia occidentalis*	T	G5	SAR	All		Disjunct	Disjunct		Smith 2000
Soapweed	*Yucca glauca*	T	G5	SAR	All		? Peripheral	Peripheral		Hurlburt 2001
Mammals										
Black-tailed Prairie Dog	*Cynomys ludovicianus*	SC	G3G4	GRank; SAR	All			Peripheral		
Ord's Kangaroo Rat	*Dipodomys ordii*	SC	G5	SAR	2			Peripheral		Gummer 1997, Gummer and Robertson 2003
Swift Fox	*Vulpes velox*	E	G3	GRank; SAR	All			Widespread		Carbyn *et al.* 1993, Pruss 1999, Smeeton and Weagle 2000
Birds										
Burrowing Owl	*Athene cunicularia*	E	G4	SAR	4	Peripheral	Widespread	Widespread	Peripheral	ASRD/ACA 2005b, Poulin *et al.* 2005
Sprague's Pipit	*Anthus spragueii*	T	G4	SAR	2	Widespread	Widespread	Widespread	Widespread	
Greater Sage-Grouse	*Centrocercus urophasianus urophasianus*	E	G4TU	SAR	All			Widespread		Aldridge 1998
Piping Plover	*Charadrius melodus*	E	G3	GRank; SAR	4	Widespread	Widespread	Widespread		Plissner and Haig 2000

Table 4.1a. Primary Species Targets

Common Name	Scientific Name	COSEWIC Status	Global Rank	Justification	Goal per ecodistrict	Aspen Parkland	Moist Mixed Grassland	Mixed Grassland	Cypress Upland	References
Mountain Plover	*Charadrius montanus*	E	G2	GRank; SAR	All			Peripheral		
Peregrine Falcon (anatum)	*Falco peregrinus anatum*	T	G4T3	SAR	All	Disjunct	Disjunct	Disjunct		
Least Bittern	*Ixobrychus exilis*	T	G5	SAR	All	Peripheral				
Prairie Loggerhead Shrike	*Lanius ludovicianus excubitorides*	T	G4T4	SAR	2	Widespread	Widespread	Widespread		Cade and Woods 1997, Prescott and Bjorge 1999
Amphibians										
Great Plains Toad	*Bufo cognatus*	SC	G5	SAR	2	Peripheral	Peripheral	Widespread	Peripheral	
Northern Leopard Frog	*Rana pipiens*	SC	G5	SAR	2	Widespread	Widespread	Widespread	Widespread	
Reptiles										
Eastern Yellowbelly Racer	*Coluber constrictor flaviventris*	T	G5T5	SAR	2			Peripheral		
Northern Prairie Skink	*Eumeces septentrionalis septentrionalis*	SC	G5	SAR; Disjunct Population	All	Disjunct				
Short-horned Lizard	*Phrynosoma hernandesi*	SC	G5	SAR; Disjunct	2			Disjunct		
Invertebrates										
Mormon Metalmark	*Apodemia mormo*	T	G5	SAR	2			Peripheral		
Dakota Skipper	*Hesperia dacotae*	T	G2G3	GRank; SAR	2	Peripheral				
Yucca Moth	*Tegeticula yuccasella*	E	G4G5	SAR	All		? Peripheral	Peripheral		ASRD 2002

Table 4.1b. Secondary Species Targets

Common Name	Scientific Name	COSEWIC Status	Global Rank	Justification	Aspen Parkland	Moist Mixed Grassland	Mixed Grassland	Cypress Upland	References
Baird's Sparrow	*Ammodramus bairdii*	NAR	G4	PIF 28; Prairie Wings Target	•	•	•	•	
Le Conte's Sparrow	*Ammodramus leconteii*		G4	PIF 25	•	•	•	•	
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	NAR	G5	PIF 27(29), Priority IA	•	•			
Short-Eared Owl	*Asio flammeus*	SC	G5	SAR	•	•	•	•	Clayton 2000
Ferruginous Hawk	*Buteo regalis*	SC	G4	SAR; Prairie Wings Target	•	•	•	•	Schmutz 1999
Swainson's Hawk	*Buteo swainsoni*		G5	PIF 25	•	•	•	•	
Lark Bunting	*Calamospiza melanocorys*		G5	Prairie Wings Target	•	•	•	•	
McCown's Longspur	*Calcarius mccownii*		G5	PIF 27; Prairie Wings Target			•	•	
Chestnut Collared Longspur	*Calcarius ornatus*		G5	PIF 24; Prairie Wings Target	•	•	•	•	
Black Tern	*Chlidonias niger*	NAR	G4	Waterbird priority	•	•	•	•	
Yellow Rail	*Coturnicops noveboracensis*	SC	G4	SAR; PIF 27	•	•	•	•	
Red-headed Woodpecker	*Melanerpes erythrocephalus*	SC	G5	SAR	•				
Long-billed Curlew	*Numenius americanus*	SC	G5	Prairie Wings Target; Core population outside (MG)	•	•	•	•	Hill 1998
American White Pelican	*Pelecanus erythrorhynchos*	NAR	G3	GRank	•	•	•	•	
Wilson's Phalarope	*Phalaropus tricolour*		G5	PIF 25	•	•	•	•	
Sharp-tailed Grouse	*Tympanuchus phasianellus*		G4	PIF 22; BCR Priority IA High regional responsibility	•	•	•		

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Amphibians

Bufo hemiophrys
Rana luteiventris
Rana sylvatica
Spea bombifrons

Birds

Accipiter cooperii
Aechmophorus clarkii
Aechmophorus occidentalis
Ammodramus savannarum
Anas cyanoptera
Aquila chrysaetos
Ardea herodias
Athene cunicularia
Athene cunicularia hypugaea
Botaurus lentiginosus
Bucephala albeola
Bucephala clangula
Cathartes aura
Cygnus buccinator
Dendroica pensylvanica
Dryocopus pileatus
Empidonax alnorum
Empidonax traillii
Euphagus carolinus
Falco mexicanus
Gavia immer
Grus americana
Haliaeetus leucocephalus
Himantopus mexicanus
Icterus bullockii
Lophodytes cucullatus
Megascops asio
Megascops kennicottii
Melanitta fusca
Melospiza georgiana
Mergus merganser
Mimus polyglottos
Numenius borealis
Nycticorax nycticorax

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Oporornis philadelphia
Oreoscoptes montanus
Phalacrocorax auritus
Phalaenoptilus nuttallii
Piranga ludoviciana
Plegadis chihi
Podiceps grisegena
Podiceps nigricollis
Seiurus noveboracensis
Sterna caspia
Sterna forsteri
Sterna hirundo
Strix varia
Vermivora chrysoptera
Vireo philadelphicus
Wilsonia canadensis
Zonotrichia albicollis

Invertebrates

Aeshna constricta
Aeshna multicolor
Amblyscirtes hegon
Amblyscirtes oslari
Amblyscirtes simius
Amphiagrion abbreviatum
Anax junius
Apodemia mormo
Battus philenor
Callophrys gryneus siva
Calopteryx aequabilis
Celastrina neglecta
Chlosyne harrisii hanhami
Chlosyne nycteis reversa
Cicindela formosa
Cicindela lepida
Cicindela nevadica
Danaus plexippus
Enallagma anna
Enallagma carunculatum
Enallagma clausum
Enodia anthedon
Erynnis brizo brizo
Erynnis juvenalis
Euphilotes ancilla
Euphydryas editha hutchinsi
Everes comyntas comyntas
Glaucopsyche piasus
Gomphus graslinellus
Hemiargus isola
Hesperia pahaska
Icaricia shasta
Ischnura cervula
Ischnura perparva
Ischnura verticalis
Leucorrhinia glacialis
Leucorrhinia intacta
Libellula pulchella
Limenitis lorquini
Limenitis weidemeyerii
Lycaena editha
Lycaena phlaeas
Lycaena phlaeas arethusa
Lycaena rubidus
Nathalis iole
Ochlodes sylvanoides
Papilio eurymedon
Papilio machaon dodi
Papilio multicaudata
Papilio multicaudatus
Papilio polyxenes asterius
Papilio rutulus
Papilio zelicaon
Pholisora catullus
Phyciodes batesii
Poanes hobomok
Polites rhesus
Polygonia comma
Polygonia gracilis zephyrus
Polygonia interrogationis
Pontia protodice
Pyrgus scriptura
Satyrium acadicum
Satyrium liparops aliparops
Satyrodes eurydice eurydice
Speyeria edwardsii
Speyeria hydaspe
Strophitus undulatus
Stylurus intricatus
Sympetrum corruptum
Sympetrum pallipes
Thymelicus lineola
Vanessa annabella
Vanessa virginiensis

Mammals

Bos bison athabascae
Lagurus curtatus
Lasionycteris noctivagans
Lasiurus cinereus
Lynx rufus
Marmota flaviventris
Microtus ochrogaster
Mustela nigripes
Myotis septentrionalis
Odocoileus hemionus
Onychomys leucogaster
Perognathus fasciatus
Reithrodontomys megalotis
Sorex hoyi
Thomomys talpoides

Reptiles

Chelydra serpentina
Chrysemys picta belli
Crotalus viridis viridis
Liochlorophis vernalis
Storeria occipitomaculata

Plants

Acorus americanus
Agalinis aspera
Agrostis exarata
Alisma gramineum
Allium cernuum
Allium geyeri
Alopecurus alpinus
Alopecurus alpinus ssp. glaucus
Alopecurus carolinianus
Amaranthus californicus
Ambrosia acanthicarpa
Anagallis minima
Anaphalis margaritacea
Andropogon gerardii
Andropogon hallii
Anemone parviflora
Antennaria anaphaloides
Antennaria corymbosa
Antennaria dimorpha
Antennaria russellii
Antennaria umbrinella
Arabidopsis salsuginea
Arenaria congesta var. lithophila
Aristida purpurea
Aristida purpurea var. longiseta
Arnica cordifolia
Arnica fulgens
Arnica sororia
Artemisia cana
Artemisia tilesii
Asarum canadense
Asclepias lanuginosa
Asclepias syriaca
Asclepias verticillata
Asclepias viridiflora
Aster campestris
Aster eatonii
Aster pauciflorus
Aster umbellatus
Aster umbellatus var. pubens
Astragalus aboriginum
Astragalus gilviflorus
Astragalus kentrophyta var. kentrophyta
Astragalus lotiflorus
Astragalus pectinatus
Astragalus purshii
Astragalus purshii var. purshii
Astragalus racemosus var. racemosus
Astragalus spatulatus
Astragalus vexilliflexus
Athyrium filix-femina
Athyrium filix-femina ssp. angustum
Atriplex argentea
Atriplex argentea ssp. argentea
Atriplex canescens
Atriplex powellii
Atriplex suckleyi
Atriplex truncata
Atriplex x aptera
Bacopa rotundifolia
Barbarea orthoceras
Beckmannia syzigachne

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Besseya wyomingensis
Bidens amplissima
Bidens frondosa
Boisduvalia glabella
Bolboschoenus fluviatilis
Boltonia asteroides var. recognita
Botrychium ascendens
Botrychium hesperium
Botrychium lanceolatum
Botrychium lunaria
Botrychium michiganense
Botrychium minganense
Botrychium multifidum
Botrychium multifidum var. intermedium
Botrychium paradoxum
Botrychium pedunculosum
Botrychium pinnatum
Botrychium simplex
Botrychium spathulatum
Bouteloua curtipendula
Bromus kalmii
Bromus latiglumis
Bromus porteri
Bromus pubescens
Calamagrostis lapponica var. nearctica
Calamagrostis montanensis
Calamagrostis rubescens
Calla palustris
Callitriche heterophylla
Calylophus serrulatus
Calypso bulbosa var. americana
Camassia quamash var. quamash
Camissonia andina
Camissonia breviflora
Carex albicans var. albicans
Carex alopecoidea
Carex assiniboinensis
Carex athrostachya
Carex backii
Carex bicknellii
Carex buxbaumii
Carex chordorrhiza
Carex crawei
Carex cristatella
Carex cryptolepis
Carex diandra
Carex douglasii
Carex eburnea
Carex echinata ssp. echinata
Carex emoryi
Carex garberi
Carex granularis
Carex gravida
Carex gynocrates
Carex hallii
Carex hoodii
Carex hookerana
Carex hystericina
Carex incurviformis var. incurviformis
Carex lacustris
Carex lasiocarpa
Carex limosa
Carex livida
Carex microptera
Carex nebrascensis
Carex pachystachya
Carex parryana
Carex pedunculata
Carex petasata
Carex platylepis
Carex prairea
Carex pseudocyperus
Carex raynoldsii
Carex retrorsa
Carex rostrata
Carex saximontana
Carex sterilis
Carex supina var. spaniocarpa
Carex sychnocephala
Carex tetanica
Carex torreyi
Carex tribuloides
Carex umbellata
Carex vesicaria
Carex vulpinoidea
Carex xerantica
Castilleja coccinea
Castilleja cusickii
Castilleja lutescens
Castilleja pallida ssp. septentrionalis
Castilleja sessiliflora
Caulophyllum thalictroides
Celastrus scandens
Celtis occidentalis
Centunculus minimus
Cerastium brachypodum
Chamaesaracha grandiflora
Chamaesyce serpens
Chenopodium atrovirens
Chenopodium desiccatum
Chenopodium hians
Chenopodium incanum
Chenopodium leptophyllum
Chenopodium watsonii
Chimaphila umbellata ssp. occidentalis
Cirsium drummondii
Cirsium muticum
Claytonia lanceolata
Clematis ligusticifolia
Clematis occidentalis var. grosseserrata
Collinsia parviflora
Conimitella williamsii
Corallorhiza striata var. striata
Coreopsis tinctoria
Corispermum nitidum
Cornus alternifolia
Crepis atribarba
Crepis intermedia
Crepis occidentalis
Cryptantha celosioides
Cryptantha kelseyana
Cryptotaenia canadensis
Cuscuta coryli
Cuscuta gronovii
Cuscuta pentagona var. pentagona
Cycloloma atriplicifolium
Cymopterus acaulis
Cynoglossum virginianum var. boreale
Cyperus houghtonii
Cyperus schweinitzii
Cyperus squarrosus
Cypripedium montanum
Cypripedium parviflorum
Cypripedium passerinum
Cypripedium planipetalum
Cypripedium pubescens
Danthonia californica var. americana
Danthonia spicata
Danthonia unispicata
Delphinium glaucum
Desmodium canadense
Dichanthelium acuminatum var. fasciculatum
Dichanthelium leibergii
Dichanthelium wilcoxianum
Diervilla lonicera
Dodecatheon conjugens
Downingia laeta
Draba reptans
Drosera anglica
Drosera linearis
Drosera rotundifolia
Dryopteris carthusiana
Dryopteris cristata
Echinacea angustifolia
Elatine rubella
Elatine triandra
Eleocharis compressa
Eleocharis compressa var. borealis
Eleocharis elliptica
Eleocharis engelmannii
Eleocharis parvula var. anachaeta
Eleocharis pauciflora
Eleocharis rostellata
Eleocharis tenuis
Ellisia nyctelea
Elodea bifoliata
Elatine triandra
Eleocharis compressa
Eleocharis compressa var. borealis
Eleocharis elliptica
Eleocharis engelmannii
Eleocharis parvula var. anachaeta
Eleocharis pauciflora

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Eleocharis rostellata
Eleocharis tenuis
Ellisia nyctelea
Elodea bifoliata
Elodea canadensis
Elodea longivaginata
Elymus diversiglumis
Elymus elymoides
Elymus glaucus
Elymus hystrix
Elymus innovatus
Elymus lanceolatus ssp. psammophilus
Elymus virginicus
Equisetum sylvaticum
Eragrostis hypnoides
Erigeron annuus
Erigeron caespitosus
Erigeron compositus
Erigeron ochroleucus var. scribneri
Erigeron radicatus
Erigeron strigosus
Eriogonum cernuum
Eriogonum cernuum var. cernuum
Eriogonum flavum
Eriogonum pauciflorum
Eriophorum chamissonis
Eriophorum viridicarinatum
Escobaria vivipara
Eupatorium maculatum
Euphorbia geyeri
Eurotia lanata
Festuca hallii
Festuca idahoensis
Festuca obtusa
Franseria acanthicarpa
Fraxinus nigra
Fraxinus pennsylvanica
Galium aparine
Galium labradoricum
Gentiana andrewsii var. dakotica
Gentiana fremontii
Gentiana puberulenta
Gentianopsis macounii
Gentianopsis procera ssp. procera
Geranium carolinianum
Geranium carolinianum var. sphaerospermum
Geranium richardsonii
Geranium viscosissimum var. viscosissimum
Glyceria pulchella
Goodyera oblongifolia
Gratiola ebracteata
Gratiola neglecta
Gymnocarpium dryopteris
Hackelia floribunda
Halenia deflexa
Hedeoma hispida
Hedyotis longifolia
Helianthus nuttallii ssp. rydbergii
Helianthus tuberosus
Heliopsis helianthoides var. occidentalis
Heliotropium curassavicum
Hepatica nobilis var. obtusa
Heuchera parvifolia var. dissecta
Hieracium albiflorum
Hordeum brachyantherum ssp. brachyantherum
Hordeum pusillum
Hudsonia tomentosa
Hutchinsia procumbens
Hydrophyllum capitatum
Hymenopappus filifolius
Hymenopappus filifolius var. polycephalus
Hypericum majus
Hypoxis hirsuta
Impatiens noli-tangere
Juncus acuminatus
Juncus brevicaudatus
Juncus confusus
Juncus ensifolius
Juncus interior
Juncus nevadensis
Juncus nevadensis var. nevadensis
Juncus tracyi
Juniperus scopulorum
Kobresia simpliciuscula
Lactuca biennis
Lactuca ludoviciana
Laportea canadensis
Leersia oryzoides
Lemna minor
Lemna turionifera
Lesquerella alpina
Lesquerella arctica var. purshii
Leymus cinereus
Lilaea scilloides
Lilium philadelphicum var. andinum f immaculata
Linanthus septentrionalis
Linnaea borealis
Liparis loeselii
Listera borealis
Lithophragma glabrum
Lithophragma parviflorum
Lithospermum ruderale
Lobelia spicata
Lomatium cous
Lomatium dissectum var. multifidum
Lomatium macrocarpum
Lomatium orientale
Lomatogonium rotatum
Lonicera oblongifolia
Lotus purshianus
Lotus unifoliolatus var. unifoliolatus
Lupinus pusillus ssp. pusillus
Luzula multiflora
Lycopus americanus
Lygodesmia rostrata
Lysimachia hybrida
Maianthemum racemosum ssp. amplexicaule
Malaxis brachypoda
Malaxis monophylla
Malaxis monophyllos var. brachypoda
Malaxis paludosa
Marsilea vestita
Matricaria maritima
Melica bulbosa
Mentzelia albicaulis
Mentzelia decapetala
Menyanthes trifoliata
Mertensia lanceolata
Milium effusum
Mimulus glabratus
Mimulus glabratus var. jamesii
Mimulus guttatus
Minuartia dawsonensis
Minuartia rubella
Mirabilis linearis
Mitella nuda
Monotropa hypopithys
Monotropa uniflora
Monroa squarrosa
Montia linearis
Muhlenbergia asperifolia
Muhlenbergia racemosa
Munroa squarrosa
Musineon divaricatum
Myosurus apetalus var. borealis
Myosurus aristatus
Myosurus minimus
Myosurus minimus ssp. minimus
Myriophyllum alterniflorum
Najas flexilis
Navarretia leucocephala ssp. minima
Nemophila breviflora
Nothocalais cuspidata
Nuttallanthus canadensis sensu lato
Oenothera caespitosa ssp. caespitosa
Oenothera flava
Oenothera psammophila
Onosmodium molle
Onosmodium molle var. occidentale
Orobanche ludoviciana
Orobanche uniflora
Oryzopsis canadensis
Oryzopsis hymenoides
Oryzopsis micrantha
Oryzopsis pungens
Osmorhiza berteroi
Osmorhiza claytonii

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Osmorhiza longistylis
Ostrya virginiana
Oxytropis besseyi var. besseyi
Oxytropis deflexa
Osmorhiza depauperata
Oxytropis lagopus var. conjugans
Oxytropis lambertii
Oxytropis sericea
Panicum leibergii
Panicum linearifolium
Panicum wilcoxianum
Parietaria pensylvanica
Parnassia glauca
Parnassia kotzebuei
Parnassia palustris var. parviflora
Parthenocissus quinquefolia
Pellaea glabella
Pellaea glabella ssp. occidentalis
Pellaea glabella ssp. simplex
Penstemon confertus
Penstemon nitidus
Penstemon procerus
Perideridia gairdneri ssp. borealis
Petasites frigidus
Phacelia linearis
Phleum alpinum
Phlox alyssifolia
Phlox hoodii
Phryma leptostachya
Physostegia ledinghamii
Picradeniopsis oppositifolia
Pinguicula vulgaris
Plagiobothrys scouleri var. scouleri
Plantago canescens
Plantago elongata
Plantago elongata ssp. elongata
Plantago patagonica
Platanthera orbiculata
Poa arida
Poa cusickii
Poa fendleriana
Poa nevadensis
Polanisia dodecandra
Polanisia dodecandra ssp. dodecandra
Polanisia dodecandra ssp. trachysperma
Polygala alba
Polygala verticillata
Polygala verticillata var. isocycla
Polygonatum biflorum var. commutatum
Polygonum polygaloides ssp. confertiflorum
Polygonum punctatum
Polygonum scandens var. scandens
Populus angustifolia
Populus x brayshawii
Potamogeton amplifolius
Potamogeton foliosus
Potamogeton illinoensis
Potamogeton natans
Potamogeton obtusifolius
Potamogeton praelongus
Potamogeton pusillus var. tenuissimus
Potamogeton strictifolius
Potamogeton vaginatus
Potentilla diversifolia
Potentilla finitima
Potentilla flabelliformis
Potentilla multifida
Potentilla nivea var. pentaphylla
Potentilla palustris
Potentilla paradoxa
Potentilla pensylvanica var. litoralis
Potentilla plattensis
Prenanthes alba
Primula incana
Primula mistassinica
Prunella vulgaris ssp. lanceolata
Prunus americana
Prunus pumila var. besseyi
Psilocarphus brevissimus var. brevissimus
Psilocarphus elatior
Pterospora andromedea
Puccinellia cusickii
Puccinellia lemmonii
Quercus macrocarpa
Ranunculus cardiophyllus
Ranunculus cymbalaria var. saximontanus
Ranunculus glaberrimus
Ranunculus inamoenus var. inamoenus
Ranunculus pedatifidus var. affinis
Rhinanthus minor
Rhus glabra
Rhynchospora alba
Rhynchospora capillacea
Rorippa curvipes
Rorippa curvipes var. truncata
Rorippa sinuata
Rorippa tenerrima
Rosa blanda
Rubus x paracaulis
Ruppia cirrhosa
Ruppia maritima var. rostrata
Sagittaria latifolia
Salix brachycarpa
Salix maccalliana
Salix pedicellaris
Salix serissima
Sanguinaria canadensis
Saxifraga occidentalis
Schedonnardus paniculatus
Scheuchzeria palustris
Scirpus cespitosus
Scirpus pallidus
Scirpus pumilus ssp. rollandii
Scirpus rollandii
Scirpus rufus var. neogaeus
Scrophularia lanceolata
Scutellaria lateriflora var. lateriflora
Sedum lanceolatum ssp. lanceolatum
Selaginella selaginoides
Senecio eremophilus
Senecio integerrimus var. scribneri
Senecio plattensis
Senecio pseudaureus
Shinnersoseris rostrata
Silene antirrhina
Silene menziesii
Sisyrinchium campestre
Sisyrinchium septentrionale
Smilax ecirrhata
Sorbus scopulina
Sorghastrum nutans
Spartina pectinata
Spergularia salina
Sphenopholis obtusata
Spiraea betulifolia var. lucida
Sporobolus heterolepis porobolus neglectus
Stellaria longipes ssp. arenicola
Stephanomeria runcinata
Stipa richardsonii
Stipa viridula
Streptopus amplexifolius var. amplexifolius
Suaeda moquinii
Subularia aquatica
Subularia aquatica var. americana
Suckleya suckleyana
Taraxacum officinale ssp. ceratophorum
Tetraneuris acaulis var. acaulis
Teucrium canadense var. occidentale
Thalictrum occidentale
Thelesperma subnudum var. marginatum
Thermopsis rhombifolia
Torreyochloa pallida var. fernaldii
Townsendia exscapa
Trichophorum clintonii
Trichophorum pumilum
Tripterocalyx micranthus

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Trisetum spicatum
Trisetum wolfii
Utricularia cornuta
Utricularia intermedia
Utricularia minor
Uvularia sessilifolia
Verbena bracteata
Verbena hastata
Verbena urticifolia
Veronica catenata
Veronica serpyllifolia var. humifusa
Viburnum lentago
Viola conspersa
Viola pallens
Viola pedatifida
Vulpia octoflora
Wolffia columbiana
Woodsia oregana ssp. oregana

Non-vascular Plants

Acarospora arenacea
Acarospora veronensis
Agrestia hispida
Aloina rigida
Amblyodon dealbatus
Aongstroemia longipes
Arthonia patellulata
Aspicilia reptans
Aulacomnium androgynum
Brachythecium acutum
Brachythecium hylotapetum
Brachythecium nelsonii
Brachythecium plumosum
Brachythecium reflexum
Brachythecium rutabulum
Bryohaplocladium virginianum
Bryum algovicum
Bryum amblyodon
Bryum cyclophyllum
Bryum flaccidum
Bryum lonchocaulon
Bryum marratii
Bryum pallens
Bryum turbinatum
Bryum uliginosum
Buellia turgescens
Caloplaca arenaria
Caloplaca flavovirescens
Caloplaca sideritis
Caloplaca trachyphylla
Calypogeia muelleriana
Campylium polygamum
Campylium radicale
Candelariella efflorescens
Catapyrenium squamulosum
Cetraria arenaria
Chaenotheca chrysocephala
Cladonia macilenta
Cladonia ramulosa
Cladonia rei
Cladonia squamosa
Collema coccophorum
Collema crispum
Collema flaccidum
Conardia compacta
Conocephalum conicum
Coscinodon cribrosus
Cyphelium inquinans
Cyphelium notarisii
Cyphelium tigillare
Desmatodon cernuus
Desmatodon heimii
Desmatodon heimii var. heimii
Desmatodon randii
Dicranum ontariense
Dicranum tauricum
Didymodon fallax
Didymodon tophaceus
Diplotomma alboatrum
Drepanocladus brevifolius
Drepanocladus crassicostatus
Encalypta spathulata
Endocarpon pusillum
Entodon concinnus
Entodon schleicheri
Esslingeriana idahoensis
Fissidens grandifrons
Flavopunctelia soredica
Fontinalis antipyretica
Fulgensia fulgens
Grimmia donniana
Gymnostomum aeruginosum
Herzogiella turfacea
Hygroamblystegium tenax
Hypnum pallescens
Hypocenomyce friesii
Jaffueliobryum raui
Jaffueliobryum wrightii
Lecania cyrtella
Lecanora chlarotera
Lecanora crenulata
Lecanora hybocarpa
Lecanora meridionalis
Lecanora saligna
Lecanora wisconsinensis
Lecidea confluens
Lecidea lithophila
Lecidella carpathica
Lecidella patavina
Lepraria lobificans
Leskea gracilescens
Leskea obscura
Leskea polycarpa
Limprichtia cossonii
Mannia fragrans
Mannia pilosa
Meesia triquetra
Melanelia infumata
Melanelia olivacea
Micarea melaena
Mnium ambiguum
Mycobilimbia sabuletorum
Mycocalicium calicioides
Orthotrichum affine
Orthotrichum pumilum
Pellia neesiana
Peltigera evansiana
Peltigera horizontalis
Peltigera polydactyla
Phaeophyscia cernohorskyi
Phascum cuspidatum
Physcia dimidiata
Physcomitrium hookeri
Physcomitrium pyriforme
Physconia enteroxantha
Physconia isidiigera
Pohlia atropurpurea
Polyblastia cupularis
Pseudevernia consocians
Pseudoleskea patens
Pseudoleskea stenophylla
Psora himalayana
Psora tuckermanii
Pterygoneurum ovatum
Pterygoneurum subsessile
Pyrrhospora elabens
Ramalina roesleri
Rhizocarpon obscuratum
Rhizomnium andrewsianum
Rhizoplaca peltata
Rhizoplaca subdiscrepans
Rhodobryum ontariense
Riccardia latifrons
Riccardia multifida
Riccia beyrichiana
Riccia cavernosa
Ricciocarpos natans
Rinodina archaea
Rinodina mucronatula
Sarcogyne regularis
Schistidium heterophyllum
Schistidium pulvinatum
Scoliciosporum chlorococcum
Scorpidium scorpioides
Scouleria aquatica
Seligeria campylopoda
Sphagnum contortum
Splachnum ampullaceum
Staurothele elenkinii
Thuidium philibertii
Toninia tristis ssp. tristis
Tortula caninervis
Trapeliopsis flexuosa
Umbilicaria lyngei
Verrucaria glaucovirens
Verrucaria viridula
Weissia controversa
Xanthoparmelia subdecipiens
Xanthoria hasseana
Xanthoria montana
Xylographa parallela

Other Elements

Bird colony
Bird rookery
Migratory Bird Concentration Site
Snake hibernacula

Table 4.1c. Other features of conservation concern (CDC tracked species and communities, wildlife concentrations, and hibernacula)

Communities

Alnus incana/Carex lacustris - (*Caltha palustris)* Swamp Shrubland

Amelanchier alnifolia Shrubland

Andropogon gerardii - (*Panicum virgatum*) Northern Tallgrass Prairie

Andropogon gerardii - (*Sorghrastrum nutans* - *Muhlenbergia richardsonis*) Tallgrass Prairie

Andropogon gerardii - *Schizachyrium scoparium* Transitional Tallgrass Prairie

Andropogon scoparius-Bouteloua spp. *(curtipendula, gracilis*)*-Carex filifolia* Herbaceous Vegetation

Artemisia longifolia - *Chrysothamnus nauseosus*

Betula papyrifera/Corylus cornuta Forest

Betula papyrifera/ Juniperus horizontalis Shale Woodland

Carex aquatilis - *Carex* spp. Wetland

Carex atherodes - *Scholochloa festucacea* Wetland

Carex oligosperma - *Carex lasiocarpa/Shagnum* spp. Poor Fen

Carex pseudocyperus - *Calla palustris*

Carex rostrata - *Carex lacustris* - (*Carex vesicaria*) Wetland

Carex spp. - *Triglochin maritima* - *Eleocharis pauciflora* Fen

Festuca hallii - *Calamovilfa longifolia*

Festuca hallii - *Koeleria macrantha* / *Juniperus horizontalis* / forbs

Festuca hallii - *Stipa curtiseta*

Festuca scabrella - *Pseudoegneria spicata* Prairie

Fraxinus pennsylvanica - *(Ulmus americana)* - *Acer negundo* Forest

Fraxinus pennsylvanica - *(Ulmus americana)/Prunus virginiana* Woodland

Fraxinus pennsylvanica - Celtis spp. - *Tilia americana* - Mixed Forest

Fraxinus pennsylvanica-(Ulmus americana)-Acer negundo Forest

Hordeum jubatum Saline Meadow

Inland Shalen Barren Slopes

Juniperus horizontalis / (Koeleria macrantha) / Cladina mitis

Juniperus horizontalis / Koeleria macrantha - *Eriogonum flavum* Pediment Vegetation

Juniperus horizontalis/Andropogon scoparius Dwarf-shrubland

Juniperus horizontalis/Schizachyrium scoparium Dwarf-shrubland

Muhlenbergia asperifolia - *Scirpus nevadensis* - *Distichlis stricta*

Pascopyrum smithii - *Atriplex nuttallii*

Pascopyrum smithii – Stipa comata Prairie

Populus deltoides / Glycyrrhiza lepidota - *Juncus balticus*

Populus deltoides / Symphoricarpos occidentalis

Populus tremuloides - *Quercus macrocarpa/Aralia nudicaulis* Forest

Populus tremuloides/Corylus cornuta Forest

Populus tremuloides/Prunus virginiana Woodland

Quercus macrocarpa Mixedgrass Till Sparse Woodland

Quercus macrocarpa/Amelanchier alnifolia/Aralia nudicaulis Forest

Quercus macrocarpa/Amelanchier alnifolia/Aralia nudicaulis-Carex assiniboinensis Forest

Quercus macrocarpa/Corylus cornuta Woodland

Quercus macrocarpa/Prunus virginiana Northern Ravine Woodland

Sarcobatus vermiculatus Silt Dune Shrubland

Schizachyrium scoparium - *Bouteloua curtipendula* - *Stipa spartea* Prairie

Schizachyrium scoparium - *Bouteloua* spp. (*curtipendula, gracilis)* Prairie

Schoenoplectus tabernaemontani - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation

Scirpus nevadensis - (*Triglochin maritima*)

Scirpus spp. - *Typha* spp. Mixed Inland Great Plains Wetland

Scolochloa festucacea Wetland

Spartina gracilis - *(Pascopyrum smithii*)

Stipa comata-Bouteloua gracilis-Carex filifolia Herbaceous Vegetation

Stipa curtiseta - *Elmus lanceolatus* Prairie

Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation

Typha spp. Inland Great Plains Wetland

4.3.1 Fine-filter Conservation Goals

Conservation goals were set for each fine-filter target based on the feature's conservation status, the importance of the ecoregion to the species, and the species' distribution.

Conservation goals for species targets were based on the species' global conservation status (G-Rank) and distribution (a measure of 'ecoregion importance') (Table 4.2). Goals indicated are numbers of "occurrences" or "element occurrences" (EOs). An EO represents a home range or, in the case of plants, a breeding population.

The fine-filter analysis is similar to the coarse-filter analysis: 1) identify primary fine-filter biodiversity targets based on the criteria above; 2) set conservation goals for each biodiversity target (the minimum number and distribution that should be represented in the blueprint); and 3) identify sites within each ecodistrict that contain viable populations of species targets and add them to the blueprint in order to meet conservation goals.

Table 4.2. Conservation goals for primary targets

Distribution	Global Conservation Rank			
	G1	G2	G3	G4-G5
Widespread	All viable occurrences		2 per ecodistrict	Secondary Target
Peripheral			2 per ecodistrict	Secondary Target
Limited			4 per ecodistrict	Secondary Target
Disjunct			4 per ecodistrict	3 per ecodistrict
Endemic			4 per ecodistrict	4 per ecodistrict
Restricted			2 per ecodistrict	2 per ecodistrict
Wide-ranging			1 per ecodistrict	1 per ecodistrict

4.3.2 Meeting the Goals

Many of the specific locations of the element occurrences (EOs) provided by the CDCs were buffered on the basis of the spatial accuracy of the record or to represent the species' home ranges. The EO for each target species were overlaid on the results of the coarse-filter analysis, protected areas and conservation lands. In each ecodistrict, the EOs captured by the blueprint were evaluated against the ecodistrict goal. Where the goal per ecodistrict was not met, additional ecological systems were added in order to represent the necessary number of EOs to meet the goals set. EOs that were small, less than 200m, were buffered by a total distance of 2km, and this area was added to the blueprint.

Where there was a number of EOs to choose from in order to meet the goal for a target, those occurrences that were closer to protected areas or closer to other blueprint sites were chosen. In situations where conservation goals for species targets could not be met by adding a natural ecological system, the site was added and was noted (and mapped on the tile maps) as being a fine-filter addition, containing no natural cover.

4.4: Assembling the Portfolio

The overall "portfolio" of sites included in the detailed blueprint mapping (Appendix D) includes the following:

A. Top-scoring ecological systems in each ecodistrict;
B. Existing protected areas and other conservationlands; and
C. Fine-filter element occurrences (EOs) additional to those already included in A and B (above) sufficient to meet the inclusion goals set for those target species, following the mapping method mentioned above (4.3.2).

4.5: The Next Blueprint

The biome is a working landscape within which significant conservation has been achieved by both public agencies and private landowners, in fact more by the latter than the former. The conservation blueprint presented here, and its results, are suggestive, not prescriptive. It does not imply that land-use constraint, securement, or any other conservation action is necessarily appropriate based on just this analysis.

The GIS analysis used to delineate the conservation blueprint is an automated modelling exercise. Its results, however, warrant ground-truthing, and are useful context and detail in the identification and design of any priority landscape where conservation action is being considered.

An analysis of this type is perfectible. It is a first-ever attempt to undertake a biome-wide analysis of biological diversity at actionable scales. The major challenge was the distribution of these ecoregions across two countries and five provinces and states. Compiling and analyzing biodiversity data across multiple jurisdictions was central to building seamless data sets that could support comparisons across theregion. To create seamless data sets, the lowest common denominator — the most widely cross-walkable unit — was used, which was necessary but unfortunate; so for example, land cover data with broader coverage, fewer cover types and poorer spatial resolution. Over the course of the project, there were a series of challenges that, if met, could establish the basis for a much more robust second iteration of this blueprint sometime in the future. Some examples follow.

Habitat Classification and Mapping

There are no agreed-upon habitat (or vegetation) classification systems or mapping for these jurisdictions. As a result, there is 1) no accepted and supported fine-scale mapping across the region to serve as the biological component of any ecological land classification system, and 2) very limited resources for conservation data centres to rank and track rare habitat or vegetation types.

Ecological Systems

The ecological systems developed for this project were cross-walked between five jurisdictions and are the first attempt that we are aware of to develop such a data layer (Appendix B). However, the results have not yet been field tested to determine their accuracy. The shortcomings in the biological component of the ecological-system classification were mentioned above, and this undermines the ecological-system layer where there are discrepancies between existing coarse-scale vegetation mapping, in this case across the Alberta-Saskatchewan boundary. There is no consistent surficial geology mapping across the region, which was cross-walked for the first time in this project, and the scale of abiotic map units varies significantly in one of the jurisdictions; Montana's geological map units are too large to provide mapping of ecological systems at useful fine scales.

Ecological system polygons were classified along surficial-geology boundaries and this affected the size and shape of polygons. Jurisdictions with coarser surficial-geology mapping have larger, more continuous polygons as a result. Alberta, with finer surficial-geology mapping, has smaller ecological system polygons. This affects scoring, particularly where comparisons are being made across jurisdictional boundaries. They do not affect comparisons within those individual jurisdictions, however.

These shortcomings are apparent in the coarse mapping in the Results section, below, where "shadows" of jurisdictional boundaries (particularly Alberta-Montana and Alberta-Saskatchewan) can be seen. Finally, there is no underlying GIS-compatible layer of stream sections and corresponding watersheds that could serve as the basis for an equivalent blueprint for aquatic biodiversity.

Fine-filter Targets

The assembly of species data sets across five jurisdictions may permit a few comments on the differences among conservation data centres (CDCs). The intensity of survey varies significantly between CDCs, leading to apparent inconsistencies in knowledge between jurisdictions. There are limited data on some under-surveyed groups, such as invertebrates and non-vascular plants. There is no organization of effort to track rare community types, despite the common knowledge that many endemic North American grassland vegetation types are globally rare. Finally, CDCs have been working with NatureServe towards more polygon-based mapping of element occurrences, but this shift requires standardization across jurisdictional boundaries if the CDCs are to retain any of their earlier goals of allowing roll-up and analysis across jurisdictional boundaries.

Conservation Goals

Expert opinion and accepted best practice were the primary reasons for setting conservation goals for target species and for ecological systems. These approaches toscoring and to stratification of results warrant testing. Are these minimum goals sufficient for representing coarse- and fine-filter targets?

Protected Areas and Conservation Lands

There was no regional mapping of existing protected areas and conservation lands, nor were there IUCN or GAP classifications for many of them. The data used in the project is a first approximation, and will have gaps. The major gap is the lack of mapping of private-sector conservation lands, specifically the large holdings of Ducks Unlimited Canada and the Nature Conservancy of Canada, which collectively represent one of the largest conservation achievements in the study area.

Limitations

Computer-based landscape assessments are limited to the available data. There are no significant regional data, either here or elsewhere in Canada, on important ecological measures such as ecological condition or environmental function, and approaches using surrogate measures remain immature.

The present study is weak in its assessment of current or desirable connectivity of natural habitats across such a highly fragmented landscape. However, the results of the study do lend themselves to further analysis such as has been done elsewhere in this regard (Riley *et al.* 2003).

The present study does not deal directly with the restoration challenges facing such a significantly modified landscape. Restoration and rehabilitation are matters usually handled at finer scales. NCC recommends that the blueprint, other regional studies, expert opinion and practitioner skills be brought to bear to move down-scale from this biome-wide assessment to the identification of the "priority landscapes" across the region where conservation actions should be pursued on a priority basis to achieve the biodiversity conservation that the region deserves.

Study Area

The original study area was the two "rainbow" ecoregions, the **Aspen Parkland** and **Moist Mixed Grassland**. It quickly became apparent that there were significant benefits to achieving a consistent methodological coverage of the entire Canadian prairie and parkland biome. As a result, the Canadian **Mixed Grassland** and **Cypress Upland** were added to the study area. This represents an advance in conservation planning for the Canadian portion of the bi-national **Northern Great Plains Steppe** ecoregion (TNC 1999), and the lack of comparable coverage for the U.S. portion deserves redress.

SECTION 5.0

Results

A goal of the Conservation Blueprint project was to identify a portfolio of the remaining natural areas across the landscape that, if properly conserved, could sustain the terrestrial biodiversity of the prairies, parklands and associated upland forests.

As well, NCC and the many contributing partners in this project had as a goal the production of a series of new data layers to assist with further conservation planning. Although the new layers, such as that for ecological systems, have not yet been fully ground-truthed, they nevertheless provide both classifications and mapping that are useful in describing the natural variability of the study area, for an area where such work has not been previously done. Another example is the project's classification and mapping of the existing network of protected areas and other conservation lands, with results reported on how those areas meet particular conservation goals.

Another goal was to produce ecoregionally-relevant lists of target species, and to assemble data on their occurrences across the whole study area. Initial conservation goals were established for those species, and occurrences of those targets were included in the overall Blueprint portfolio, to meet those goals. Most of the target occurrences were in existing protected areas, other conservation lands, or in high-scoring ecological system polygons.

In the following section, the blueprint results are reported thematically, with sample maps of how the data may be used. Summary statistics are presented for the biome (Table 5.1), by ecoregion and ecodistrict (Table 5.2) and by ecological system type (Table 5.3). In this way the reader can get a sense of the relative importance of the blueprint results according to the spatial scale of interest.

Conservation Blueprint –Tile Maps
(Appendix D)

The blueprint is a contribution to a shared understanding of the conservation geography of the region, to help frame the identification of a suite of core biodiversity conservation areas, set within a supporting network of remaining natural cover.

The mapped results illustrate a remotely-assessed suite of natural areas with high probability of being core biodiversity conservation areas. As such, they warrant ground-truthing to validate their condition, special features and ecological functions. On this basis, individuals, agencies, organizations and others may find the data useful, alone and with other data, in determining the set of **priority landscapes** that should be the focus of conservation efforts.

Twenty-one percent of the study area is provincial or state lands and waters (major lakes and rivers), with 79% of the study area in private ownership (Fig. 3.1)

Overall, the blueprint maps 34% of the study area as a supporting network of remaining natural cover. This area excludes remnant natural-areas smaller than 0.36ha, which are considered as smaller than needed to sustain native ecological systems (Fig. 5.1).

This is a remarkable figure. The only comparable land conversion that has occurred at this scale in Canada is in Ontario south of the Canadian Shield, where again only 34% of the land base remains in natural cover (Henson *et al.* 2005). By comparison, 97% of the Northern Appalachian-Acadian ecoregion of maritime Canada and New England remains in natural cover (Anderson *et al.* in prep.).

The sum total of regulated protected areas is close to 2% of the study area, with another 5.2% as informal conservation lands of various types, for a total maximum area of 7.2% of the study area under some type of conservation stewardship. The blueprint identifies an additional 11% of the land base that constitutes the highest-scoring of the remaining ecological systems and the additional occurrences of target species needed to meet minimum conservation goals for those species. So, in total, the blueprint maps 18.1% of the land base as **core biodiversity conservation areas** on this basis, set within a **supportive network of remaining natural cover** of about one third of the land base. These figures vary tremendously across the study area: for example, in the **Aspen Parkland** the recommended conservation lands range from 1% to 71% of particular ecodistricts, generally paralleling the extent of remaining natural cover, 4% to 85%.

Tile Maps

The summary maps from the study are presented as a series of edge-matched tile maps (Appendix D). These maps include major highways and rail lines, provincial and state boundaries, major settlements and major hydrological features as the underlying base.

On this base, all ecodistricts are mapped and named, and the extent of **natural cover** is shaded lightly across the map. Natural cover is not distinguished by type (grassland, *etc.*).

The highest scoring **ecological system types** (top two per ecodistrict) are mapped in bold, within general ecological-system types: woodlands, grasslands/shrublands, wetlands, and mud/sand/ saline areas.

Also mapped are existing **protected areas and other conservation lands**, outlined in dark green so that constituent high-scoring ecological systems can be seen where they occur within such conserved areas.

Finally, the tile maps shsow the **occurrences of target species**, where they occur outside of high-scoring ecological systems and where they occur outside of existing protected areas and conservation lands. Areas of natural and non-natural cover are indicated at these element occurrences.

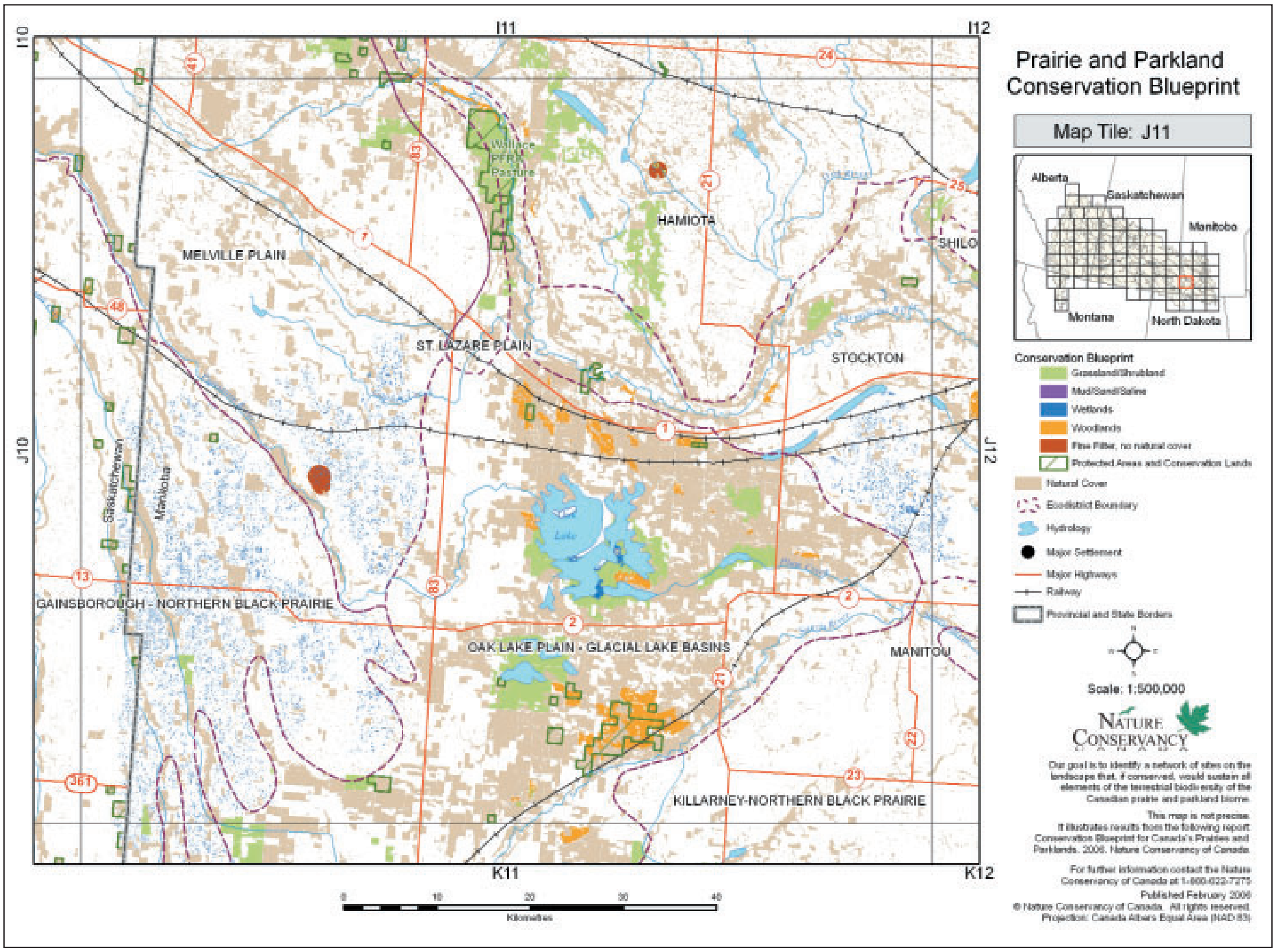


Table 5.1. Blueprint data summary, by ecoregion

		Natural Cover in Ecoregion			Protected Areas and Conservation Lands		Conservation Blueprint			Crown & State Lands and Waters	
ECOREGION NAME	Total area of Ecoregion (ha)	Major Hydrological Features (ha)	Total Ecological Systems (ha)	Total %	Area (ha)	%	Conservation Blueprint outside PA and CL	Total Blueprint PA/CL and BP Sites (ha)	Total Blueprint PA/CL and BP Sites (%)	Area of Crown and State Lands (ha)	Crown and State Lands and Waters (%)
Aspen Parkland	20,570,614	452,350	4,764,100	25%	858,330	4.2%	993,788	1,852,118	9%	2,222,500	13%
Moist Mixed Grassland	13,027,071	233,380	3,684,255	30%	541,200	4.2%	1,682,678	2,223,878	17%	1,943,600	17%
Mixed Grassland	13,401,679	273,650	5,753,400	45%	1,628,300	12.1%	2,179,673	3,807,973	28%	4,286,300	34%
Cypress Upland	832,461	5,243	637,980	77%	124,070	14.9%	363,789	487,859	59%	394,090	48%
Portion of Boreal Transition***	711,781	20,706	492,377	72%	311,629	43.8%	11,980	323,609	45%	350,479	52%
Total	**48,543,606**	**985,329**	**15,332,112**	**34%**	**3,463,529**	**7.1%**	**5,231,908**	**8,695,437**	**18%**	**9,196,969**	**21%**

* Includes major lakes and rivers; termed "waters" in right-hand column.

**Ecological systems are Grasslands/Shrublands, woodlands, Wetlands and Mud/Sand/Saline polygons that are 0.36ha or larger.

***Consists of two ecodistricts around Riding Mountain National Park.

Table 5.2 Blueprint data summary, by ecodistrict (ecodistricts are mapped on Fig. 10)

ASPEN PARKLAND ECOREGION			Natural Cover			Protected Areas and Conservation Lands		Conservation Blueprint		
Ecodistrict	Ecodistrict Number	Total Area of Ecodistrict (ha)	Major Hydrological Features (ha)	Area Ecological Systems (ha)	Natural Cover (%)	Area of PA and CL (ha)	Area of PA and CL (%)	Conservation Blueprint Outside PA and CL (ha)	Total Conservation Blueprint (ha)	Percent of Ecodistrict in Bueprint
Leduc	727	855,446	18,681	64,061	10%	4,849	1%	8,781	13,630	2%
Andrew	728	390,289	6,456	26,621	8%	0	0%	4,278	4,278	1%
Lloydminister Plain	729	981,452	12,916	235,310	25%	29,051	3%	73,012	102,063	10%
Vermilion	730	1,008,361	9,804	145,550	15%	9,784	1%	12,725	22,509	2%
Daysland	731	829,535	25,401	63,032	11%	18,122	2%	10,081	28,203	3%
Cooking Lake	732	158,483	11,850	55,721	43%	31,041	20%	6,335	37,376	24%
Whitewood Hills	733	357,054	10,614	117,010	36%	33,377	9%	31,934	65,311	18%
Lower Battle River Plain	734	150,973	3,503	91,360	63%	38,080	25%	23,542	61,622	41%
Maymont Plain	735	246,483	15,309	33,183	20%	5,500	2%	6,787	12,287	5%
Waldheim Plain	736	412,250	11,432	68,809	19%	7,121	2%	15,999	23,120	6%
Red Deer	737	345,055	10,529	23,634	10%	1,038	0%	2,921	3,959	1%
Sedgewick	738	229,191	387	21,158	9%	0	0%	4,874	4,874	2%
Edgerton-Ribstone Plain	739	416,791	15,701	206,010	53%	108,860	26%	44,023	152,883	37%
Bashaw	740	378,208	12,487	70,761	22%	8,807	2%	10,022	18,829	5%
Cudworth Plain	741	232,563	7,072	36,286	19%	2,493	1%	4,957	7,450	3%
Hafford Plain	742	72,492	1,523	24,558	36%	7,626	11%	9,945	17,571	24%
Provost Plain	743	194,501	1,897	27,290	15%	1,477	1%	8,578	10,055	5%
Pine Lake	744	363,174	1,957	46,176	13%	207	0%	9,588	9,794	3%
Quill Lake Plain	745	1,030,100	85,068	99,596	18%	63,072	6%	13,505	76,577	7%
Olds	746	251,284	520	8,787	4%	0	0%	1,300	1,300	1%
Whitesand Plain	747	163,869	6,949	80,525	53%	28,557	17%	35,191	63,748	39%
Touchwood Hills Upland	748	1,020,421	4,618	192,640	19%	40,489	4%	39,111	79,600	8%
Yorkton Plain	749	612,509	3,918	99,365	17%	5,433	1%	18,147	23,580	4%
Black Diamond	750	399,323	975	238,940	60%	5,799	1%	46,495	52,294	13%
St. Lazare Plain	751	207,837	5,293	120,720	61%	42,032	20%	20,379	62,411	30%
Melville Plain	752	976,015	4,822	187,600	20%	14,923	2%	34,985	49,908	5%

Table 5.2 Blueprint data summary, by ecodistrict cont'd

ASPEN PARKLAND ECOREGION			Natural Cover			Protected Areas and Conservation Lands		Conservation Blueprint		
Ecodistrict	Ecodistrict Number	Total Area of Ecodistrict (ha)	Major Hydrological Features (ha)	Area Ecological Systems (ha)	Natural Cover (%)	Area of PA and CL (ha)	Area of PA and CL (%)	Conservation Blueprint Outside PA and CL (ha)	Total Conservation Blueprint (ha)	Percent of Ecodistrict in Bueprint
Hamiota	753	829,780	7,806	182,440	23%	770	0%	16,474	17,244	2%
Indian Head Plain	754	343,363	5,327	62,837	20%	981	0%	20,820	21,801	6%
Moose Mountain Upland	755	270,583	1,059	41,590	16%	3,142	1%	12,836	15,978	6%
Kipling Plain	756	548,973	3,045	101,670	19%	14,796	3%	28,311	43,107	8%
Shilo	757	265,114	187	163,620	62%	69,790	26%	17,499	87,289	33%
Stockton	758	343,163	945	104,670	31%	15,209	4%	14,000	29,209	9%
Carberry	759	57,408	257	12,382	22%	621	1%	3,074	3,695	6%
Gainsborough-Northern Black Prairie	760	1,327,678	3,718	181,250	14%	28,260	2%	16,917	45,177	3%
Moose Mountain	761	117,753	5,204	86,037	77%	54,661	46%	29,438	84,099	71%
Moose Mountain Creek Plain	762	139,627	1,185	48,125	35%	9,899	7%	19,111	29,010	21%
Oak Lake Plain – Glacial Lake Basins	763	445,266	11,988	166,330	40%	6,389	1%	30,594	36,983	8%
Hilton	764	134,190	500	39,259	30%	2,678	2%	5,774	8,451	6%
Killarney – Northern Black Prairie	765	616,549	12,280	90,871	17%	15,001	2%	16,454	31,455	5%
Manitou	766	326,803	7,655	75,760	26%	3,644	1%	11,102	14,746	5%
Grandview	839	221,958	70	70,819	32%	2,472	1%	10,756	13,228	6%
Dauphin	840	211,695	51,371	74,080	59%	10,719	5%	7,595	18,314	9%
Alonsa	841	488,239	31,330	382,940	85%	44,044	9%	86,987	131,031	27%
Ste. Rose	843	92,563	237	52,304	57%	15,517	17%	14,081	29,598	32%
McCreary	844	144,893	1,092	67,437	47%	1,559	1%	8,136	9,695	7%
Gladstone	847	105,710	6,994	24,555	30%	8,138	8%	3,704	11,841	11%
MacGregor	850	289,892	0	98,947	34%	2,237	1%	7,552	9,790	3%
Pembina	854	153,496	1,020	30,385	20%	662	0%	2,813	3,476	2%
Turtle Mountains	855	167,187	5,975	113,770	72%	29,740	18%	66,811	96,551	58%
Northern Black Prairie 1	ND1	575,217	3,420	89,163	16%	7,609	1%	36,080	43,689	8%
Pembina Escarpment	ND2	69,846	0	18,128	26%	2,063	3%	9,376	11,439	16%
Tramping Lake Plain	767	682,520	18,655	136,330	23%	11,092	2%	42,651	53,743	8%

Table 5.2 Blueprint data summary, by ecodistrict cont'd

ASPEN PARKLAND ECOREGION			Natural Cover			Protected Areas and Conservation Lands		Conservation Blueprint		
Ecodistrict	Ecodistrict Number	Total Area of Ecodistrict (ha)	Major Hydrological Features (ha)	Area Ecological Systems (ha)	Natural Cover (%)	Area of PA and CL (ha)	Area of PA and CL (%)	Conservation Blueprint Outside PA and CL (ha)	Total Conservation Blueprint (ha)	Percent of Ecodistrict in Bueprint
Senlac Hills	768	60,991	1,000	26,319	45%	2,069	3%	13,464	15,533	25%
Castor	769	406,676	22,250	34,718	14%	0	0%	16,803	16,803	4%
Goose Lake Plain	770	511,442	25,986	118,400	28%	47,739	9%	26,175	73,914	14%
Neutral Hills	771	460,974	6,081	177,020	40%	20,160	4%	72,096	92,256	20%
Saskatoon Plain	772	107,424	2,125	21,562	22%	245	0%	9,344	9,590	9%
Estow Plain	773	482,448	9,977	54,938	13%	7,338	2%	9,718	17,057	4%
Minichinas Upland	774	97,021	723	22,516	24%	1,547	2%	10,539	12,086	12%
Bear Hills	775	122,896	181	38,992	32%	6,847	6%	17,449	24,296	20%
Moosewood Sand Hills	776	216,067	4,912	129,090	62%	67,970	31%	44,685	112,655	52%
Sullivan Lake	777	127,790	6,106	16,271	18%	0	0%	7,598	7,598	6%
Biggar Plain	778	58,317	1,331	27,730	50%	4,703	8%	17,715	22,418	38%
Endiang	779	153,567	5,790	40,402	30%	14,212	9%	18,519	32,731	21%
Rosetown Plain	780	415,243	11,230	41,345	13%	6,772	2%	12,764	19,536	5%
Drumheller	781	326,425	765	51,933	16%	3,806	1%	21,766	25,572	8%
Arm River Plain	782	742,329	7,009	95,232	14%	17,231	2%	22,360	39,591	5%
Strasbourg Plain	783	442,652	7,885	58,532	15%	18,187	4%	26,652	44,839	10%
Last Mountain Lake Plain	784	210,046	16,630	47,278	30%	36,112	17%	6,460	42,572	20%
Allan Hills	785	116,397	16	22,936	20%	2,216	2%	4,812	7,028	6%
Wintering Hills	786	190,141	1,549	82,972	44%	2,383	1%	38,448	40,831	21%
Majorville Upland	787	306,781	4,982	137,690	47%	7	0%	72,001	72,008	23%
Standard Plain	788	107,136	978	15,017	15%	0	0%	6,906	6,906	6%
Eyebrow Plain	789	270,986	9,946	72,017	30%	31,983	12%	29,489	61,472	23%
Blackfoot Plain	790	132,294	7,393	53,592	46%	145	0%	23,874	24,019	18%
Vulcan Plain	791	220,192	689	31,953	15%	0	0%	12,910	12,910	6%
Regina Plain	792	910,502	4,494	74,544	9%	12,583	1%	23,297	35,880	4%

Table 5.2 Blueprint data summary, by ecodistrict cont'd

ASPEN PARKLAND ECOREGION			Natural Cover			Protected Areas and Conservation Lands		Conservation Blueprint		
Ecodistrict	Ecodistrict Number	Total Area of Ecodistrict (ha)	Major Hydrological Features (ha)	Area Ecological Systems (ha)	Natural Cover (%)	Area of PA and CL (ha)	Area of PA and CL (%)	Conservation Blueprint Outside PA and CL (ha)	Total Conservation Blueprint (ha)	Percent of Ecodistrict in Bueprint
Lethbridge Plain	793	743,692	9,499	188,900	27%	329	0%	46,537	46,866	6%
Griffin Plain	794	641,046	2,296	69,491	11%	11,043	2%	13,082	24,125	4%
Trossachs Plain	796	841,564	17,461	221,560	28%	86,553	10%	60,422	146,975	17%
Milk River Upland	797	177,512	80	124,010	70%	26,543	15%	73,380	99,923	56%
Delacour Plain	798	746,764	8,790	106,230	15%	1,348	0%	18,826	20,174	3%
Willow Creek Upland	799	181,813	51	140,200	77%	826	0%	95,958	96,784	53%
Cardston Plain	800	306,243	4,397	128,360	43%	5,550	2%	35,880	41,430	14%
Twin Butte	801	134,341	1,156	96,025	72%	13	0%	39,979	39,992	30%
Del Bonita Plateau – Foothill Grassland	802	400,532	2,101	295,250	74%	2,591	1%	223,370	225,961	56%
Foothill Grassland	MT1	578,239	4,169	400,795	70%	63,500	11%	257,150	320,650	55%
North Central Brown Glaciated Plains	MT2	160,402	2,473	80,011	51%	3,992	2%	38,134	42,126	26%
Rocky Mountain Front Foothill Potholes 1	MT3	167,126	834	152,853	92%	1,296	1%	133,590	134,886	81%
Rocky Mountain Front Foothill Potholes 2	MT4	62,181	1,392	58,883	97%	22,229	36%	34,054	56,283	91%
Rocky Mountain Front Foothill Potholes 3	MT5	6,347	0	4,654	73%	37	1%	3,821	3,857	61%

Table 5.2 Blueprint data summary, by ecodistrict cont'd

MIXED GRASSLAND ECOREGION			Natural Cover			Protected Areas and Conservation Lands		Conservation Blueprint		
Ecodistrict	Ecodistrict Number	Total Area of Ecodistrict (ha)	Major Hydrological Features (ha)	Area Ecological Systems (ha)	Natural Cover (%)	Area of PA and CL (ha)	Area of PA and CL (%)	Conservation Blueprint Outside PA and CL (ha)	Total Conservation Blueprint (ha)	Percent of Ecodistrict in Blueprint
Kerrobert Plain	803	252,361	12,602	75,952	35%	47,682	19%	11,004	58,686	23%
Sounding Creek Plain	804	214,430	2,450	130,620	62%	0	0%	81,931	81,931	38%
Sibbald Plain	805	148,039	2,196	34,132	25%	5,038	3%	7,019	12,057	8%
Berry Creek Plain	806	800,915	11,605	620,520	79%	20,790	3%	355,050	375,840	47%
Bad Hills	807	171,811	1,700	63,338	38%	18,866	11%	21,156	40,022	23%
Eston Plain	808	923,039	30,265	179,890	23%	112,530	12%	31,558	144,088	16%
Oyen Plain	809	536,813	2,704	269,600	51%	33,556	6%	105,460	139,016	26%
Coteau Hills	810	150,813	1,237	34,552	24%	1,639	1%	25,923	27,562	18%
Acadia Plain	811	82,652	299	20,447	25%	685	1%	13,318	14,003	17%
Brooks Plain	812	359,299	2,564	204,740	58%	1,107	0%	83,675	84,782	24%
Beechy Hills	813	291,049	10,667	126,450	47%	74,856	26%	37,761	112,617	39%
Rainy Hills Upland	814	278,571	1,454	250,660	91%	138,290	50%	74,704	212,994	76%
Bindloss Plain	815	441,649	9,059	297,730	69%	120,780	27%	62,517	183,297	42%
Chaplin Plain	816	670,483	63,878	181,410	37%	84,623	13%	50,735	135,358	20%
Hazlet Plain	817	218,082	236	41,068	19%	22,097	10%	11,408	33,505	15%
Bow City Plain	818	167,830	9,022	92,775	61%	527	0%	63,272	63,799	38%
Great Sand Hills	819	125,034	561	110,220	89%	95,889	77%	14,826	110,715	89%
Antelope Creek Plain	820	271,849	3,551	59,381	23%	16,683	6%	13,397	30,080	11%
Schuler Plain	821	424,030	10,209	201,660	50%	16,368	4%	60,888	77,256	18%
Dirt Hills	822	335,057	615	155,650	47%	26,106	8%	81,789	107,895	32%
Vauxhall Plain	823	246,056	3,108	64,731	28%	56	0%	32,615	32,671	13%
Gull Lake Plain	824	152,858	809	68,314	45%	24,944	16%	29,689	54,633	36%
Swift Current Plateau	825	759,335	4,669	149,060	20%	14,772	2%	27,296	42,068	6%
Wood River Plain	826	1,005,394	13,473	173,750	19%	38,096	4%	43,524	81,620	8%
Swift Current Plateau	825	759,335	4,669	149,060	20%	14,772	2%	27,296	42,068	6%
Wood River Plain	826	1,005,394	13,473	173,750	19%	38,096	4%	43,524	81,620	8%
Wood River Plain	826	1,005,394	13,473	173,750	19%	38,096	4%	43,524	81,620	8%

Table 5.2 Blueprint data summary, by ecodistrict cont'd

MIXED GRASSLAND ECOREGION			Natural Cover			Protected Areas and Conservation Lands		Conservation Blueprint		
Ecodistrict	Ecodistrict Number	Total Area of Ecodistrict (ha)	Major Hydrological Features (ha)	Area Ecological Systems (ha)	Natural Cover (%)	Area of PA and CL (ha)	Area of PA and CL (%)	Conservation Blueprint Outside PA and CL (ha)	Total Conservation Blueprint (ha)	Percent of Ecodistrict in Bueprint
Maple Creek Plain	827	261,776	12,235	203,180	82%	81,554	31%	113,300	194,854	74%
Foremost Plain	828	1,094,427	25,857	331,660	33%	8,109	1%	106,090	114,199	10%
Purple Springs Plain	829	137,998	1,605	76,149	56%	0	0%	47,562	47,562	34%
Coteau Lakes Upland	830	669,513	21,300	258,810	42%	79,927	12%	95,460	175,387	26%
Lake Alma Upland	831	212,197	783	51,219	25%	8,445	4%	17,536	25,981	12%
Wood Mountain Plateau	832	884,722	4,444	523,380	60%	258,480	29%	205,550	464,030	52%
Wild Horse Plain	833	566,465	5,572	472,600	84%	158,230	28%	201,880	360,110	64%
Climax Plain	834	355,333	2,594	112,100	32%	63,722	18%	20,809	84,531	24%
Old Man on His Back Plateau	835	137,723	223	94,611	69%	53,210	39%	35,785	88,995	65%
Sweetgrass	836	33,346	0	23,088	69%	625	2%	13,186	13,811	41%
CYPRESS UPLAND ECOREGION										
Cypress Slope	837	171,989	727	100,850	59%	5,640	3%	68,839	74,479	43%
Cypress Hills	838	660,545	4,512	537,130	82%	118,430	18%	294,950	413,380	63%
BOREAL TRANSITION ECODISTRICTS										
Swan River Plain (MB only)	709	242,047	7,781	110,669	49%	14,809	6%	4,660	19,469	8%
Riding Mountain Park	716	469,734	12,925	381,708	84%	296,820	63%	7,319	304,139	65%

Table 5.3 Blueprint data summary, portfolio site contribution by ecological system type

ECOREGION	Target Woodland Systems (ha)	Taget Wetland Systems (ha) (ha)	Target Grassland/ Shrubland Systems (ha)	Target Mud / Sand/ Saline Systems (ha)	All Targeted Systems (ha)
Aspen Parkland	1,403,166	619,680	2,728,590	12,655	4,764,091
Aspen Parkland Blueprint	479,860	180,406	963,076	11,379	1,634,721
Aspen Parkland Blueprint as % of total area of remaining ecological systems	34.2%	29.1%	35.3%	89.9%	34.3%
Moist Mixed Grassland	183,604.0	253,600	3,245,666	1,385	3,684,255
Moist Mixed Grassland Blueprint	47,667.2	53,050	2,008,762	853.9	2,110,333
Moist Mixed Grassland Blueprint as % of total area of remaining ecological systems	26.0%	20.9%	61.9%	61.7%	57.3%
Mixed Grassland	19,849	176,480	5,545,805	11,260	5,753,394
Mixed Grassland Blueprint	7,247	39,075	3,624,252	9,846.3	3,680,420
Mixed Grassland Blueprint as % of total area of remaining ecological systems	36.5%	22.1%	65.4%	87.4%	64.0%
Cypress Upland	25,720	3,942	608,322	0	637,984
Cypress Upland Blueprint	20,121.2	1,390.2	462,016	0	483,528
Cypress Upland Blueprint as % of total area of remaining ecological systems	78.2%	35.3%	75.9%	0.0%	75.8%
Portion of Boreal Transition	339,237	45,783	107,356	n/a	492,377
Portion of Boreal Transition Blueprint	271,246	34,615	12,988	n/a	318,848
Portion of Boreal Transition Blueprint as % of total area of remaining ecological systems	80.0%	75.6%	12.1%	n/a	64.8%
Total	1,971,576	1,099,486	12,235,739	25,300	15,332,101
Conservation Blueprint total	**826,141**	**308,536**	**7,071,093**	**22,080**	**8,227,850**
% included in Conservation Blueprint	41.9%	28.1%	57.8%	87.3%	53.7%

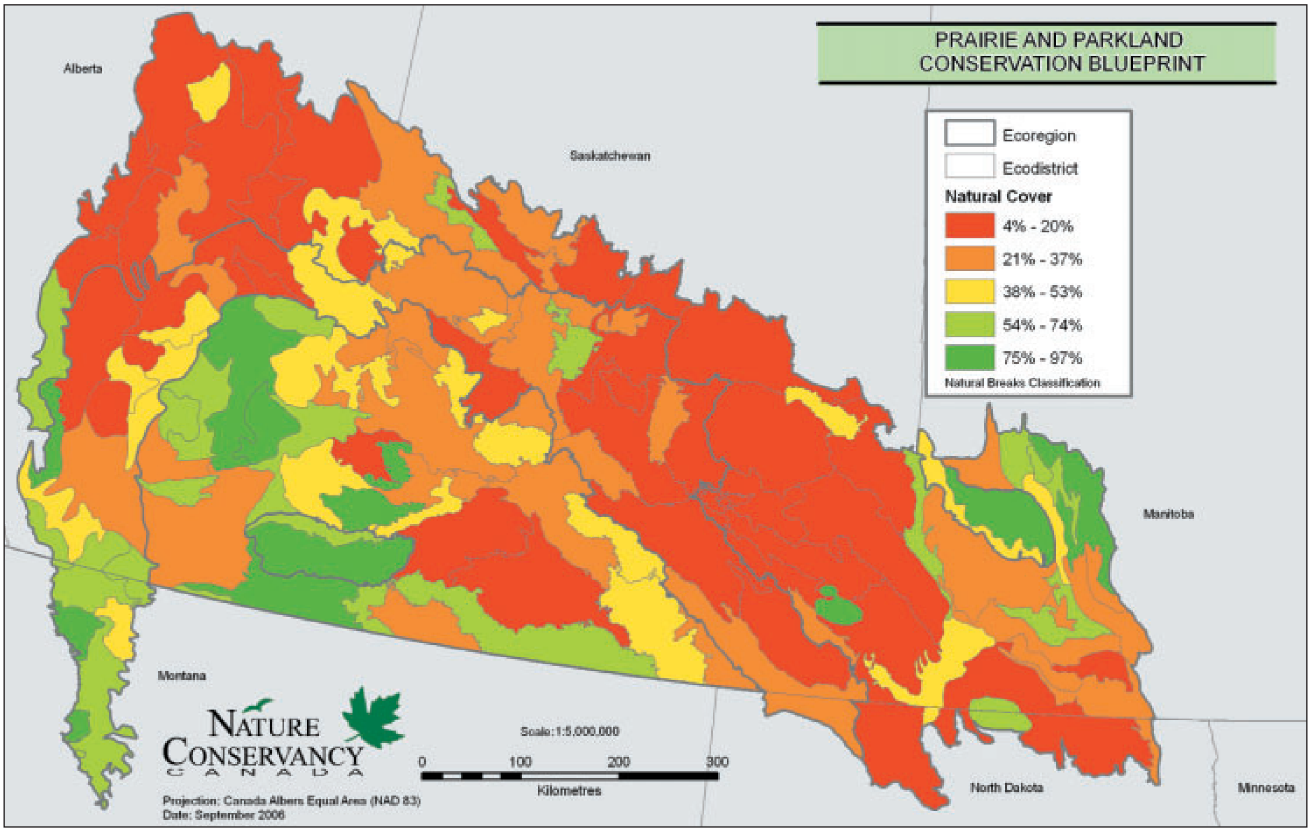


Figure 22. Extent of natural cover, by ecodistrict

Natural Cover and Existing Protected Areas and Conservation Lands

Natural cover varies tremendously across the study area, but there are definite patterns (Fig. 22, Tables 5.1, 5.2). The **Aspen Parkland** has been reduced to about 25% remaining natural cover; **Moist Mixed Grassland** to 30% and **Mixed Grassland** to 45%. This reflects the moisture gradient across the region, the notable exception to which is the **Cypress Upland,** where 77% of natural cover remains.

Among ecodistricts, the variation is radically variable, reflecting suitability for agricultural conversion.

Aspen Parkland — From Olds (4%) to Turtle Mountain (72%), Moose Mountain (77%) and Alonsa (85%);

Moist Mixed Grassland — From the Regina Plain (9%) and Griffin Plain (11%) to the Moosewood Sand Hills (62%), Milk River Upland (70%) and Willow Creek Upland (77%);

Mixed Grassland — From Hazlet and Wood River Plains (19%) and Swift Current Plain (20%) to the Great Sand Hills (89%) and Rainy Hills Upland (91%).

These patterns parallel the extent regulated protected area and other conservation lands (PA/CL) in each ecoregion. Aspen Parkland and Moist Mixed Grassland both have 4.2% of lands in PA/CL; Mixed Grassland has 12.1% and the Cypress Upland has 14.9% of its lands in PA/CL.

Among ecodistricts, there is greater variability (Fig. 23, Table 5.2):

Aspen Parkland — Lower Battle River Plain (25%), Edgerton-Ribstone Plain and Shilo (26%) and Moose Mountain (46%);

Moist Mixed Grassland — Milk River Upland (15%), Last Mountain Lake Plain (17%) Moosewood Sand Hills (31%), and Rocky Mountain Front 2 (36%);

Mixed Grassland — Old Man on His Back Plateau (39%), Rainy Hills Upland (50%) and Great Sand Hills (77%);

Cypress Upland — Cypress Hills ecodistrict (18%); and

Boreal Transition — Riding Mountain (63%).

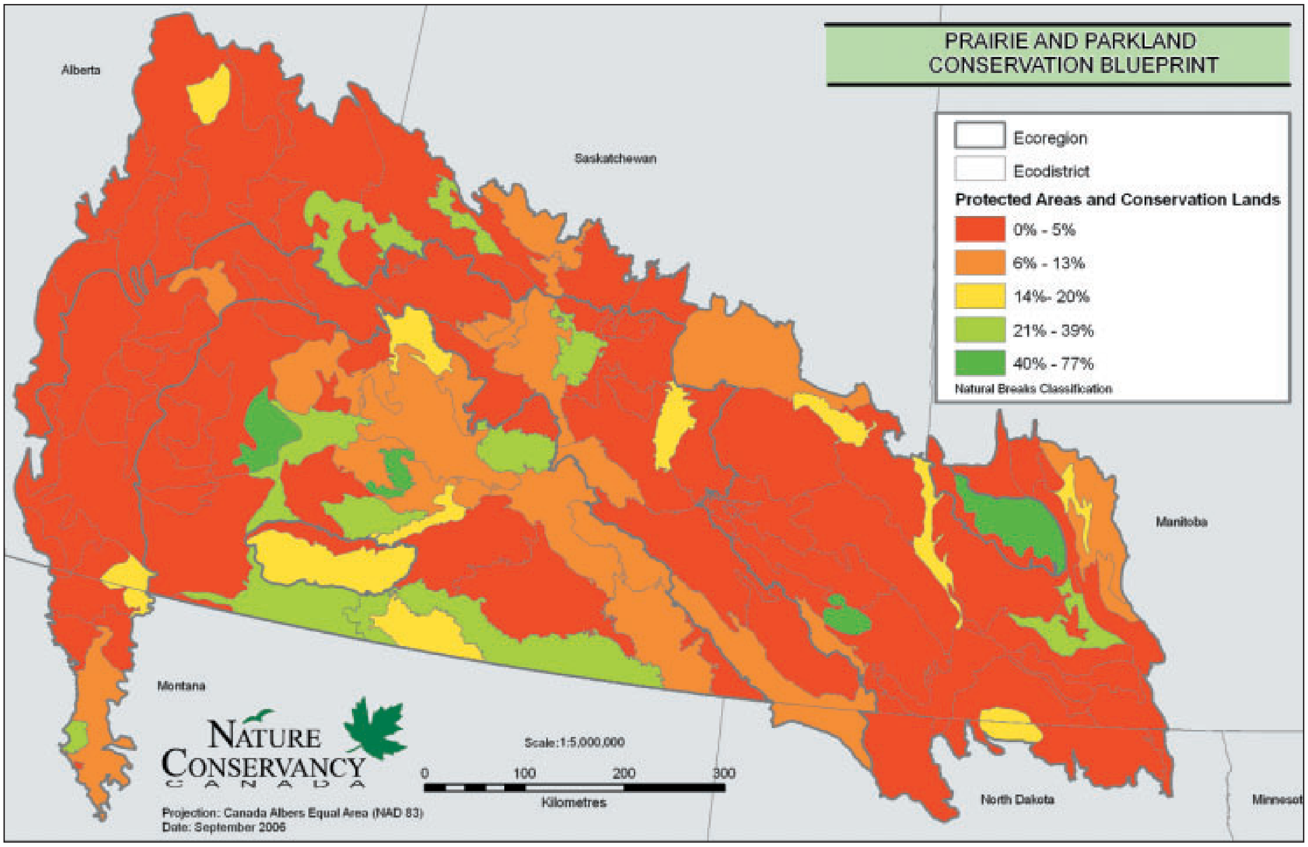


Figure 23. Extent of protected areas and other conservation lands, by ecodistrict

Top Scoring Ecological Systems

The tile maps illustrate the scoring and selection of the ecological system polygons that meet the goal of representing the top two scoring ecological system types per ecodistrict in the blueprint (Appendix C). This is the level of replication the project considered the minimum level needed for the conservation of organisms and ecosystems on a landscape that is so heavily converted.

The present study did not inject minimum area requirements for the representation of natural cover across the landscape, although this analysis can be done on the basis of the data developed for the project. Minimum area requirements cannot be met in the large proportion of ecodistricts with less than 15-20% natural cover left, where rehabilitation and restoration will be needed to meet any modicum of ecological functionality at sustainable levels.

The study data permit different scoring approaches among ecological systems. Three others are illustrated here to demonstrate approaches different from the detailed tile mapping:

- The "top ten" scoring general ecological system types within each ecoregion making up the study area (Fig. 24); and
- The "top ten" scoring general ecological system types within each province or state in the study area (Fig. 25).
- The "top fifteen" scoring general ecological system types within the Canadian portion of the study area (Fig. 26).

Each of these illustrates a different approach to considering regional context, which can be useful in identifying priority landscapes for conservation action across the region.

On the other hand, the maps also illustrate shortcomings in the underlying data. For example, as discussed above, the weak surficial geology mapping in Montana resulted in ecological-system mapping for Montana that had larger average polygon sizes than elsewhere in the study area, hence the overstated connectedness of the areas selected there. The boundary between Saskatchewan and Alberta is also subtly evident on Figures 24 and 26, again reflecting a less-than-seamless ecological system classification based on the available information.

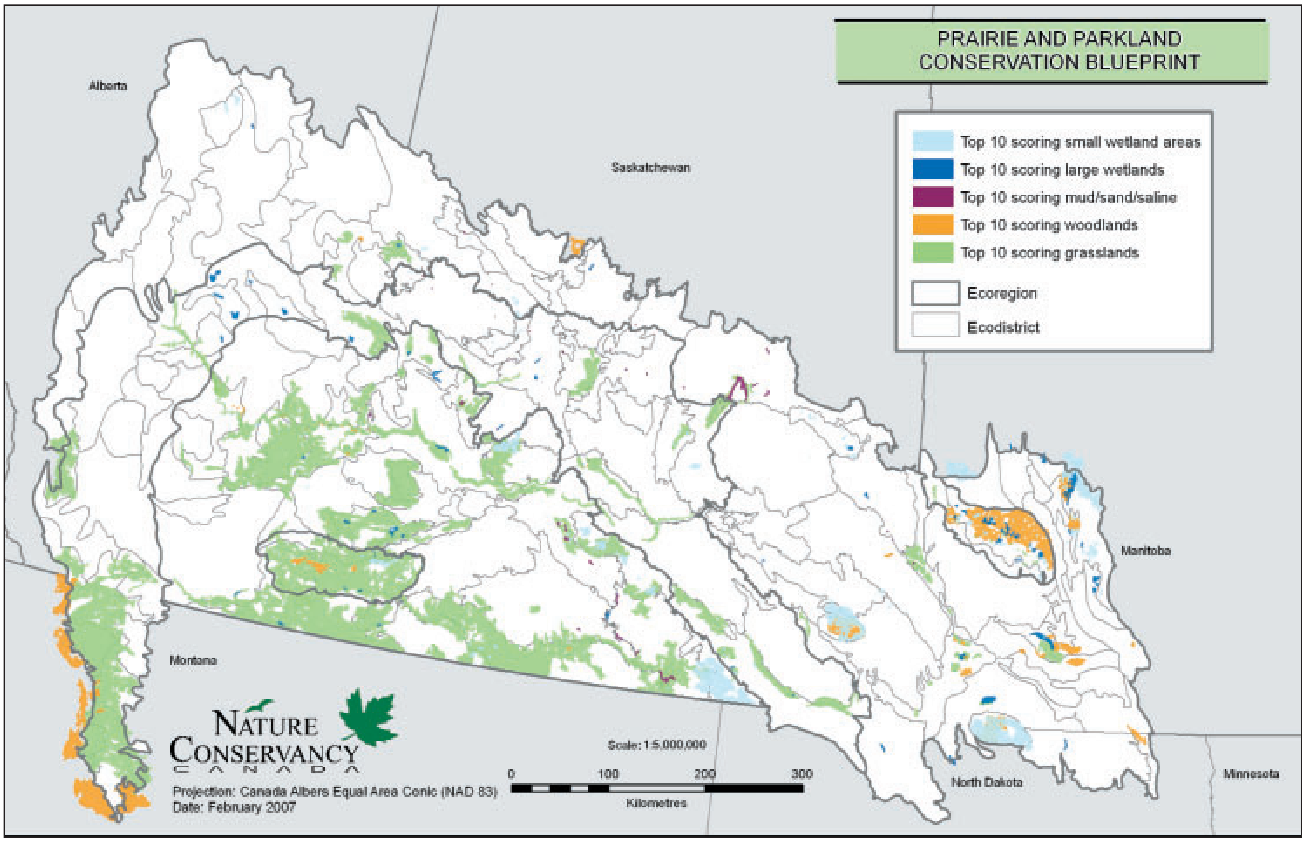


Figure 24. "Top ten" scoring general ecological system types within each ecoregion making up the study area

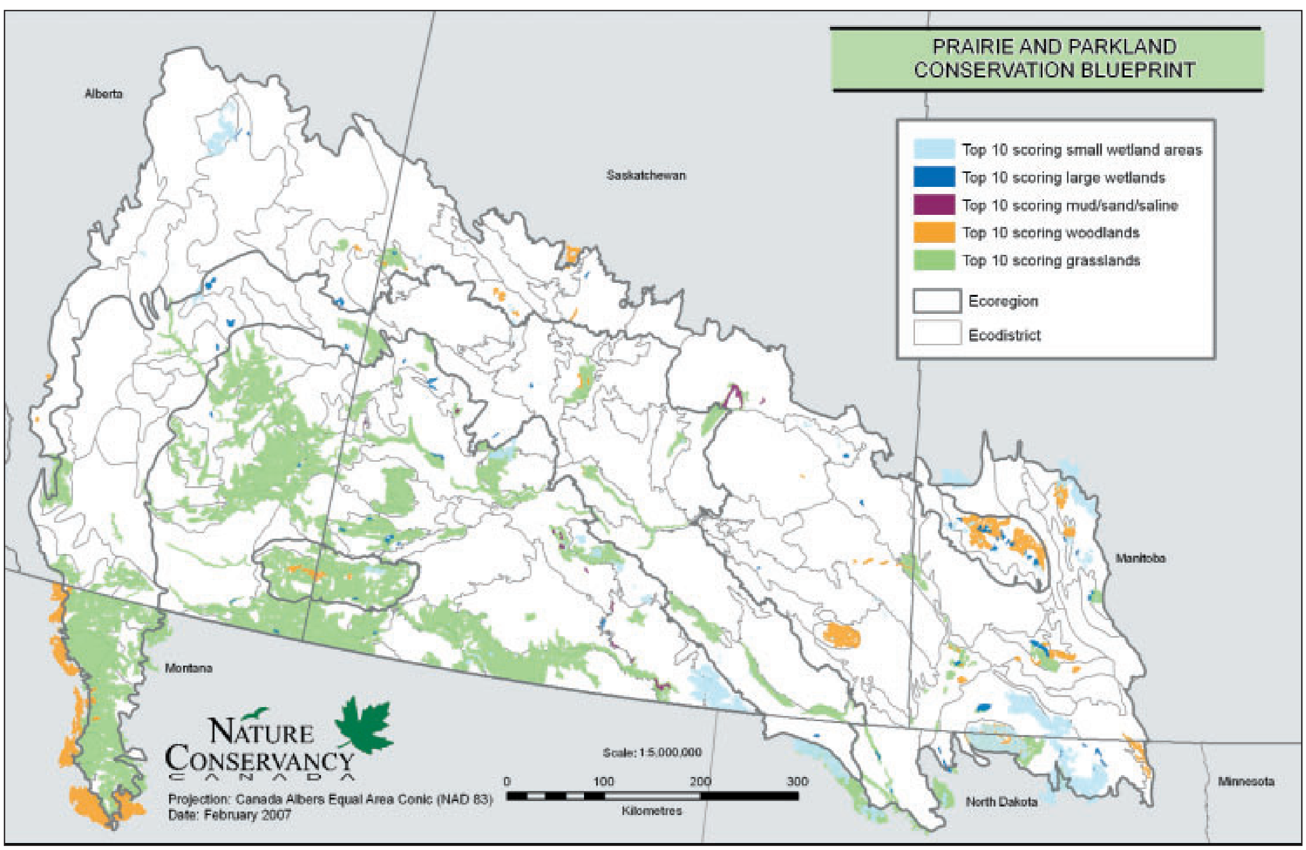


Figure 25. "Top ten" scoring general ecological system types within a province or state portion of the study area

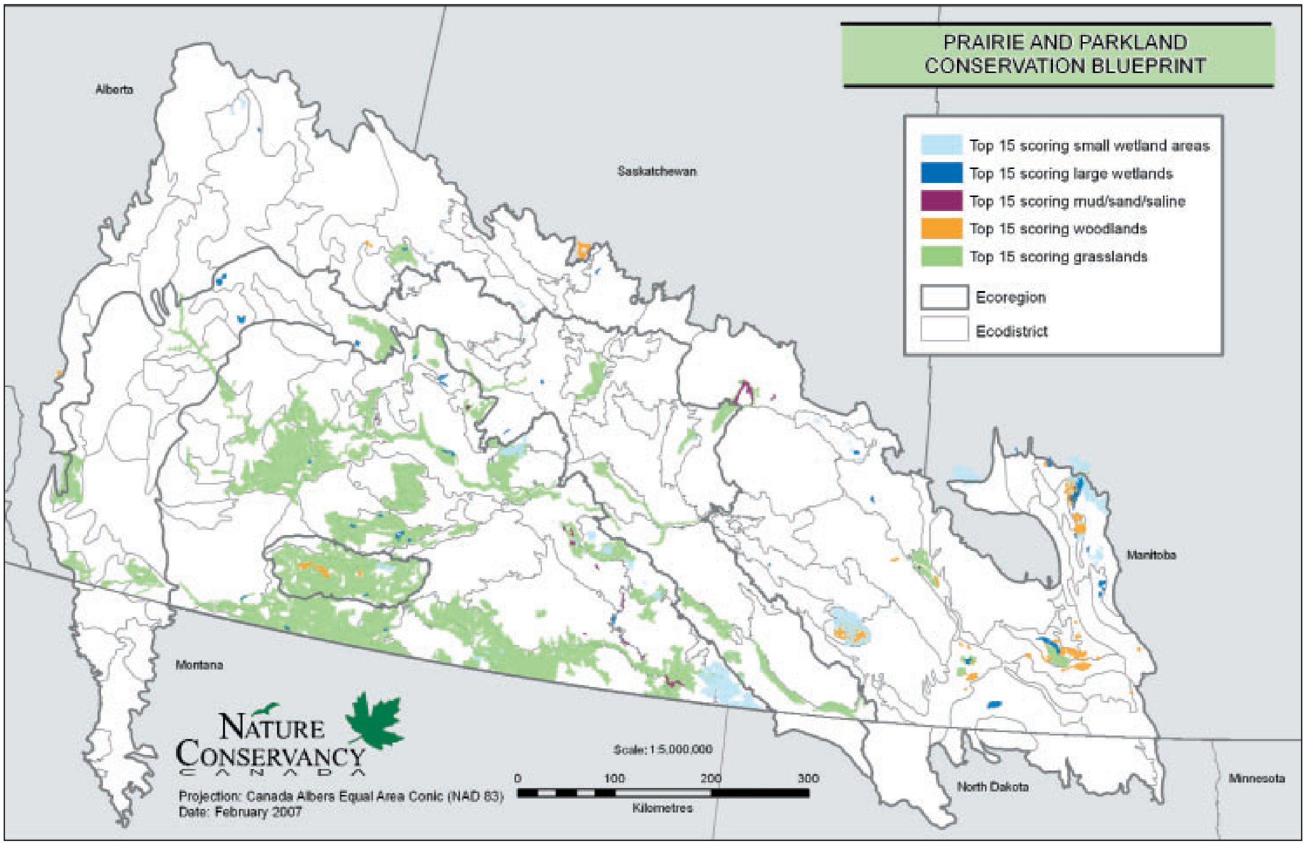


Figure 26. "Top fifteen" scoring general ecological system types within the Canadian portion of the study area

Concentrations of Fine-filter Targets

A data set of all known current occurrences of thirty primary species targets was used to positively score the ecological system polygons in which they occurred, as well as to assess existing protected areas and to ensure that minimum levels of inclusion of these targets were achieved in the final blueprint portfolio (Table 4.1a).

A data set of the known current occurrences of other targets included secondary targets (Table 4.1b) and other features of conservation concern, such as other species tracked by CDCs that had S1-S3 ranks or were COSEWIC-listed, documented migratory bird concentration sites and snake hibernacula (Table 4.1c). These occurrences also contributed scores to polygons.

Collectively, the occurrences of all of these species and features is portrayed on Figure 27. There is some unevenness in survey intensity between jurisdictions but the overall coverage is strong.

The distribution of these targets across the region can be illustrated in a variety of ways.

- The density of all target occurrences by ecodistrict across the study area (Fig. 28). This illustrates the importance of the Mixed Grassland ecoregion, the eastern slopes and key eastern river valleys to rare species conservation.
- The density of all target occurrences by ecodistrict within each ecoregion (Fig. 29). The pattern here is that more southern ecodistricts within each ecoregion are particularly important for rare species.
- The density of all target occurrences by ecodistrict within each province or state jurisdiction (Fig. 30). Again, as above, the Mixed Grassland ecoregion, the eastern slopes and key eastern river valleys are particularly important to rare species conservation.

Again, each of these illustrates a different approach to overall regional context, which can be useful in identifying priority landscapes for conservation action.

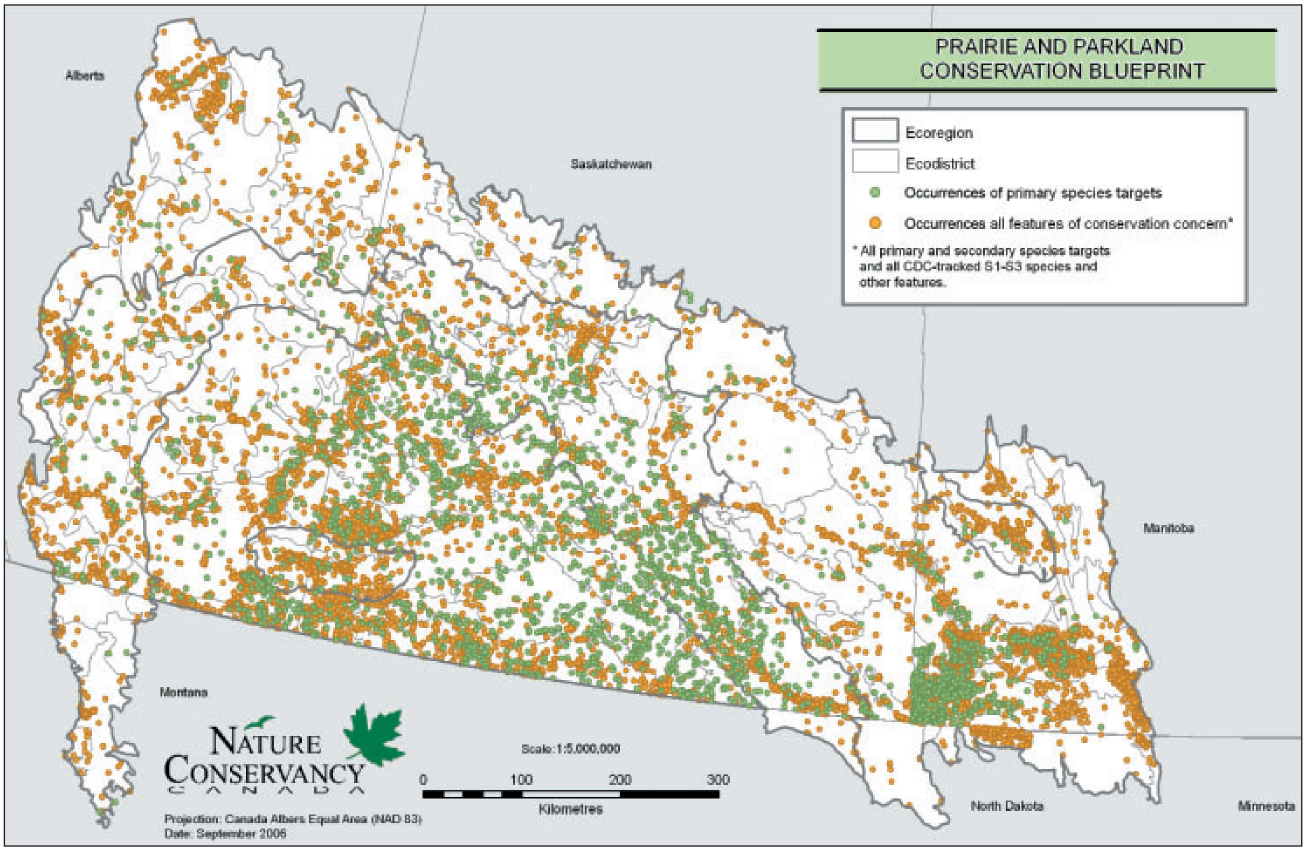


Figure 27. Occurrences of all features of conservation concern and target species

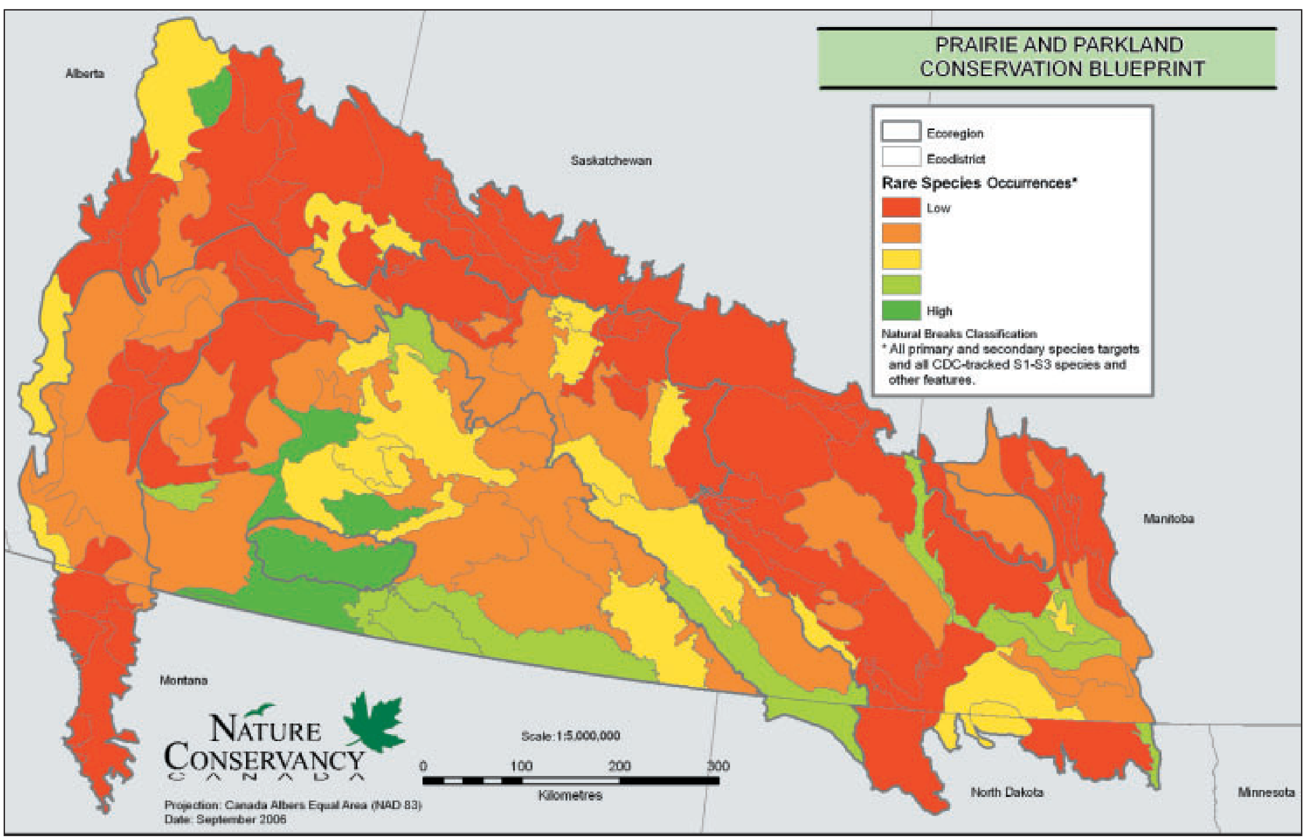


Figure 28. Density of all features of conservation concern and target species, by ecodistricts across the study area

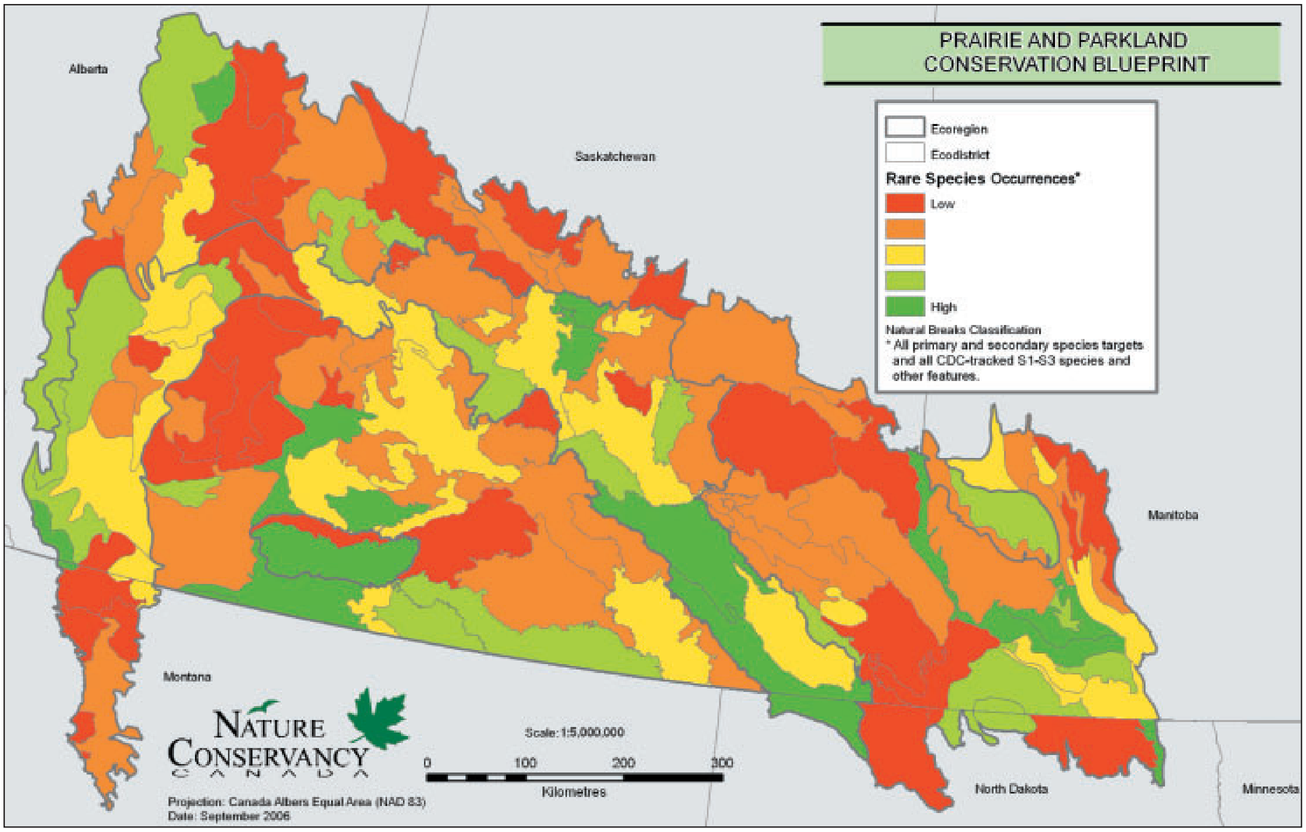


Figure 29. Density of all features of conservation concern and target species, by ecodistrict within each ecoregion

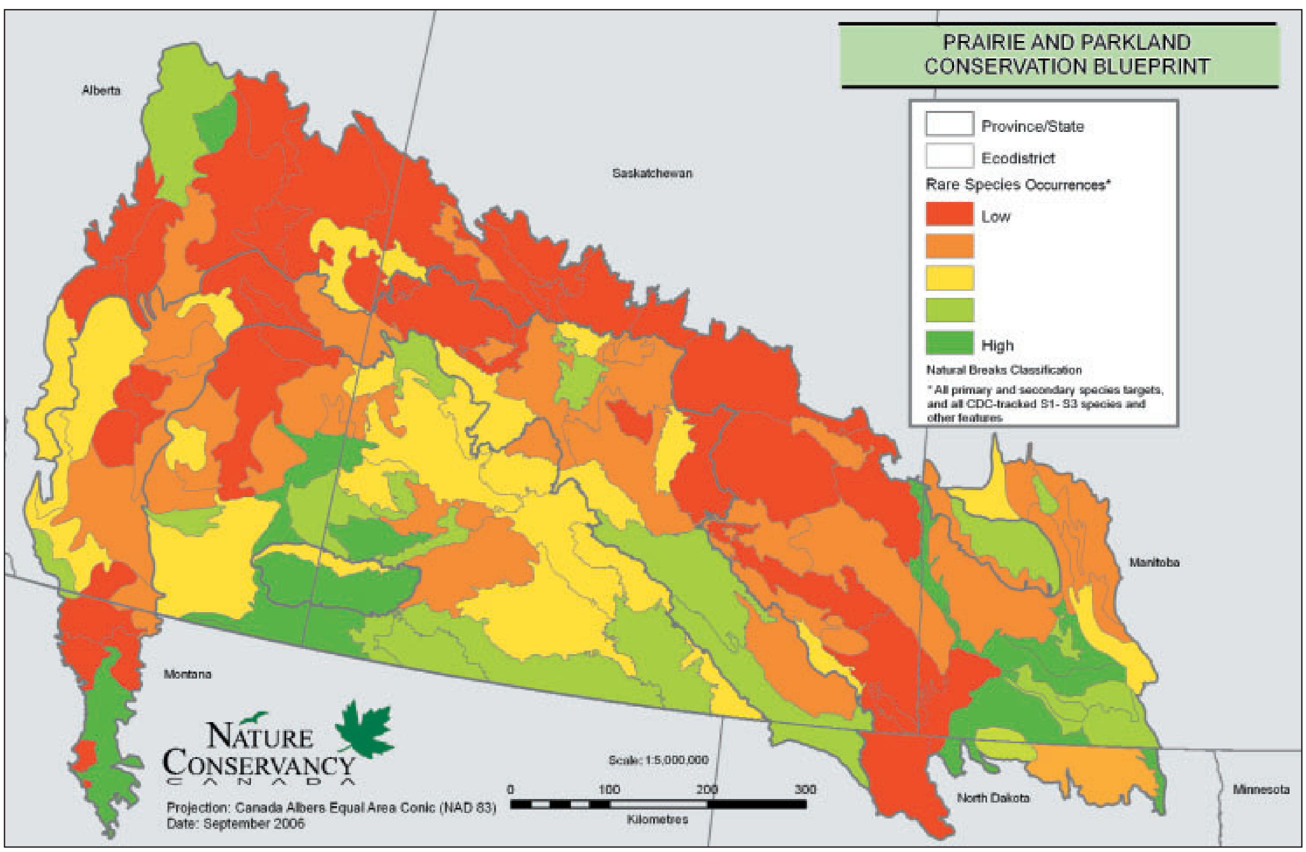


Figure 30. Density of all features of conservation concern and target species, by ecodistrict, within each provincial or state jurisdiction

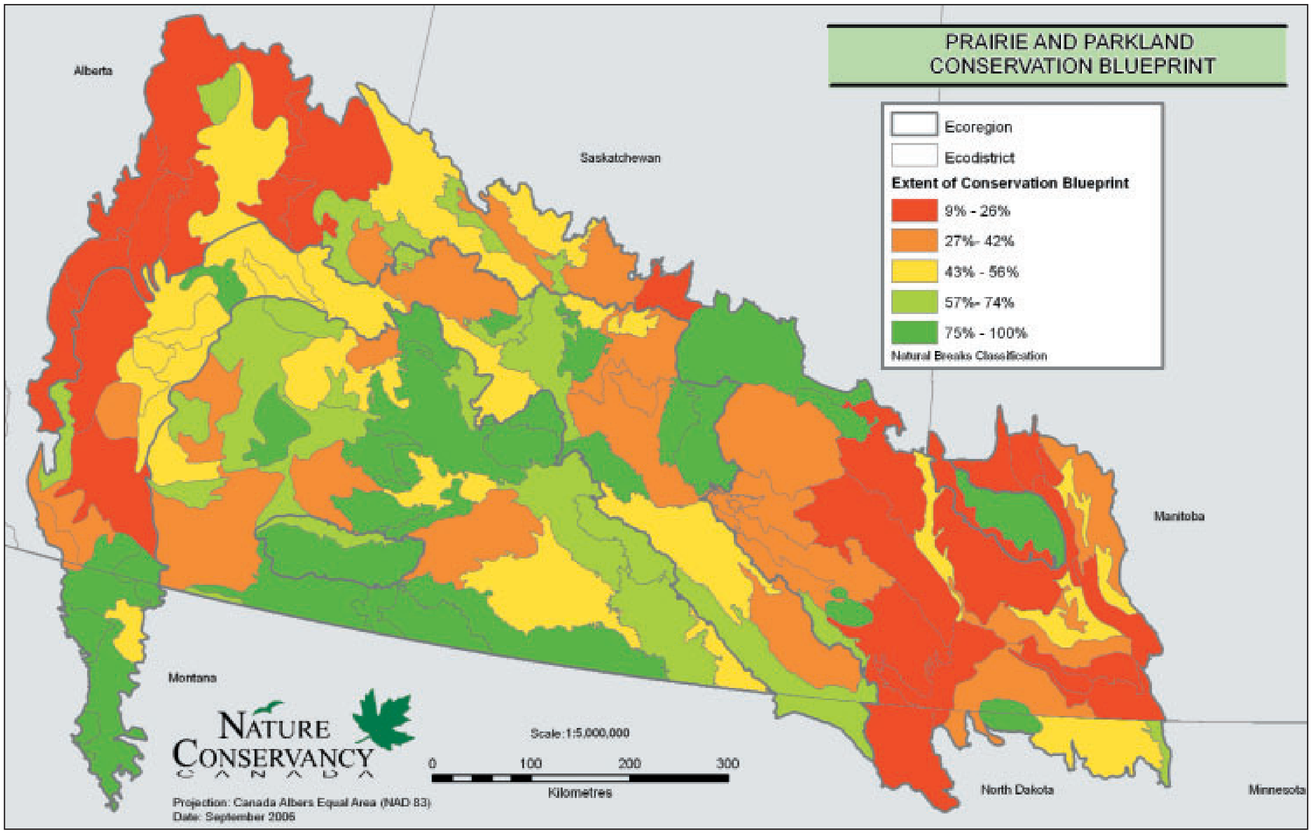


Figure 31. Core biodiversity conservation areas identified by the blueprint, including existing protected areas and other conservation lands, by ecodistrict across the study area

Core Biodiversity Conservation Lands

This study of Canada's prairies and parklands documents particular lands and waters in each ecodistrict where the highest and best use may be conservation, based on the methods used.

These core biodiversity conservation areas are illustrated in a series of tile maps for the entire study area (Appendix D). The blueprint portfolio is also mapped as the percentage of each ecodistrict in the region (Fig. 31, Table 5.2). It is also illustrated as the total percent of the land base recommended for recognition as core biodiversity conservation lands over and above the existing network of protected areas and conservation lands (Fig. 32). These results vary significantly from ecodistrict to ecodistrict (Table 5.2).

Aspen Parkland: There is a set of ecodistricts that have less than 16% natural cover remaining, none of them with more than 2% of the land base as protected area or conservation land (PA/CL), for which the blueprint recommends between 1% and 8% of lands be conserved.

These ecodistricts are:

Leduc	Andrew
Vermilion	Daysland
Red Deer	Sedgewick
Olds	Moose Mountain Upland
Black Prairie	Northern Black Prairie

Agricultural cropland has been long identified as the highest and best land use for these ecodistricts.

Another set of ecodistricts, however, have more than 50% natural cover remaining, and have PA/CL lands covering from 1% to 26% of their land bases. For these ecodistricts, the blueprint recommends total core biodiversity conservation lands of from 9% to 58%.

These are:

Lower Battle River Plain	Edgerton-Ribstone Plain
Whitesand Plain	Black Diamond
St. Lazare Plain	Shilo
Dauphin	Alonsa,
Ste. Rose	Turtle Mountains

These are key ecodistricts for the conservation of Aspen Parkland biodiversity.

Moist Mixed Grassland: For this ecoregion, there is another set of ecodistricts that have less than 16% natural cover remaining. Only one of these has more than 2% of the land base as protected area or conservation land (PA/CL), and it has only 4%. For these the Blueprint recommends between 2% and 10% of lands be conserved. These ecodistricts are:

Castor	Estow Plain
Rosetown Plain	Drumheller
Arm River Plain	Strasbourg Plain
Standard Plain	Vulcan Plain
Regina Plain	Griffin Plain.

Agricultural cropland has long been identified as the highest and best land use for these ecodistricts.

Another set of ecodistricts have more than 50% natural cover remaining, and have PA/CL lands covering from 0% to 36% of their land bases. For these ecodistricts, the blueprint recommends total core biodiversity conservation lands of from 26% to 91%.

These are:

Moosewood Sand Hills	Biggar Plain
Milk River Upland	Willow Creek Upland
Twin Butte	Del Bonita Plateau
Foothill Grassland	Rocky Mountain Front 1, 2, 3
North Central Brown Glaciated Plains	

These are key ecodistricts for the conservation of Moist Mixed Grassland biodiversity.

Mixed Grassland: This ecoregion includes no ecodistricts with less than 16% natural cover remaining. A number have between 19% and 25% remaining natural cover, and these ecodistricts all have less than 10% of the land base as protected area or conservation land (PA/CL), except one with 12%. For these the blueprint recommends between 6% and 18% of lands be conserved.

These ecodistricts are:

Sibbald Plain	Eston Plain
Coteau Hills	Acadia Plain
Hazlet Plain	Antelope Creek Plain
Swift Current Plateau	Wood River Plain
Lake Alma Upland	

Another set of ecodistricts have more than 2/3 of their land base remaining in natural cover, and these have PA/CL lands covering from 2% to 77% of their land bases. For these ecodistricts, the blueprint recommends total core biodiversity conservation lands of from 41% to 89%.

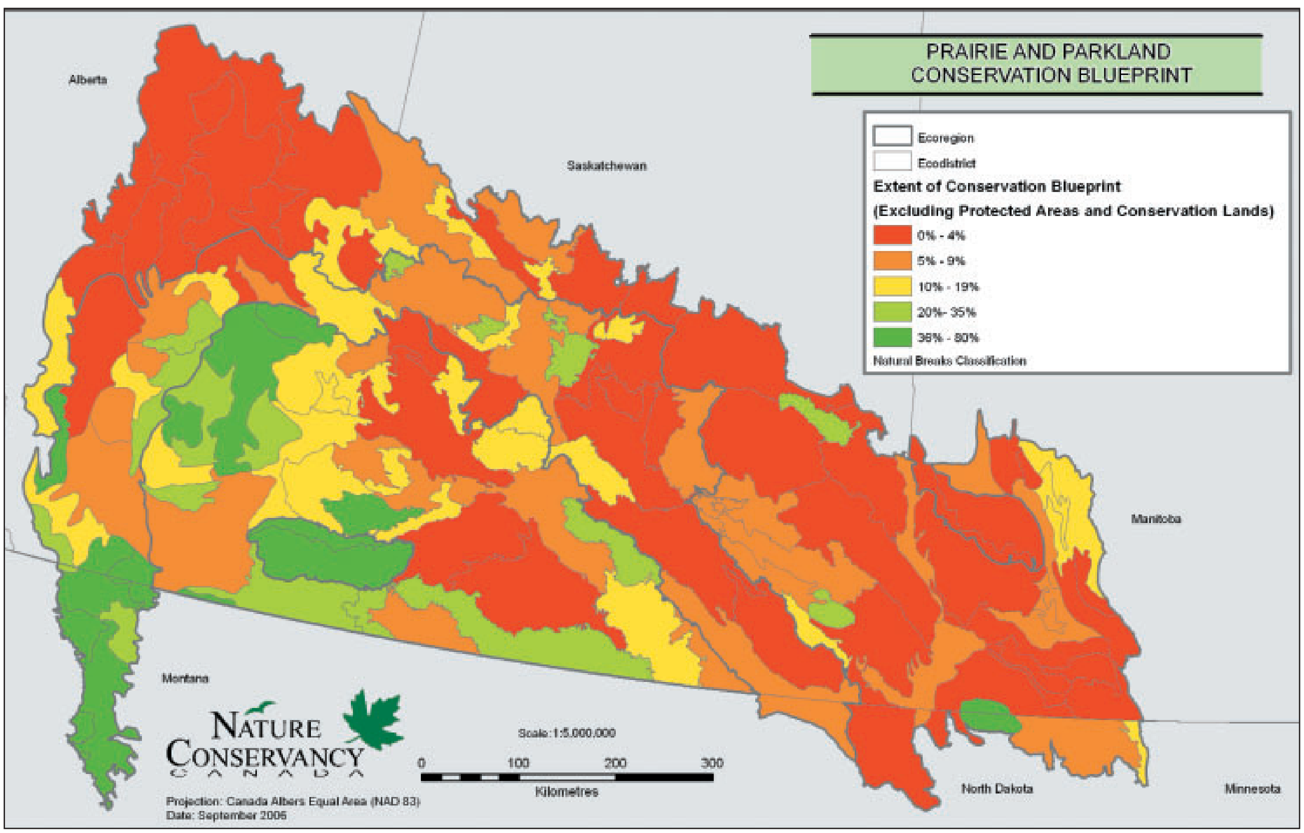


Figure 32. Conservation lands identified by the blueprint that are in addition to existing protected areas and other conservation lands, by ecodistrict across the study area

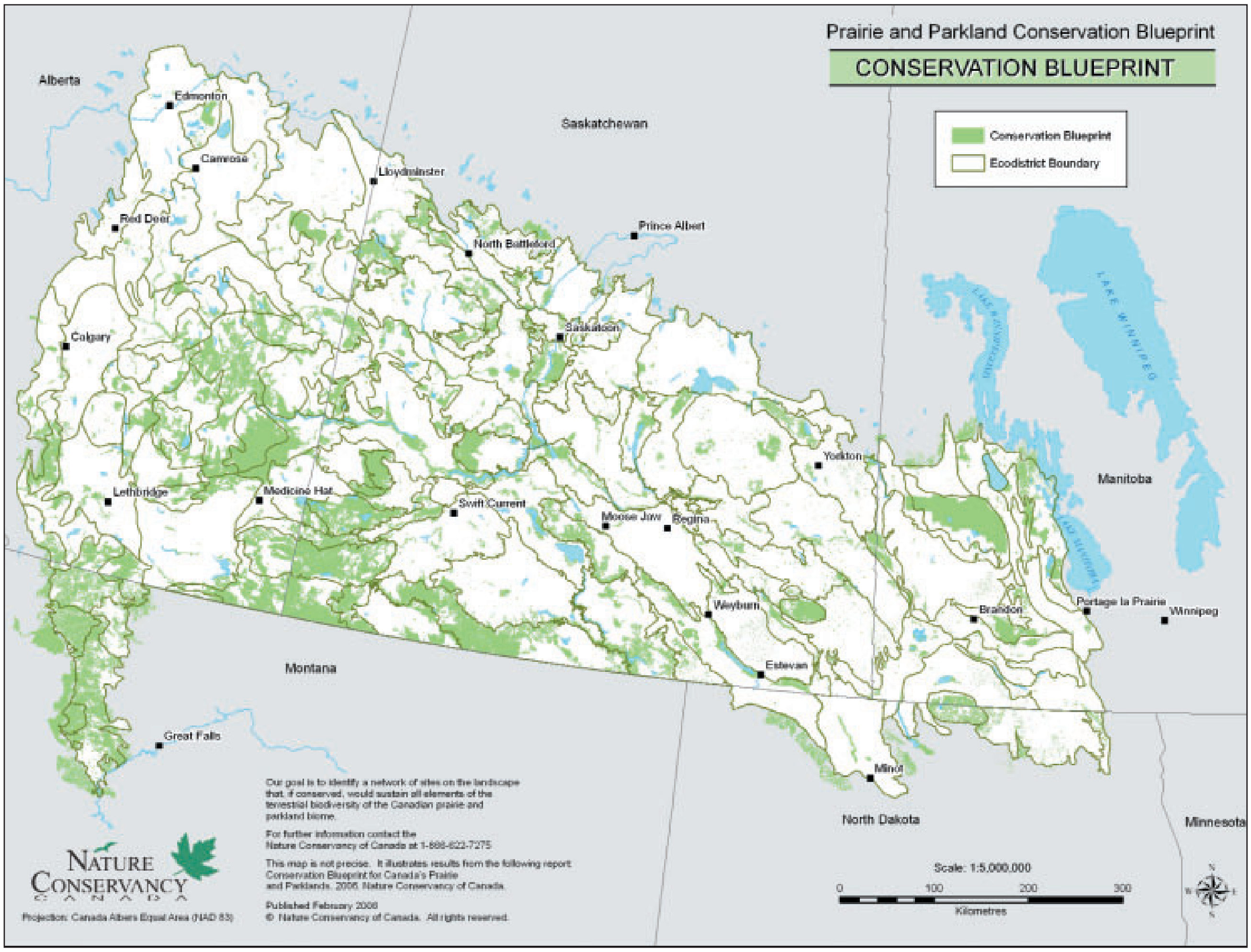


Figure 33. Conservation blueprint for the prairie and parkland ecoregions

These ecodistricts are:

Berry Creek Plain	Rainy Hills Upland
Bindloss Plain	Great Sand Hills
Maple Creek Plain	Wood Mountain Plateau
Wild Horse Plain	Old Man on His Back Plateau
Sweetgrass	

These are key ecodistricts for the conservation of Mixed Grassland biodiversity.

Cypress Upland and Boreal Transition: Both of the other two areas in the study area, the Cypress Upland (two ecodistricts) and the Boreal Transition (two ecodistricts) uniformly have high levels of remaining natural cover (50% or more), with highly variable levels of PA/CL lands (3% to 63%), for which the blueprint suggests the need for from 8% to 65% of the lands in conservation.

In Figure 32, the summary data in Table 5.2 are mapped to communicate the recommended percent of additional lands that deserve overt conservation stewardship, in addition to existing PA/CL, as lands for which the highest and best use is conservation, based on the methods used in this analysis.

The conservation needs of prairie and parkland ecodistricts vary greatly across the study area but the blueprint results particularly emphasize the extraordinary conservation needs of the western and southern portions of the region (Fig. 33). Moving these lands into overt commitments to conservation, through mechanisms ranging from appropriate commitments of public-land management, to landowner agreements, easements and fee-simple securement of key lands, is the regional priority.

How and where to set priorities for conservation action are the questions that need to be additionally tackled, using these types of data to support informed decisions.

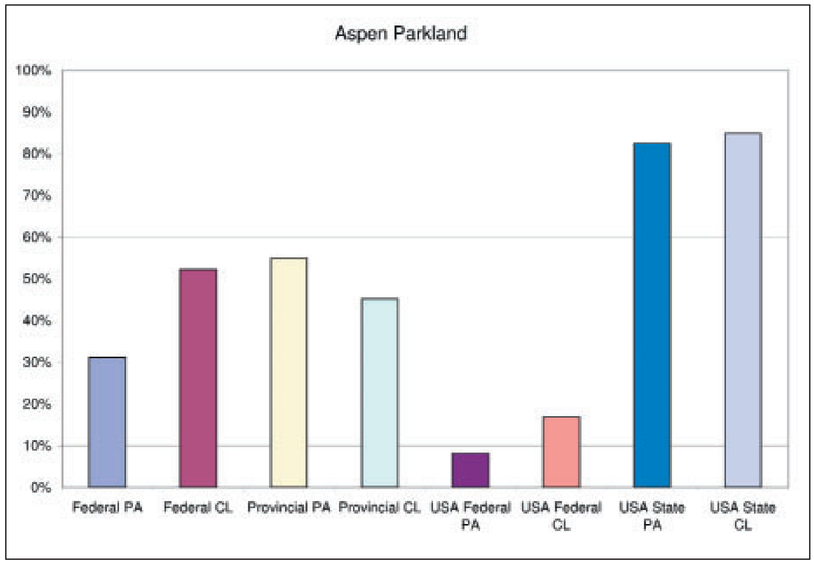
Blueprint Conservation by Public Agencies – Ecological Systems

The scoring of the top two ecological systems in each ecodistrict resulted in the mapping of many systems that already occur on existing protected areas (PA) and other conservation lands (CL) (Fig. 34-38).

In Canada, federal protected areas are small, 515,016ha. Of these, top-scoring ecological systems make up 30% of federal PA on the **Aspen Parkland,** 45% on the **Moist Mixed Grassland**, and 70% on the **Mixed Grassland.** Provincial protected areas rank even higher in their inclusion rates for top-scoring ecological systems but, again, the extent of such areas is modest (391,081ha).

More than 2/3 of conserved lands in the region are not regulated as protected areas but have indirect mandates for conservation. Their extent makes them extremely important (federal CL 1,111,902ha; provincial CL 1,297,798ha). Top-scoring ecological systems make up >50% of federal CLs on the **Aspen Parkland**, >70% on the **Moist Mixed Grassland**, and >80% on the **Mixed Grassland**. Provincial conservation lands also have high inclusion rates for top-scoring ecological systems: >45% of provincial CLs on the **Aspen Parkland**, >60% on the **Moist Mixed Grassland,** >75% on the **Mixed Grassland**, and over 85% on the **Cypress Upland**.

Existing protected areas and, even more so, other conservation lands such as community pastures, national defence lands and Saskatchewan lease lands under the Wildlife Habitat Protection Act make extremely important contributions to the conservation of prairie and parkland biodiversity, and their role in biodiversity conservation should be even more strongly mandated than is currently the case.



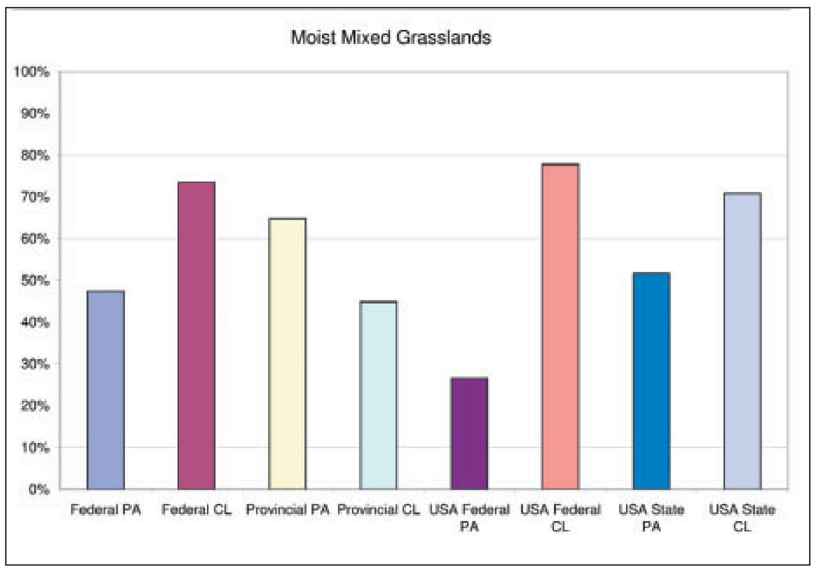


Figure 34. Percent of area by land type that represents top-scoring systems within the *Aspen Parkland*

Figure 35. Percent of area of land type that is a top-scoring ecological system in the *Moist Mixed Grassland*

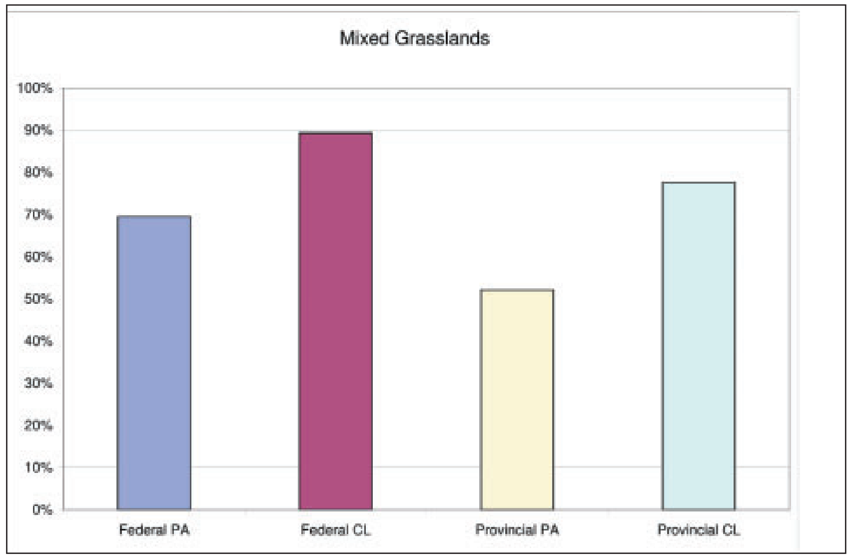


Figure 36. Percent of area of land type that is a top-scoring ecological system in the *Mixed Grassland*

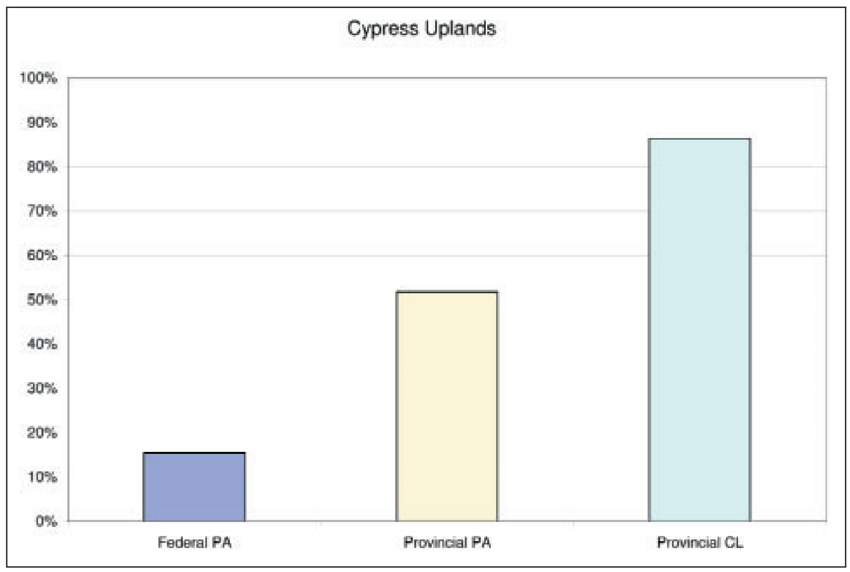


Figure 37. Percent of area of land type that is a top-scoring ecological system in the *Cypress Upland*

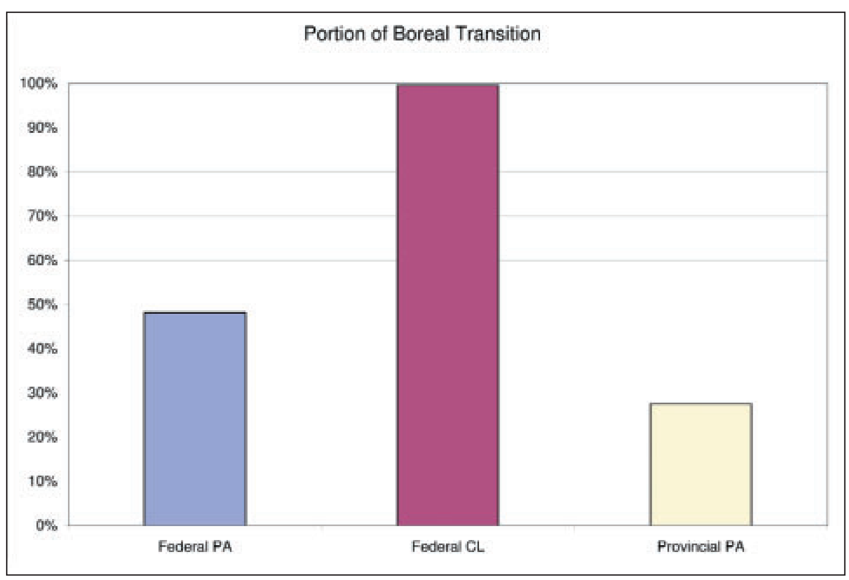


Figure 38. Percent of area of land type that is a top-scoring ecological system in the *Boreal Transition*

Blueprint Conservation by Others – Ecological Systems

The scoring of the top two ecological systems in each ecodistrict also documented the extraordinary role that non-agency lands, the vast majority being privately owned, play in the current conservation of prairie and parkland biodiversity (Fig. 39-43). These range from >70% on the **Aspen Parkland**, >83% on the **Moist Mixed Grassland,** >60% on the **Mixed Grassland**, and over 79% on the **Cypress Upland**.

These lands not only conserve high-quality natural communities and biological diversity, but also provide important environmental goods and services across their local landscapes and beyond. The ecological services provided by these lands are critical to the future sustainability of these highly converted landscapes and should be recognized by society for the critical role that they play.

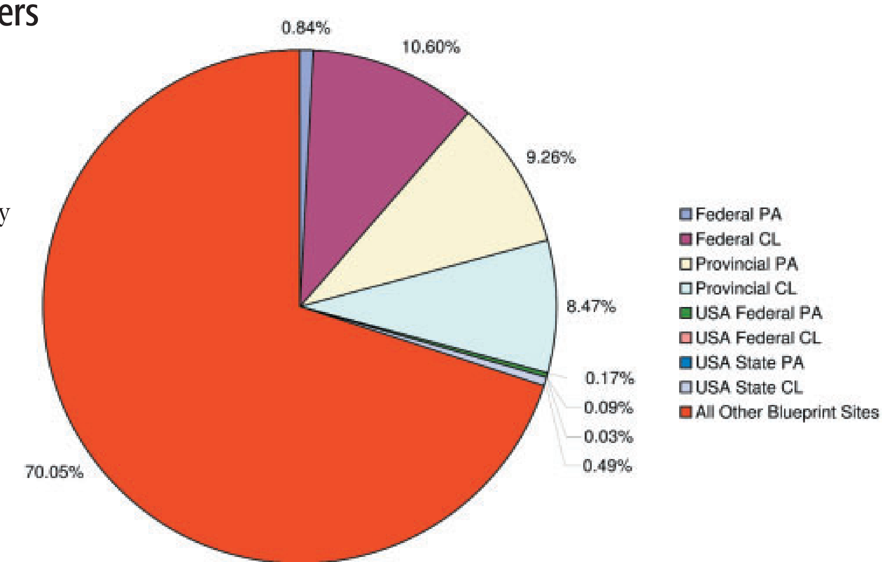


Figure 39. Distribution of top ecological systems in the *Aspen Parkland*

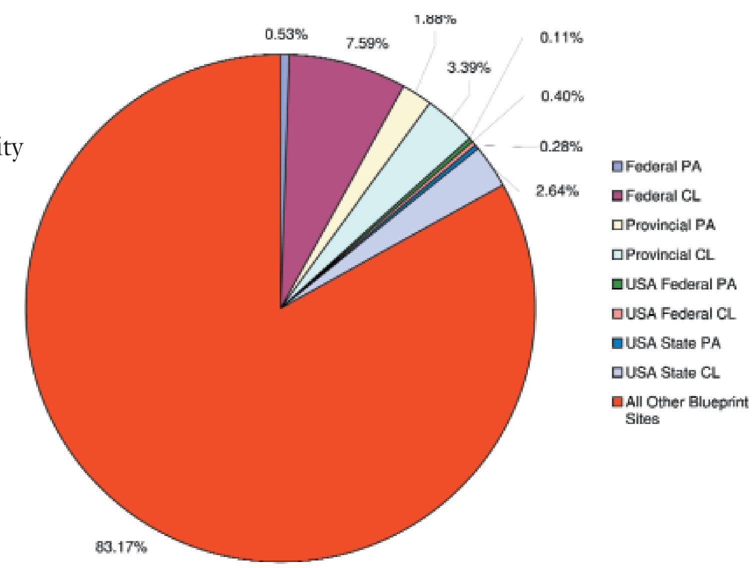


Figure 40. Distribution of top ecological systems in the *Moist Mixed Grassland*

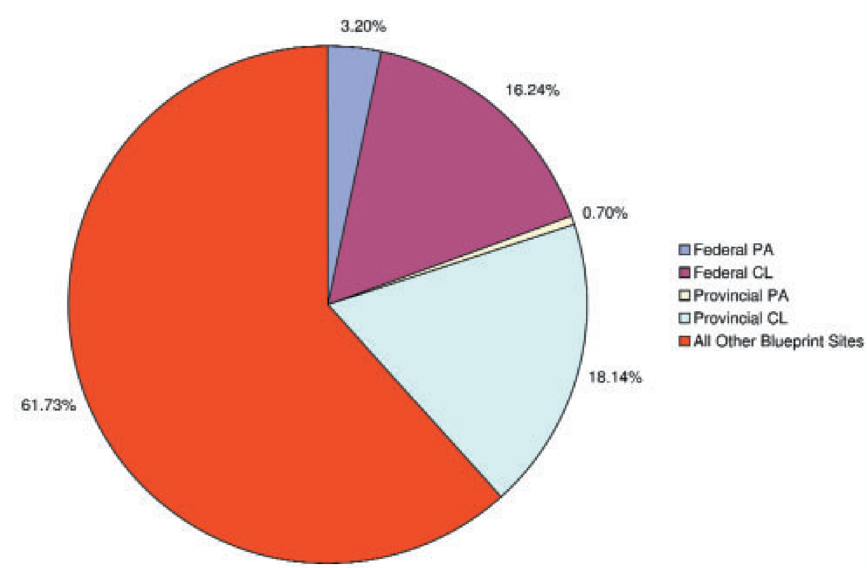


Figure 41. Distribution of top ecological systems in the *Mixed Grassland*

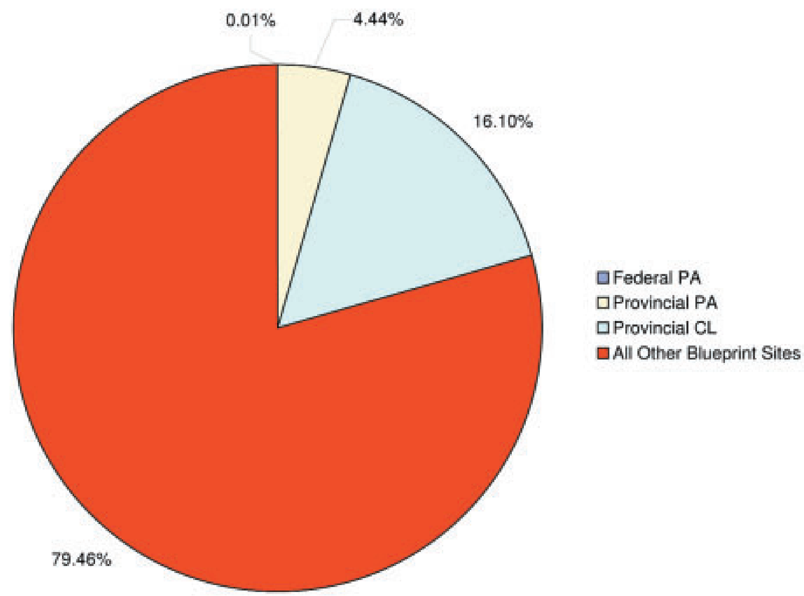


Figure 42. Distribution of top ecological systems in the *Cypress Upland*

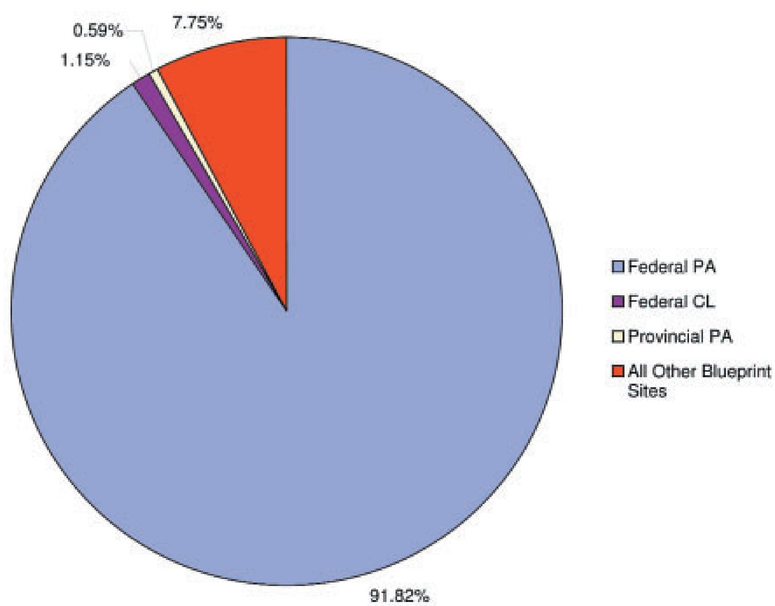


Figure 43. Distribution of top ecological systems in the *Boreal Transition*

Blueprint Conservation by Public Agencies– Fine-filter Target Species

The occurrence of fine-filter target species can be used as a measure of the conservation success of existing regulated protected areas (PA) and other unregulated conservation lands (CL). Surveys for such rarities are more frequent on public and agency lands than on private lands of the region and, hence there may be a bias in the data towards public lands.

Several types of protected areas (PL) and conservation lands(CL) are considered in this study, and their importance to the study's primary target species is graphed below (Fig. 44-48). The appropriate management of federal and provincial protected areas and conservation lands is clearly critical to the long-term persistence of these imperilled species across the whole region (Fig. 49).

Figure 44. Percent of area by land type that provides habitat for primary targets in the *Aspen Parkland*

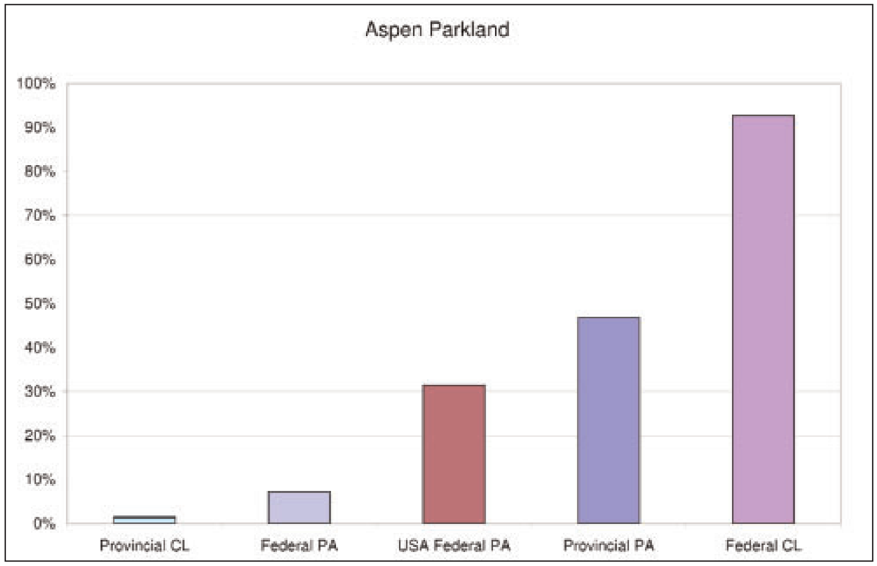


Figure 45. Percent of area by land type that provides habitat for primary targets in the *Moist Mixed Grassland*

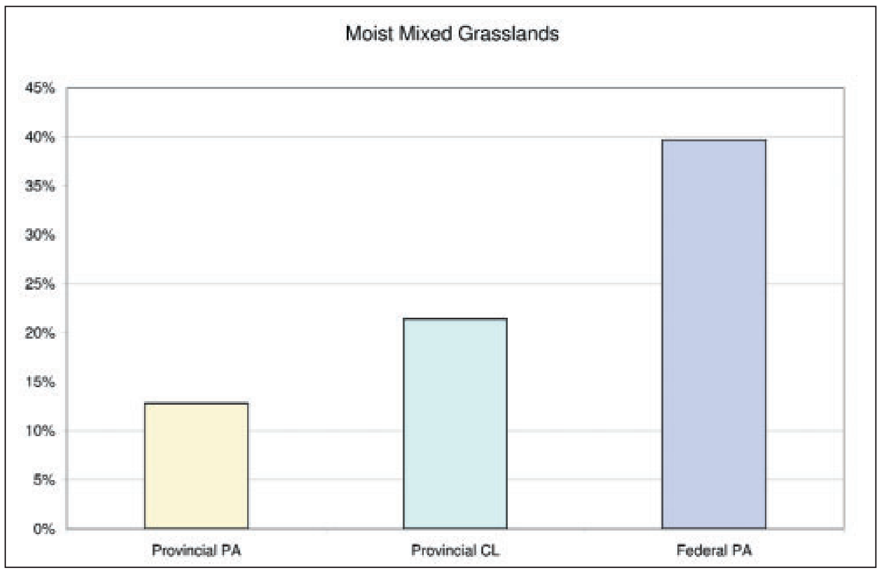


Figure 46. Percent of area by land type provides habitat for primary targets in the *Mixed Grassland*

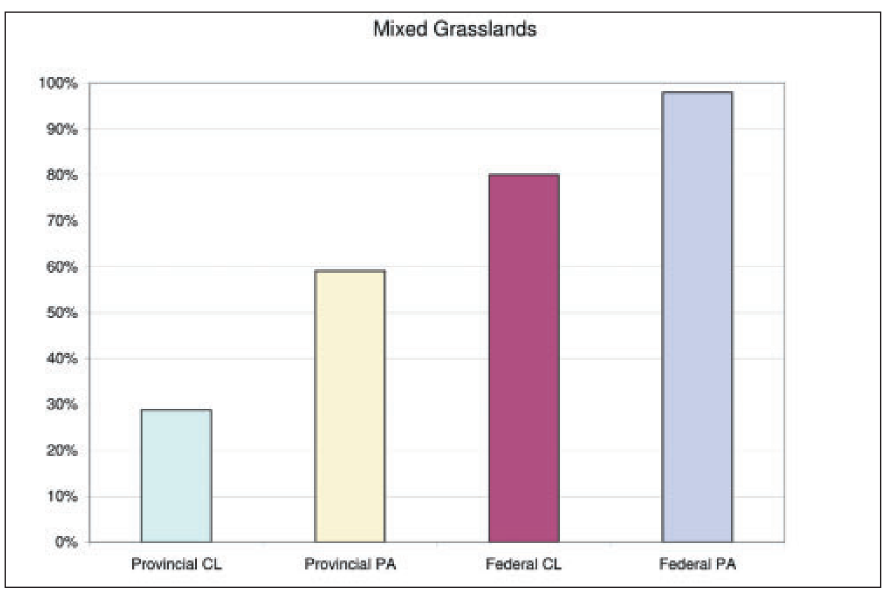


Figure 47. Percent of area by land type that provides habitat for primary targets in the *Cypress Upland*

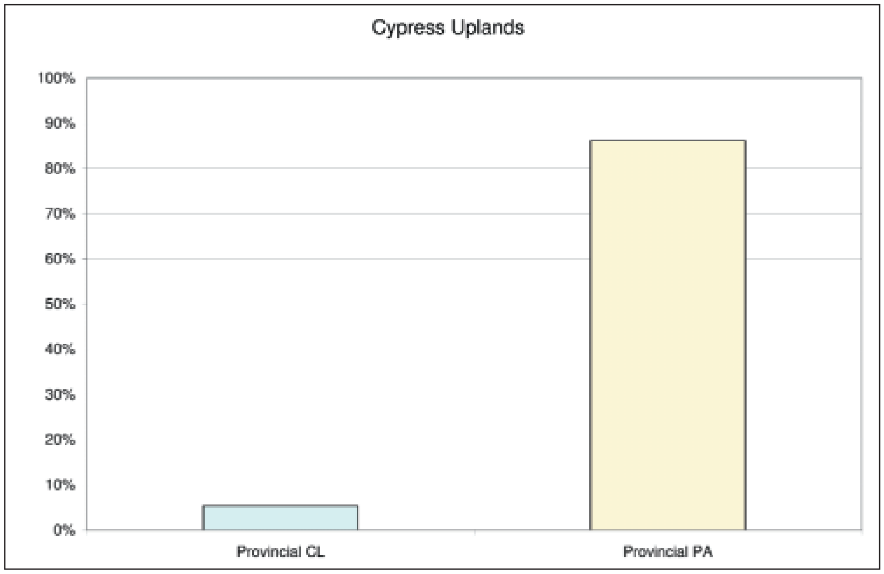


Figure 48. Percent of area by land type that provides habitat for primary targets in the *Boreal Transition*

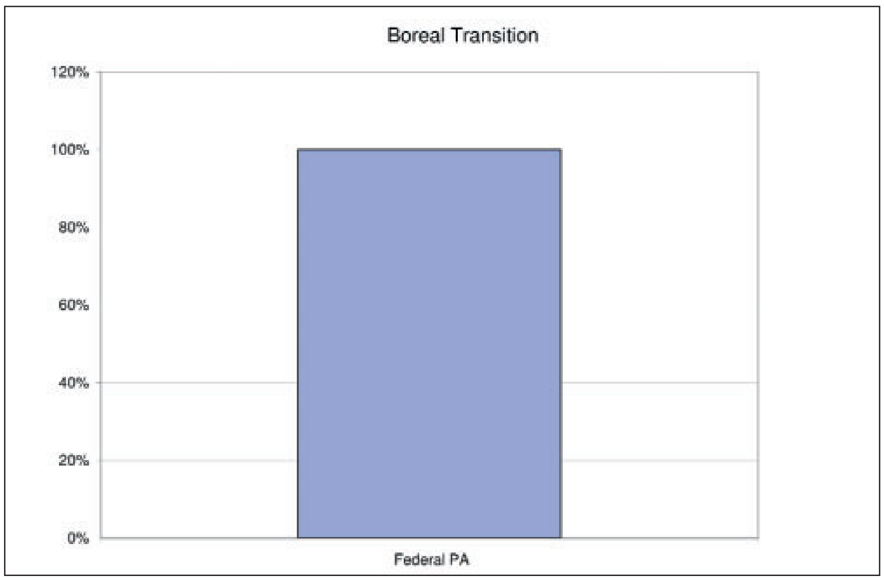
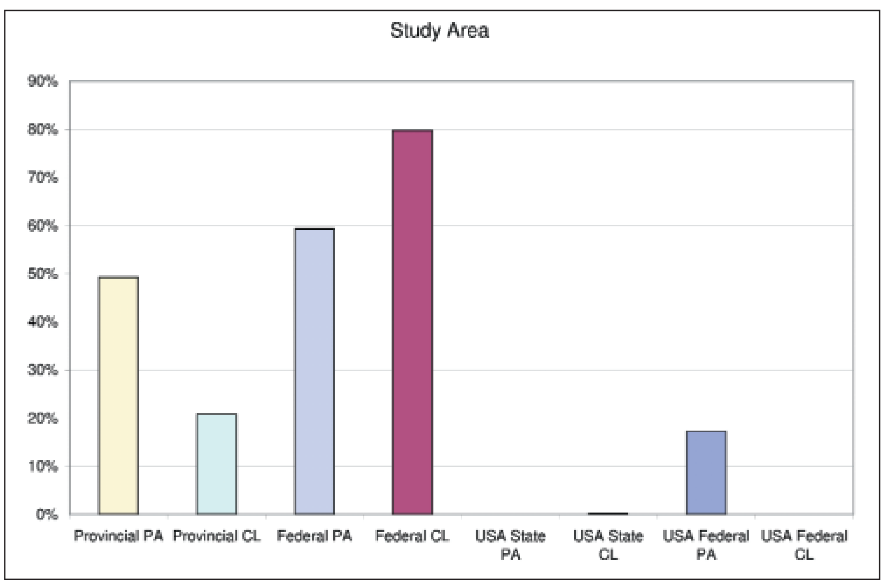


Figure 49. Percent of area by land type that provides habitat for primary targets in the entire study area



Discussion and Applications

It remains a worthwhile and achievable goal to assemble region-wide data sets that can support region-wide assessments of our collective achievements and needs with regard to biodiversity conservation. This first-iteration attempt is an encouragement to others to continue to partner in this task, and to consider an even more deliberate organization of collective conservation planning across the region.

To this end, priorities need to be set for developing region-wide classifications and mapping of native habitats and vegetation, of surficial geology and landform, of ecological systems, and of conservation targets. The degree to which such efforts can have seamless, region-wide digital layers as a goal, is the degree to which effective conservation planning can occur. Without these tools, the measurement of targets, goals and achievements will be weak, which can undermine or misdirect conservation efforts.

Target Viability

The collective conservation goal is to conserve viable examples of all conservation targets, appropriately distributed across each ecoregion in sufficient quantity to sustain the ecoregion's biological diversity over the next century.

Although it is difficult to assess the long-term viability of occurrences of conservation targets on a landscape, nevertheless an attempt was made through proxy and surrogate measures. For example, species occurrences were included where it was considered they have a good chance of surviving more than 10 years. The viability of ecological systems (coarse-filter targets) was measured by assigning surrogate scores that suggest a higher probability of persistence on the landscape. The long-term survival of an ecological system at a site may be more probable than the persistence of a fine-filter target. Fine-filter viability often depends on a number of variables, some of which may not be directly linked to a fine-filter target occurrence. For example a bird's nest and foraging habitats may differ, and conserving a site with good nest sites in an area of poor foraging may eventually result in loss of breeding from that particular site.

The blueprint optimizes the design of a remnant natural-area system that will support the targets that were identified. The appropriate recognition and conservation of those targets at the locations identified by the blueprint (at a minimum) would contribute significantly to the long-term persistence of those targets and the overall biological diversity of the region.

The blueprint suggests a suite of sites with conservation potential. All of them deserve site visits and validation. Conservation activities should focus on long-term target viability. Securement should be focused on sites with a high probability of long-term survival (as identified through the blueprint as well as verified through field and expert validation). Stewardship activities should, in the same way, focus on maintaining or increasing the suitability of a site for the targeted ecological systems or species that depend on that site for their survival.

Applications

Conservation ecology is an evolving field, and assessments such as this reflect the best available data and knowledge at the time of analysis. The blueprint's data model is thought of as iterative, whereby new information can be incorporated into the model, and can be used to generate new results.

The blueprint's data model is designed so that particular targets or areas, or groups of targets or ecodistricts can be isolated and queried as required by staff and partners. This permits the data base and mapping to be considered a tool that can be directed at a range of useful purposes. The key purpose to which NCC will apply the tool is to the identification and validation of **priority conservation landscapes** across the region, some of which should become conservation action sites for NCC and its partners.

To our knowledge, there are no region-wide tools to assess the present achievements of public agencies or private-sector groups in conserving the biological diversity of the Canadian prairies and parklands. Without such metrics properly applied across the region as a whole, there is little chance of recognizing the overall success of which has occurred or of assessing the gaps in success that deserve our collective conservation attention. The blueprint is a modest contribution towards this end.

Finally, as society comes to terms with the recognition of the important ecological services provided by our remaining natural landscapes, region-wide assessments of the comparative values of different areas will become more and more important. It has been demonstrated that ecoregional biodiversity assessments such as this do, in fact, serve as highly efficient assessments of ecological services as well (Chan *et al.* 2006).

Glossary

This glossary attempts to aid the reader of this document understand the terminology. There are many words in everyday speech that have special meanings in ecology and conservation biology. In addition, words from other disciplines such as portfolio are used to help portray the ideas of modern conservation biology. The definitions provided are intended to aid the reader in understanding this planning process.

Adaptive Management – Is based on the premise that managed natural systems are complex and unpredictable. Adaptive management is a type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policies, strategies, and practices.

Area Sensitive – Refers to species that have minimum habitat size requirements for survival.

Aspen Parkland – A transitional ecoregion between the boreal forest to the north and the grasslands to the south. It is a patchy habitat matrix composed of clusters of grassland and deciduous trees (Bird 1961). Some consider the entire ecoregion an ecotone, while others contest that an ecotone exists at each grassland/forest interface.

Biodiversity – Biological diversity is the variety of different species, the genetic variability of each species, and the variety of different ecosystems that they form, and their composition, structure and ecological function.

Biodiversity targets – Species, vegetation communities, or ecological systems considered important to the conservation of the biological diversity and natural heritage of their ecoregions (Riley *et al.* 2004).

Biome – A regional grouping of ecosystems as a grassland, desert, or tropical rainforest. Biomes are characterized by consistent plant forms and are found over a large climatic area. For example the prairie and parkland biome includes grassland and parkland species, vegetation communities, and ecological systems. (Synonymous with *ecozone,* ESWG 1995).

Chernozem soils – Type of deep A-horizon soil that develops under grassland.

Coarse-filter/fine-filter approach– A method designed to analyze the landscape for the best examples of ecological systems (coarse-filter targets). These sites are then assessed in terms of the fine-filter targets that they conserve. Where representation gaps exist for fine-filter targets additional sites are selected to fill these gaps.

Coarse-filter biodiversity targets – The derived ecological system conservation targets. In fragmented landscapes such as the Aspen Parkland, the best examples of each ecological system are selected for inclusion in the conservation blueprint. By conserving representative examples of each ecological system type, the majority of the native biodiversity is also conserved. See also *fine-filter targets.*

Condition – The current state of an ecosystem. Used as a measure of ecosystem 'health'. In a conservation blueprint a measure of condition allows for comparison among sites (ecological systems) and a means by which to rank and select the 'best' examples of a particular ecological system type. See also *viability.*

Conservation Blueprint – (synonyms *ecoregional assessment; ecoregional plan*) — a plan that identifies conservation targets, sets goals for those targets, and identifies a portfolio of sites that if conserved will allow for the long-term survival of all native species, habitats, and ecological systems within the ecoregion (Groves 2003; Riley *et al.* 2004)

Conservation Goals – In this case, explicit quantitative goals for measuring the rate of inclusion of a biodiversity target in the blueprint.

Conservation Lands – Includes all lands managed or used in such a manner they have from neutral to positive benefits to the native wildlife and vegetation communities. For example pastures are managed primarily for livestock grazing; however grazing is a natural ecological process that creates patchiness and small disturbances on the landscape, which in turn creates the required habitat for many different individual species. See also *protected areas.*

COSEWIC, COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA: ASSIGNS THE FOLLOWING STATUS TO SPECIES:

Status	Description
Extinct (X)	A wildlife species that no longer exists
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats
Not At Risk (NAR)	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Critical habitat – The habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species (SARA Public Registry).

Crosswalk – In conservation science, cross-walking is the process of matching different classification systems of similar features into broader 'seamless' or universal classifications. For example one land cover classification may define 3 wetland types while the land cover classification for a neighbouring jurisdiction only defines 2 types. In this case each of the 3 wetland types would be best matched to the 2 (*i.e.,* common denominator) resulting in a cross-walked classification. Conversely, new classes may be created to meet the needs of the classification project.

Crown land – In Canada, public land managed by either the provincial or federal government. In the prairie ecoregions much of this land is leased for agriculture (grazing and crop production).

Declining Species – Species that exhibit significant, long-term declines in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioural requirements that expose them to a great risk.

Disjunct Distribution – Species that have populations that are found a significant distance from their primary range.

Disturbance – In community ecology, an event that removes organisms and opens up space which can be filled or recolonized by individuals of the same or different species.

Ecodistrict – A subdivision of an ecoregion characterized by distinctive assemblages of relief, landforms, geology, soil, vegetation, water bodies, and fauna (Marshall and Schut, 1999).

Ecological Systems – As used here, unique combinations of landforms (surficial geology) and land cover (dominant vegetation type) that can be mapped and used as units by which to measure representation of coarse filter targets.

Ecological Systems Polygon – A distinct spatial feature derived from the features in the ecological systems layer and which may represent a remnant of a continuous ecological system (terrestrial) or may represent small distinct ecological systems such as wetlands or wetland complexes.

Ecological Integrity – A condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes.

Ecological Reserves – Examples of functioning ecosystems protected for scientific research, education and heritage appreciation. Road access and facilities are not developed in Ecological Reserves (GOA 2003).

Ecoregion – The second subdivision of an ecozone characterized by distinctive regional ecological factors, including climate, physiography, vegetation, soil, water, and fauna (Marshall and Schut 1999).

Ecoregional assessment, ecoregional plan. See also *conservation blueprint*

Ecosystem – A dynamic spatial assemblage (functional unit) consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical (*e.g.*, elevation) and chemical factors (*e.g.*, soils, geology) of their environment, linked together through similar ecological processes (*e.g.*, fire) for nutrient cycling and energy flow. An ecosystem can be of any size-a log, pond, field, forest, or the earth's biosphere — that functions as a whole unit in some manner. Ecosystems are commonly described according to the major type of vegetation (*e.g.*, grassland ecosystem).

Ecotone – A transition zone between two distinct habitats, vegetation communities, or ecoregions that contains species from each area, as well as organisms unique to it.

Element Occurrence (EO) – An area of land and or water where a species or vegetation community is or was present (NatureServe 2002)

Endemic – A plant or animal that occurs naturally in a certain region and whose distribution is relatively limited geographically.

Fine-filter Target – Those species that are rare or have very specialized habitat requirements may not be included in the portfolio of sites selected through the coarse filter analysis. To ensure these targets are adequately conserved a separate landscape analysis is used to identify the sites required to conserve these species.

Focal Species – Species that have spatial, compositional, and functional requirements that may encompass those of other species in the region and may help address the functionality of ecological systems. For example, keystone species, wide-ranging species, cave-dwelling species.

Fragmentation or Fragmented Landscapes – The breaking up of large and continuous ecosystems, communities, and habitats (i.e. natural areas) into smaller discontinuous areas that are surrounded by altered or disturbed lands or aquatic features (*e.g.* natural areas can be fragmented through the addition of roads or conversion to other land uses such as human development or croplands).

Functional Landscapes – Those that conserve a large number of ecological systems, communities, and species at all scales below regional (*i.e.*, coarse, intermediate, and local). In addition, the identified conservation targets are usually intended to represent many other ecological systems, communities, and species, known and unknown (*i.e.*, "all" biodiversity). Functional landscapes have a high degree of ecological intactness, and retain (or can have restored) most or all of their key components, patterns, and processes. The distinction between functional landscapes and functional sites in practice, however, is not always clear cut because even communities and ecological systems at functional sites represent other elements of biodiversity (*i.e.*, their coarse-filter function) (Poiani and Richter 1999).

Functional Networks – A functional network is an integrated set of functional sites and landscapes designed to conserve regional species with or without finer-scale biodiversity. Sites or landscapes within functional networks can be arranged contiguously over one or more regions to protect wide ranging species such as, pronghorn. Conversely, sites or landscapes may form a series of stepping-stones spread over a large area to conserve migratory shorebirds or neotropical migrants. In addition to conserving biodiversity at local, intermediate, and coarse scales, a well designed ecoregional portfolio should serve as a functional network for regional species within an ecoregion; collectively, our ecoregional plans should provide functional networks for species that span multiple ecoregions (Poiani and Richter 1999)

Functional Site – Regardless of size, a site that can maintain the target species, community or ecosystem, and their supporting ecological processes, within their natural ranges of variability, if managed appropriately (Riley *et al.* 2004).

Gap Analysis Program (GAP) – A program of the US Geological Survey. The program is a scientific means for assessing to what extent native animal and plant species are being protected. It can be done at a state, local, regional, or national level. The goal of Gap Analysis is to keep common species common by identifying those species and plant communities that are not adequately represented in existing conservation lands. Common species are those not threatened with extinction. By identifying their habitats, Gap Analysis gives land managers, planners, scientists, and policy makers the information they need to make better-informed decisions when identifying priority areas for conservation. Gap Analysis came out of the realization that a species-by-species approach to conservation is not effective because it does not address the continual loss and fragmentation of natural landscapes. Only by protecting regions already rich in habitat, can we adequately protect the animal species that inhabit them (USGS 2005).

GAP Codes – A ranking system of how lands are being managed. (USGS 2005)

- **Gap 1** An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management. Examples: national parks, nature reserves, wilderness area.
- **Gap 2** An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance. Examples: state parks, national wildlife refuges, national recreation areas.
- **Gap 3** An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (*e.g.*, logging) or localized intense type (*e.g.*, mining). It also confers protection to federally listed endangered and threatened species throughout the area. Examples: national forests, most Bureau of Land Management Land, wildlife management areas.
- **Gap 4** There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Ranking	Description
G1, Extremely rare	usually 5 or fewer occurrences in the overall range or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction
G2, Very rare	usually between 5 and 20 occurrences in the overall range or with many individuals in fewer occurrences; or because of some factor(s) making it vulnerable to extinction
G3, Rare to uncommon	usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances
G4, Common	usually more than 100 occurrences; usually not susceptible to immediate threats
G5, Very common	demonstrably secure under present conditions
GH	Historic, no records in the past 20 years
GU	Status uncertain, often because of low search effort or cryptic nature of the species; more data needed
GX	Globally extinct. No recent records despite specific searches
?	Denotes inexact numeric rank (i.e. G4?)
9G?	Unranked, or, if following a ranking, rank tentatively assigned (e.g. G3?)
Q	Denotes that the taxonomic status of the species, subspecies, or variety is questionable
T	Denotes that the rank applies to a subspecies or variety

GIS – Geographic information system; an integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed.(http://support.esri.com/index.cfm?fa=knowledgebase.gisDictionary.gateway; current October 2006)

Globally Imperilled – Species that have a global rank of G1-G3G4 by Natural Heritage Programs or Conservation Data Centres.

GRank; G-Rank; Global Rank – Assigned by a consensus of the network of CDCs, scientific experts and The Nature Conservancy to designate a rarity rank based on the range-wide status of a species, subspecies or variety. The most important factors considered in assigning global (and provincial) ranks are the total number of known, extant sites world-wide, and the degree to which they are potentially or actively threatened with destruction. Other criteria include the number of known populations considered to be securely protected, the size of the various populations, and the ability of the taxon to persist at its known sites. The taxonomic distinctness of each taxon has also been considered. Hybrids, introduced species, and taxonomically dubious species, subspecies and varieties have not been included.

Great Plains – A general term describing the grasslands of central North America stretching from Canada to Mexico.

Hectare (ha) – A metric unit of area equal to 10,000 m^2 or 2.471 acres.

Heritage Rangelands – Preserve and protect natural features that are representative of Alberta's prairies; grazing is used to maintain the grassland ecology (GOA 2003).

Important Bird Areas (IBA) – An international conservation initiative co-ordinated by Bird Life International. The Important Bird Areas program is a science-based initiative to identify, conserve, and monitor a network of sites that provide essential habitat for the world's birds and other biodiversity.

Invasive alien species – Species introduced deliberately or unintentionally outside their natural habitats where they have the ability to establish themselves, invade, out-compete natives and take over the new environments. They are widespread in the world and are found in all categories of living organisms and all types of ecosystems. However, plants, mammals and insects comprise the most common types of invasive alien species in terrestrial environments. The threat to biodiversity due to invasive alien species is considered second only to that of habitat loss. They are thus a serious impediment to conservation and sustainable use of global, regional and local biodiversity, with significant undesirable impacts on the goods and services provided by ecosystems (Convention on Biological Diversity 2005).

IUCN – The World Conservation Union – The world's largest conservation network, the Union brings together 82 States, 111 government agencies, more than 800 non-governmental organizations (NGOs), and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership.

IUCN categories of protected areas by management objective and has identified six distinct categories of protected areas.

Matrix communities – Vegetation communities that form extensive and contiguous cover on the landscape. Matrix communities occur on extensive landforms (*e.g*,. glacial moraine) and typically have wide ecological tolerances. Matrix community types are often influenced by large-scale processes *(e.g.,* climatic patterns, fire) and are important habitat for wide-ranging or area sensitive fauna, such as large herbivores or birds.

IUCN Protected Area Category	Management Objectives
I	Strict Nature Reserve/Wilderness Area: protected area managed mainly for science of wilderness protection
II	National Park: protected area managed mainly for ecosystem protection and recreation
III	Natural Monument: protected area managed mainly for conservation of specific natural features
IV	Habitat/Species Management Area: protected area managed mainly for conservation through management intervention
V	Protected Landscape/Seascape: protected area managed mainly for landscape/seascape protection and recreation
VI	Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

Land cover –The observed biophysical cover of the earth's surface including vegetation, water, rock, and human-made features. Land cover is often mapped using remotely sensed data (*e.g*,. satellite imagery) as cover types can be delineated based on differences of their spectral (light) reflectance.

Limited distribution – A species or ecological system primarily occurring within one ecoregion. They may occur in other adjacent ecoregions however their core range is contained within one ecoregion.

Metapopulation – A network of semi-isolated populations with some level of regular or intermittent migration and gene flow among them, in which individual populations may go extinct but can then be recolonized from other source populations (known as the rescue effect).

Native Species – Species that would have occurred in a region before European settlement.

Natural Areas (1) In Alberta, natural areas protect special and sensitive natural landscapes of local and regional significance while providing opportunities for education, nature appreciation and low intensity recreation. Facilities are limited to staging areas, trails and signs (GOA 2003). **(2)** *NCC definition* – Natural areas are sites that are defined by natural ecological boundaries, and can be identified on the landscape as potentially ecologically-functioning landscapes (or parts of landscapes) that are configured at scales appropriate to the features that they sustain, and predictably large enough to sustain those feature for several generations, *e.g.*, a century. The conservation of these features includes both a biotic component and the abiotic or environmental structure and function that support the biota (Riley 2005).

Patch – Used to define contiguous areas of similar habitat types or ecological systems (Begon *et al.* 1990).

Peripheral Distribution – Species or ecological systems that are located closer to the outer boundaries of the ecoregion and are not considered widespread throughout the ecoregion. For example in the Aspen Parkland ecoregion, species common to the boreal forest may be present, however in the parkland they maybe at the extreme edge of their range.

Population – A group of individuals of one species in an area, that mate with one another and produce offspring. The size and nature of the area needs to be defined. See also *metapopulation*.

Population (gene pool) – A group of interbreeding organisms of the same species within a given area. In practice, it is difficult to distinguish where populations begin or end. Often, best-estimate sizes and numbers are documented and adopted.

Portfolio of sites – A suite of conservation sites within an ecoregion that would collectively conserve the native biodiversity targets of the ecoregion.

Prairie – An area of flat or rolling topographic relief that principally supports grasses and forbs, with few trees, and is generally of a mesic (moderate or temperate) climate. The French explorers called these areas *prairie* from the French word for "meadow".

Prairie Wings – A program of The Nature Conservancy (TNC–USA) designed to protect imperilled grassland birds of the central United States, south-central Canada and north-central Mexico.

Protected areas – A geographically defined area which is designated or regulated and managed to achieve specific conservation objectives. See also *conservation lands.*

Provincial Parks – Provincially significant natural and historical landscapes and features. A range of facilities along with interpretive and educational programs enhance opportunities for visitors to explore, understand, appreciate and respect the natural environment (GOA 2003).

Recreation Areas – Cater to a wide range of intensive recreation pursuits in natural, modified or man-made settings. Most Recreation Areas have little or no preservation value due to the levels of facility development, intensity of visitor use and frequently small size (GOA 2003).

Recovery strategy – A recovery strategy is a document that outlines the long-term goals and short-term objectives for recovering a species at risk, based on the best available scientific baseline information (SARA Public Registry).

Representative Areas Network – In Saskatchewan, a provincial government process of establishing a network of ecologically important land and water areas across the province. This system incorporates all of the unique features, landscapes, and resources already being managed as parks, ecological reserves, wildlife lands, and other reserves. New sites are selected to complement existing sites and ensure that the wide range of Saskatchewan's natural features and diversity are represented within the network.

Restricted distribution – A species or ecological system that is confined to a specific habitat type such as sand hills, as such will not be found outside of these habitat associations.

SAR Species at Risk – Species designated as Extinct (X), Extirpated (XT), Endangered (E), Threatened (T), Special Concern (SC), Not At Risk (NAR), or Data Deficient (DD), by the Committee on the Status of Species at Risk in Canada (COSEWIC) under the Species at Risk Act (SARA).

S-Rank (Provincial Rank) – Provincial (or sub-national) ranks are used by the Conservation Data Centres and Natural Heritage Information Centres to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of the state or province. The data centres evaluate provincial ranks on a continual basis and produce updated lists at least annually.

Ranking	Description
S1	Extremely rare in the state/province; usually 5 or fewer occurrences in the province or very few remaining individuals; often especially vulnerable to extirpation
S2	Very rare in the state/province; usually between 5 and 20 occurrences in the province or with many individuals in fewer occurrences; often susceptible to extirpation
S3	Rare to uncommon in the state/province; usually between 20 and 100 occurrences in the province; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances. Most species with an S3 rank are assigned to the watch list, unless they have a relatively high global rank
S4	Common and apparently secure in the state/province; usually with more than 100 occurrences in the province
S5	Very common and demonstrably secure in the state/province
SH	Historically known from the state/province, but not verified recently (typically not recorded in the province in the last 20 years); however suitable habitat is thought to be still present in the province and there is reasonable expectation that the species may be rediscovered
C	Captive/Cultivated; existing in the province only in a cultivated state; introduced population not yet fully established and self-sustaining
S?	Not Ranked Yet, or if following a ranking, Rank Uncertain (e.g. S3?). S? species have not had a rank assigned
SA	Accidental; of accidental or casual occurrence in the province; far outside its normal range; some species may occasionally breed in the province
SAB	Breeding accidental
SAN	Non-breeding accidental
SE	Exotic; not believed to be a native component of the states/province's flora
SR	Reported for in the state/province, but without persuasive documentation which would provide a basis for either accepting or rejecting the report
SRF	Reported falsely from in the state/province
SU	Unrankable, often because of low search effort or cryptic nature of the species, there is insufficient information available to assign a more accurate rank; more data is needed
SX	Apparently extirpated from the state/province, with little likelihood of rediscovery. Typically not seen in the province for many decades, despite searches at known historic sites
SZ	Not of practical conservation concern inasmuch as there are no clearly definable occurrences; applies to long distance migrants, winter vagrants, and eruptive species, which are too transitory and/or dispersed in their occurrence(s) to be reliably mapped; most such species are non-breeders, however, some may occasionally breed
SZB	Breeding migrants/vagrants
SZN	Non-breeding migrants/vagrants

Special Places – An initiative in Alberta of the provincial government's Round Table on the Environment and Economy to protect Alberta's endangered species by setting aside portions of each of the six distinct geographical regions (ecoregions).

Stewardship (*NCC definition*) – To protect, manage, and where appropriate, restore natural areas so they sustain the natural ecosystems that define them (Riley *et al.* 2004).

Succession – A directional change within a community of colonization and extinction on a site by populations. *Primary succession* begins on a bare surface not previously occupied by living organisms, such as a recently deposited gravel bar. Secondary succession occurs following disturbances on sites that previously supported living organisms.

Target – See *conservation targets.*

Threat – Outside factors that lower conservation targets overall viability and therefore its chances of long-term survival. Examples of threats include habitat destruction or fragmentation, exotic species, and inappropriate resource use.

Viable/viability – The ability of a species to persist for many generations or an ecological community or system to persist over some time period. An assessment of viability will often focus on the minimum area and number of occurrences necessary for persistence. However, conservation goals should not be restricted to the minimum but rather should extend to the size, distribution, and number of occurrences necessary for a community to support its full complement of native species.

Western Hemispheric Shorebird Reserve Network (WHSRN) – A network of key sites identified to conserve shorebird species and their habitats across the Americas. A program of Manomet Center for Conservation Sciences (http://www.manomet.org/).

Wetland – Wetlands are naturally undrained basins less than 20.2ha (50ac) in area; lakes include basins greater than 20.2ha (Stewart and Kantrud 1971). Wetlands include several land cover types that have been grouped together such as marsh, bog, fen, etc. Wetland size for the classification (*i.e.,* lake or wetland) was based on the calculation of open water areas from classified land cover imagery. After the initial calculation, land cover classes associated with wetlands were also assigned to the wetland class. This will account for the reason why some of the larger wetlands may be larger than 20.2ha in the analysis.

Wetland Density Polygon (WDP)– A term coined to describe polygons or regions that contain similar wetland densities (proxy measure of wetland complexes). To derive these polygons, a wetland density function was used to calculate a grid for the entire landscape. From this grid wetland densities were divided into five categories based on natural breaks in the data. Each category of grid cells was grouped and then converted into a WDP. These WDP become the landscape features added to the final portfolio.

Wide-ranging distribution – Species that depend on large areas, sometimes multiple ecoregions for its lifecycle. Examples include top-level predators (*e.g.* bobcat *Felis rufus*) or migratory mammals, birds, and insects. These species can be used in examining necessary linkages among conservation sites in a true "network" of sites.

Widespread Distribution – Species or ecological systems that are found throughout the ecoregion as well other adjacent ecoregions.

Working Landscape – A working landscape is a place where agriculture and other natural resource based economic endeavors are conducted with the objective of maintaining the viability and integrity of its commercial and environmental values. On a working landscape, both private production, as well as public regulatory decisions account for the sustainability of families, businesses and communities, while protecting and enhancing the landscape's ecological health. The working landscape is readily adaptable to change according to economic and ecosystem needs (California Bay-Delta Public Advisory Committee 2002).

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North Dakota Notes: Articles on North Dakota's Geology and Landforms (http://www.state.nd.us/ndgs/ndnotes/ nd_notes%20.htm)

Online Resources

Biodiversity

- Federation of Alberta Naturalists – Alberta Birdlist Program. http://fanweb.ca/projects/bird_list/
- Manitoba Museum of Nature and Man – Bird and Birder Page http://www.virtualmuseum.ca/Exhibitions/Birds/MMMN/English/parkland.html
- Montana Audubon – State Bird List. http://mtaudubon.org/html/science_MBRC8.htm
- Nature Saskatchewan Bird Checklist. http://www.naturesask.ca/pdf/Checklist1.pdf
- North Dakota – Birds of North Dakota Checklist http://www.state.nd.us/gnf/ndoutdoors/issues/articles-brochures/nd-birds-check-list/
- TNC Migratory Bird Program – Prairie Wings http://nature.org/initiatives/programs/birds/explore/

Climate

- Canadian Climate Normals http://www.mb.ec.gc.ca/air/a00s04.en.html
- United States Climate Data http://www.cdc.noaa.gov/USclimate

Conservation – General

- Conserve Online – TNC website for a broad range of conservation documents. http://conserveonline.org/

Conservation – Targets and General Species Information

- Alberta amphibian information http://www3.gov.ab.ca/srd/fw/amphib/index.html
- Canadian Amphibian and Reptile Conservation Network http://www.carcnet.ca
- NatureServe Explorer – An online encyclopedia of life http://www.natureserve .org/explorer/
- North American Bird Conservation Initiative. www.nabci.net
- Partners in Flight – US. http://www.partnersinflight.org/ or Canada - http://www.cws-scf.ec.gc.ca/birds/lb_ot_e.cfm
- Species at Risk Public Registry http://www.sararegistry.gc.ca/
- Species At Risk http://www.speciesatrisk.gc.ca/
- World Wildlife Fund – Wildfinder: Mapping the World's Species http://www.worldwildlife.org/wildfinder/searchByPlace.cfm

Conservation – Threats

- Alberta Invasive Plants Council. http://www.invasiveplants.ab.ca/

Landscape descriptions

- Montana Valley & Foothill Grasslands; http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0808_full.html

Data Links

Agriculture and Agri-Food Canada PFRA Gross Watershed Boundaries for the Canadian Prairies. Online http://www.agr.gc.ca/pfra/gis/gwshed_e.htm

Alberta Community Development. 2005. Parks and Protected Areas: Land Reference Manual http://www.cd.gov.ab.ca/preserving/parks/lrm/index.asp

USGS PrairieMap http://prairiemap.wr.usgs.gov/

GAP Program (USA) – North Dakota http://www.npwrc.usgs.gov/ndgap/

Montana http://ku.wru.umt.edu/news/mtgap_su93.html/

Appendices

Appendix A – Ecological Systems *Coarse-filter Targets*

Land Cover & Surficial Geology

Building Seamless Data Sets: Province-by-Province and State-by-State

Alberta

Three sources of land cover data exist for Alberta; 1) Agriculture and Agri-Food Canada (AAFC) – PFRA's 9-cover class for the entire planning area in Alberta; 2) a 4-class "Central Aspen Parkland Vegetation Inventory" created by Alberta Sustainable Development for the **Aspen Parkland** and the northern portion of the **Moist Mixed Grassland (MMG)** ecoregions; and 3) 800m x 800m (1/4 section) resolution Native Prairie Vegetation Inventory (NPVI) for parts of the **MMG** (used as a cross-reference). The NPVI layer was used as the land cover layer for the **Mixed Grassland** and **Cypress Uplands** ecoregion. Surficial geology (1:1M scale) exists for all but the extreme west of the planning area (Alberta Energy and Mines). Gaps missing geological information were digitized from 1:0.5M maps.

Two ecological systems layers were created using the combinations from each of the land cover layers and surficial geology. This was done so that the areas that have newer or higher quality information available would not lose the benefits of these data. The surficial geology layer contains a number of 'undifferentiated' classes. Undifferentiated polygons were assigned to adjacent geology polygons that we felt would best represent changes in the newly mapped 'ecological systems'.

Water bodies were removed from the ecological systems data set. Small wetlands were included, but were not differentiated by their underlying surficial geology. Also, an ancillary sand dune data set was added to the surficial geology data set to better map these unique ecological systems.

Saskatchewan

Saskatchewan had two digital data sets available; 1:1M surficial geology and a 24 class – land cover (30m pixel resolution) for southern Saskatchewan (1994). The land-cover data set was clipped to fit the buffered planning area which reduced the total number of cover classes. Similar classes were further combined to eliminate potential errors in the land cover classification or where it was felt that the classes were part of the same habitat type. For example, tall shrub and native dominated grassland classes were combined to form a grassland/shrubland class. As well, the 3 'unnatural' classes of cultivated land, hay crop (forage), and farmsteads were removed before the ecological systems were created. Similar to land cover, surficial geology classes were aggregated to create classes that the team assumed would reflect changes in ecological systems on the landscape.

Two additional ecological systems (wetland complexes and sand dune complexes) were considered. The wetland complexes were derived from the original land cover and include water bodies, marsh, and mud/sand/saline, while sand dune complexes were added from a separate data source. The classes of shrub fen, herbaceous fen, treed bog, and open bog were aggregated in with the wetland complexes because of the uncertainty of their presence or locations in the study area. These systems were considered to be 'more important', in that they were given priority when they were merged with the ecological systems data set.

Manitoba

Manitoba's provincial government reclassified imagery collected by AAFC into a 16-class land cover layer. This layer is available for the entire planning area. Surficial geology was available at a scale of 1:1M for the entire area. Methods followed that of the other areas (see Saskatchewan for methods) to create the ecological systems data set.

North Dakota

A 19-cover class land cover data set from the USGS national land cover was combined with geological stratigraphy map of North Dakota. The satellite imagery for land cover was acquired in 1992.

Montana

Montana land cover data for was extracted from the GAP Analysis program. Geology was extracted using 5 (generalized) geological classes.

Creation of the Ecological Systems Data Set

All land cover data sets were converted to raster data sets, 30m pixel resolution; Albers Equal Area Canadian (NAD83) projection). Six land land-cover data sets were crosswalked to create a seamless layer for the Montana, Alberta, Manitoba, Saskatchewan and North Dakota portions of the study area. This land-cover layer consisted of seven natural land cover classes. All other land cover classes were not considered to be natural and therefore were considered "no data" for the purposes of the analysis.

Following Stewart and Kantrud (1971), water bodies greater than 20.2ha (50 acres) were considered lakes while those less than 20.2ha were considered ponds. Ponds adjacent to wetlands (marsh, bog, swamp, etc.) were reclassified as belonging to the wetlands class, while all other water bodies were removed prior to the merged land-cover classes being overlaid with the surficial geology units. More information on the cross-walk of land cover units for the three Canadian prairie provinces and North Dakota follows.

Land Cover

Final (Cross-walked) Land Cover Classes (AB, SK, MB, ND)

#	Name	Description
1	Grasslands / Shrubland	Native grasslands and low growing shrubs
2	Deciduous woodlands	Deciduous woodlands dominated by Aspen
3	Coniferous woodlands	Coniferous woodlands including spruce and pine
4	Mixed Woods	Includes a mixture of deciduous and coniferous cover
5	Water Bodies	All open water areas larger than 20.2 hectares
6	Wetlands	All open water areas <20.2 hectares as well as marshes, bogs, fens, etc.
7	Mud/Sand/Saline	Mudflats, sand beaches, sandbars, and alkali wetlands

Original Classification by Jurisdiction

ALBERTA: Southern part of planning area
source: Agriculture and Agri-Food Canada Data

#	Original Class	New Class
1	Cropland	No data
2	Forage	No data
3	Grasslands	Grasslands / Shrubland
4	Shrubs	Grasslands / Shrubland
5	Trees	Deciduous woodlands
6	Wetlands	Wetlands
7	Water bodies	Water Bodies
8	Other lands	No data
9	Mud/Sand/Saline	Mud/Sand/Saline

ALBERTA: Northern part of planning area
source: Central Parklands Native Vegetation Inventory Project Data

#	Original Class	New Class
1	Human Modified	No data
2	B_Decid	Deciduous woodlands
3	Coniferous	Coniferous woodlands
4	Deciduous	Deciduous woodlands
5	Island	Water Bodies
6	N_Conif	Coniferous woodlands
7	N_Decid	Deciduous woodlands
8	N_Grass	Grasslands / Shrubland
9	Water	Water Bodies
10	Wetland	Wetlands

SASKATCHEWAN: Southern Digital Land Cover
source: Saskatchewan Environment

#	Original Class	New Class
1	Crop Land	No data
2	Hay Crops (Forage)	No data
3	Native Dominant Grasslands	Grasslands / Shrubland
4	Tall Shrubs	Grasslands / Shrubland
5	Pasture (Seeded Grasslands)	No data
6	Hardwoods: Open Canopy	Deciduous woodlands
7	Hardwoods: Closed Canopy	Deciduous woodlands
8	Jack Pine: Closed Canopy	Coniferous woodlands
9	Jack Pine: Open Canopy	Coniferous woodlands
10	Spruce: Close Canopy	Coniferous woodlands
11	Spruce: Open Canopy	Coniferous woodlands
12	Mixed Woods	Mixed Woods
16	Cutovers	No data
17	Water Bodies	Water Bodies
18	Marsh	Wetlands
19	Herbaceous Fen	Wetlands
20	Mud/Sand/Saline	Mud/Sand/Saline
21	Shrub Fen (Treed Swamp)	Wetlands
22	Treed Bog Peat	Wetlands
23	Open Bog	Wetlands
24	Farmstead	No data

MANITOBA:
source: Manitoba Land Initiative

Value	Original Class	New Class
1	Agricultural Cropland	No data
2	Deciduous Forest	Deciduous woodlands
3	Water Bodies	Water Bodies
4	Grassland / Rangeland	Grasslands / Shrubland
5	Mixedwood Forest	Mixed Woods
6	Marsh and Fens	Wetlands
7	Treed and Open Bogs	Wetlands
8	Treed Rock	No data
9	Coniferous Forest	Coniferous woodlands
10	Burnt Areas	No data
11	Open Deciduous	Deciduous woodlands
12	Forage Crops	No data
13	Cultural Features	No data
14	Forest Cutovers	No data
15	Bare Rock, Gravel and Sand	No data
16	Roads and Trails	No data

NORTH DAKOTA
source: National Land Cover Data (USGS 2000)

#	Original Class	New Class
11	Water - Open Water	Water Bodies
21	Developed -Low Intensity Residential	No data
22	Developed – High Intensity Residential	No data
23	Developed Commercial/Industrial/Transportation	No data
31	Barren - Bare Rock/Sand/Clay	No data
32	Barren - Quarries/Strip Mines/ Gravel Pits	No data
33	Barren – Transitional	No data
41	Forested Upland - Deciduous Forest	Deciduous woodlands
42	Forested Upland - Evergreen Forest	Coniferous woodlands
43	Forested Upland - Mixed Forest	Mixed Woods
51	Shrubland	Grasslands / Shrubland
71	Herbaceous Upland - Grasslands/Herbaceous	Grasslands / Shrubland
81	Herbaceous Planted/Cultivated – Pasture/Hay	No data
82	Herbaceous Planted/Cultivated – Row Crops	No data
83	Herbaceous Planted/Cultivated – Small Grains	No data
84	Herbaceous Planted/Cultivated – Fallow	No data
85	Herbaceous Planted/Cultivated Urban/Recreational Grasses	No data
91	Wetlands - Woody Wetlands	Wetlands
92	Wetlands - Emergent Herbaceous – Wetlands	Wetlands

MONTANA
Original GAP data (Redmon et al. 1998)

#	Original Class	New Class
1100	Urban or Developed Lands	No Data
2010	Agricultural Lands – Dry	No Data
2020	Agricultural Lands – Irrigated	No Data
3110	Altered Herbaceous	No Data
3130	Very Low Cover Grasslands	Grassland / Shrubland
3150	Low/Moderate Cover Grasslands	Grassland / Shrubland
3170	Moderate/High Cover Grasslands	Grassland / Shrubland
3180	Montane Parklands & Subalpine Meadows	Grassland / Shrubland
3200	Mixed Mesic Shrubs	Grassland / Shrubland
3300	Mixed Xeric Shrubs	Grassland / Shrubland
3309	Silver Sage	Grassland / Shrubland
3310	Salt-Desert Shrub/ Dry Salt Flats	Grassland / Shrubland
3350	Sagebrush	Grassland / Shrubland
4000	Low Density Xeric Forest	Grassland / Shrubland
4140	Mixed Broadleaf Forest	Deciduous Woodlands
4203	Lodgepole Pine	Coniferous Woodlands
4205	Limber Pine	Coniferous Woodlands

MONTANA cont'd

#	Original Class	New Class
4206	Ponderosa Pine	Coniferous Woodlands
4212	Douglas-fir	Coniferous Woodlands
4214	Rocky Mountain Juniper	Coniferous Woodlands
4215	Larch	Coniferous Woodlands
4223	Douglas-fir/Lodgepole Pine	Coniferous Woodlands
4260	Mixed Whitebark Pine Forest	Coniferous Woodlands
4270	Mixed Subalpine Forest	Coniferous Woodlands
4280	Mixed Mesic Forest	Coniferous Woodlands
4290	Mixed Xeric Forest	Coniferous Woodlands
4300	Mixed Broadleaf & Conifer Forest	Mixed Woods
4400	Standing Burnt Forest	No Data
5000	Water	Water
6110	Conifer Riparian	Coniferous Woodlands
6120	Broadleaf Riparian	Deciduous Woodlands
6130	Mixed Broadleaf & Conifer Riparian	Mixed Woods
6200	Graminoid & Forb Riparian	Wetlands
6300	Shrub Riparian	Grassland / Shrubland
6400	Mixed Riparian	Grassland / Shrubland
7300	Rock	Bedrock
7500	Mines, Quarries, Gravel Pits	No Data
7800	Mixed Barren Sites	No Data
8100	Alpine Meadows	Grassland / Shrubland
9100	Snowfields or Ice	No Data
9800	Clouds	No Data
9900	Cloud Shadows	No Data

Surficial Geology

Surficial geology data sets varied by jurisdictions, by scale and by surficial units. A class-by-class crosswalk of the surficial units in each jurisdiction was done so that each class could be simplified, aggregated or reclassified to create an ecologically significant, cross-walked surficial geology layer. (Assistance was provided by quaternary geologist Janet Campbell, Saskatchewan Industry and Resources)

All data sets were projected into a common Albers Equal Area Canadian (NAD83) and converted to grids (30m pixel resolution) to facilitate overlay. Any 'no data' areas in this new surficial geology layer created by lakes or 'slivers' (overlapping boundaries that should align, but don't), from the original geology data sets were removed using the nibble function in ESRI Arc/Info grid. Landcover data were used to help fill these no-data areas.

Final Crosswalked Surficial Geology Classes (AB, SK, MB, ND, MT)

#	Class Name	Description
1	Bedrock	Exposed or partly exposed bedrock
2	Eolian Plain	Thin or flat deposits of wind blown sand or loess
3	Escarpment Complex	Till, slump and ice pushed deposits
4	Glaciofluvial Deposits	Poor to well stratified deposits of sands and gravels, deposited by glacial melt water
5	Glaciolacustrine (coarse deposits)	Coarse grained deposits of sands, silts and clays deposited on the bottom of temporary glacial lakes or glacial lake margins, including such features as deltas and beach deposits
6	Glaciolacustrine (fine deposits)	Fine grained deposits of sands, silts and clays deposited on the bottom of temporary glacial lakes, may also include more recent lake deposits of non glacial origin
7	Moraine Hummocky	An unstratified heterogeneous mixture of particles sizes generally containing a mixture of sand, silt, clay, gravel, and rocks
8	Moraine Plain	A complex sequence of slopes ranging form rounded deposes or kettles to irregular to conical knolls or knobs. May also include a regular sequence of moderate slopes that range for rounded concavities to convexities producing a wave like pattern of moderate relief
9	Moraine Ridged	Narrow elevation of the surface, usually sharp crested with steep sides
10	Moraine Undulating	A regular sequence of gentle slopes that range for rounded concavities to convexities producing a wave like pattern of low local relief
11	Sand Hills	Thick deposits of wind blown sand or loess containing stabilised and active sand dunes
13	Valley Complex	The steep sides of a valley and the valley bottoms, generally centred on a river or stream
14	Glaciofluvial Hummocky	Undifferentiated glacial sediment likely similar to #5 Glaciolacustrine (coarse deposits); Kept separate in report
15**	Coarse-grained stratified sediment	Undifferentiated glacial sediment likely similar to #5 Glaciolacustrine (coarse deposits); Kept separate in report
16**	Fine-grained	Undifferentiated glacial sediment #6 stratified sediment Glaciolacustrine (fine deposits)
17**	Till	Undifferentiated deposit (moraine)
18**	Exposed bedrock or non-glacial sediment	Unglaciated portions of the ecoregion
19**	Bedrock	Exposed bedrock (may have some deposits covering)

**Note: these types apply to Montana only, due to Montana geological units that could not be cross-walked seamlessly with other jurisdictions.

Reclassification of Surficial Units

Crosswalk table showing original, intermediate, and final classes

Saskatchewan	Manitoba	Alberta	North Dakota	Intermediate class	Final class
Alluvial Plain	Alluvial Deposits	Fluvial	*River Sediment*	*Alluvial Deposits*	*Valley Complex*
Eolian Hummocky Eolian Ridged	Sand Dunes	Eolian	*Windblown Sand, Sand of the OAHE and Older Formations, Undivided*		*Sand Hills / Eolian Plain*
Eolian Plain		Cryoturbated Eolian and Fluvial Sand	Windblown Sand, of the OAHE and Older Formations, Undivided		*Sand Hills / Eolian Plain*
	Bedrock	Bedrock Bedrock and glacial, undivided	*Hell Creek Formation, Niobrara and Carile Formations, Pierre Formation, Bullion Creek Formation, Cannonball Formation*	*Bedrock*	*Bedrock*
Glaciofluvial Eroded				*Glaciofluvial*	*Valley Complex*
Glaciofluvial Plain	Glaciofluvial Deposits	Ice-Contacted Fluvial	*Uncollapsed River Sediment, Collapsed River Sediment*	*Glaciofluvial Deposits*	*Glaciofluvial Deposits*
Glaciofluvial Terrace				*Glaciofluvial*	*Valley Complex*
Glaciolacustrine Delta	Deltaic Deposits Beach and Nearshore Deposits	Ice-contact Lacustrine and Fluvial, undivided Ice-contacted Lacustrine	*Shoreline Sediment*	*Glaciolacustrine (Coarse Deposits)*	*Glaciolacustrine (Coarse Deposits)*
Glaciolacustrine Plain	Deep Basin Deposits	Lacustrine	*Progalcial Lake Sediment Pond Sediment*	*Glaciolacustrine Plain (Fine Deposits)*	*Glaciolacustrine Plain (Fine Deposits)*
Major Meltwater Channel					*Valley Complex*
Moraine Eroded					*Valley Complex / Moraine Plain*
Moraine Plain	Tills (Without topography)	Glacial and Fluvial, undivided (Draped) Glacial (Topography) flat flat to gently undulating flat to undulating	*Glacial - Collapsed Glacial Sediment (Supraglacial) Gently Undulating Glacial Sediment Draped over Pre-existing Topography (Over Glacial Deposits or Non Glacial) Wave Eroded Glacial Sediment*	*Moraine Plain*	*Moraine Plain*
Moraine Undulating Moraine Dumlinoid		Glacial (Topography) undulating undulating to rolling undulating to hummocky	*Glacial - Collapsed Glacial Sediment (Supraglacial) Undulating or Rolling Glacial sediment on subglacially moulded surfaces*	*Moraine undulating*	*Moraine Undulating*
	Escarpment Complex				*Escarpment Complex*
Moraine Hummocky	Tills (Hummocky)	Glacial & Fluvial, undivided (Stagnation) Glacial (Topography) hummocky mixed hummocky and moraine plateau rolling to hummocky thick rolling to hummocky	*Collapsed Glacial Sediment (Supraglacial) Hilly Ice Walled Lake sediment or Collapsed Supra Glacial Lake Sediment Collapsed / Draped Transition Sediments*	*Moraine Hummocky*	*Moraine Hummocky*

Saskatchewan	Manitoba	Alberta	North Dakota	Intermediate class	Final class
	Tills	ridged end	*Glacial Sediment*	*Moraine Ridged*	*Moraine Ridged*
Moraine Ridged	(Stagnation or interlobate/ end Moraine)	ridges, irregular shaped hills and depression hummocky to ridged	*on Thrust Masses Slope Wash Eroded Glacial Sediment*		
		Stream and Slopewash Eroded	*Landslides*		*Valley Complex*
	Organic Deposits	Organic		*Organic Deposits*	*Wetlands**
				Water	*Valley Complex or Nibbled*
Glaciofluvial Hummocky					*Glaciofluvial Hummocky*

* Note - Organic Deposits – Due to the close relationship between the surficial organic deposits classification and the land cover wetlands classification, the wetlands class from the land cover was used and the organic deposits were given a "no data" value.

Ecological Systems

Of the six natural land-cover classes, 4 were combined with 12 surficial classes to produce the initial systems map. Wetlands and mud/sand/saline classes were added after the initial overlay based on the assumption that surficial geology would not help separate these classes into individual types. In total 73 unique classes of ecological system were identified in the **Aspen Parkland** and **Moist Mixed Grassland** ecoregions. In the **Mixed Grassland** and **Cypress Upland** an additional surficial geology unit was present. For these two ecoregions, due to limited amounts of woodlands, all three types were grouped together to create the one cover class woodlands.

Ecological Systems for the *Aspen Parkland, Moist Mixed Grassland* and *Boreal Transition* ecoregions

1	Grasslands / Shrublands, Eolian Plain	25	Deciduous Woodlands, Valley Complex
2	Grasslands / Shrublands, Escarpment Complex	26	Coniferous Woodlands, Bedrock
3	Grasslands / Shrublands, Glaciofluvial Deposits	27	Coniferous Woodlands, Eolian Plain
4	Grasslands / Shrublands, Glaciolacustrine (Coarse Deposits)	28	Coniferous Woodlands, Escarpment Complex
		29	Coniferous Woodlands, Glaciofluvial Deposits
5	Grasslands / Shrublands, Glaciolacustrine (Fine Deposits)	30	Coniferous Woodlands, Glaciolacustrine (Coarse Deposits)
6	Grasslands / Shrublands, Moraine Hummocky	31	Coniferous Woodlands, Glaciolacustrine (Fine Deposits)
7	Grasslands / Shrublands, Moraine Plain		
8	Grasslands / Shrublands, Moraine Ridged	32	Coniferous Woodlands, Moraine Hummocky
9	Grasslands / Shrublands, Moraine Undulating	33	Coniferous Woodlands, Moraine Plain
10	Grasslands / Shrublands, Organic Deposits	34	Coniferous Woodlands, Moraine Ridged
11	Grasslands / Shrublands, Sand Hills	35	Coniferous Woodlands, Moraine Undulating
12	Grasslands / Shrublands, Valley Complex	36	Coniferous Woodlands, Organic Deposits
13	Deciduous Woodlands, Bedrock	37	Coniferous Woodlands, Sand Hills
14	Deciduous Woodlands, Eolian Plain	38	Coniferous Woodlands, Valley Complex
15	Deciduous Woodlands, Escarpment Complex	39	Mixed Woodlands, Bedrock
16	Deciduous Woodlands, Glaciofluvial Deposits	40	Mixed Woodlands, Eolian Plain
17	Deciduous Woodlands, Glaciolacustrine (Coarse Deposits)	41	Mixed Woodlands, Escarpment Complex
		42	Mixed Woodlands, Glaciofluvial Deposits
18	Deciduous Woodlands, Glaciolacustrine (Fine Deposits)	43	Mixed Woodlands, Glaciolacustrine (Coarse Deposits)
19	Deciduous Woodlands, Moraine Hummocky	44	Mixed Woodlands, Glaciolacustrine (Fine Deposits)
20	Deciduous Woodlands, Moraine Plain		
21	Deciduous Woodlands, Moraine Ridged	45	Mixed Woodlands, Moraine Hummocky
22	Deciduous Woodlands, Moraine Undulating	46	Mixed Woodlands, Moraine Plain
23	Deciduous Woodlands, Organic Deposits	47	Mixed Woodlands, Moraine Ridged
24	Deciduous Woodlands, Sand Hills	48	Mixed Woodlands, Moraine Undulating

Ecological Systems for the *Aspen Parkland, Moist Mixed Grassland* and *Boreal Transition* ecoregions cont'd

49	Mixed Woodlands, Organic Deposits
50	Mixed Woodlands, Sand Hills
51	Mixed Woodlands, Valley Complex
52	Mud / Sand / Saline
53	Wetlands
54	Grasslands / Shrublands, coarse-grained stratified sediment
55	Deciduous Woodlands, coarse-grained stratified sediment
56	Coniferous Woodlands, coarse-grained stratified sediment
57	Mixed Woodlands, coarse-grained stratified sediment
58	Bedrock, coarse-grained stratified sediment
59	Grasslands / Shrublands, fine-grained stratified sediment
60	Deciduous Woodlands, fine-grained stratified sediment
61	Coniferous Woodlands, fine-grained stratified sediment
62	Mixed Woodlands, fine-grained stratified sediment
63	Bedrock, fine-grained stratified sediment
64	Grasslands / Shrublands, till
65	Deciduous Woodlands, till
66	Coniferous Woodlands, till
67	Mixed Woodlands, till
68	Bedrock, till
69	Grasslands / Shrublands, exposed bedrock or sediment not of glacial origin
70	Deciduous Woodlands, exposed bedrock or sediment not of glacial origin
71	Coniferous Woodlands, exposed bedrock or sediment not of glacial origin
72	Mixed Woodlands, exposed bedrock or sediment not of glacial origin
73	Bedrock, exposed bedrock or sediment not of glacial origin

* Note: Green ecological systems are unique to Montana

Ecological Systems for the *Mixed Grassland* and *Cypress Upland*

1	Grasslands / Shrublands, Bedrock
2	Grasslands / Shrublands, Eolian Plain
3	Grasslands / Shrublands, Glaciofluvial Deposits
4	Grasslands / Shrublands, Glaciolacustrine (Coarse Deposits)
5	Grasslands / Shrublands, Glaciolacustrine (Fine Deposits)
6	Grasslands / Shrublands, Moraine Hummocky
7	Grasslands / Shrublands, Moraine Plain
8	Grasslands / Shrublands, Moraine Ridged
9	Grasslands / Shrublands, Moraine Undulating
10	Grasslands / Shrublands, Sand Hills
11	Grasslands / Shrublands, Valley Complex
12	Grasslands / Shrublands, Glaciofluvial Hummocky
13	Woodlands, Bedrock
14	Woodlands, Eolian Plain
15	Woodlands, Glaciofluvial Deposits
16	Woodlands, Glaciolacustrine (Coarse Deposits)
17	Woodlands, Glaciolacustrine (Fine Deposits)
18	Woodlands, Moraine Hummocky
19	Woodlands, Moraine Plain
20	Woodlands, Moraine Ridged
21	Woodlands, Moraine Undulating
22	Woodlands, Sand Hills
23	Woodlands, Valley Complex
24	Woodlands, Glaciofluvial Hummocky
25	Wetlands
26	Mud / Sand / Saline

Appendix B – Ranking Ecological Systems

Aspen Parkland / Moist Mixed Grassland / Portion of Boreal Transition: *Grasslands*

Parameter	Variable	% Total	Scoring Value	Scoring Score	Measure	Notes
Condition 15%	% Natural cover	10	1-10 % 10 -20 20 – 30 to 90 – 100	1 2 3 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0-1km/ km^2 1-3km/ km^2 > 3km/ km^2	5 2 0	Average road density for each ecological system polygon	Calculated as the km per square km within a 500m search radius
Diversity 5%	Simple diversity	5	0,1 2,3 4,5 >5	0 2 4 5	Done on a pixel-by-pixel basis, then 'zonalmax' for the ecological system polygon was taken	Calculated using a 2-by-2 cell size window and the variety was recorded
Ecological Function 50%	Size of patch	15	16 – 64ha 65 – 256ha 256 – 1024ha 1024 – 4096ha > 4096ha	3 6 9 12 15	Value per ecological system polygon	Based on a minimum of 16 ha patch size
	Shape (minimum habitat area)	20	30m -180m 180 – 360m 360 – 720m 720 – 1440m >1440m	0 5 10 15 20	Value per ecological system polygon	Based on a minimum of 16 ha patch size. Calculated based on the largest diameter circle that can be drawn ithin an ESP
	Connectivity	15	0 – 1.6km 1.6 – 3.2km 3.2 – 4.8km > 4.8km	15 10 5 0	Average value per ecological system polygon	Beyond 4.8 km not considered connected enough to score points.This varies with of organism, so is a relative measure only.
Special Features 30%	Presence of primary species targets	15	1 2 -3 >3	5 10 15	Count of EO for an ecological system polygon	Ecological system contains an EO for a primary target species
	Presence of additional features of conservation concern	10	1-3 4 -6 6- 9 >9	2 5 8 10	Count of additional EOs for an ecological system polygon	Ecological system contains an EO for additional features tracked (by CDC)
	Distance to protected area or conservation land	5	0 – 1.6km 1.6 – 3.2km 3.2 – 4.8km > 4.8km	5 3 1 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher conservation value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Aspen Parkland / Moist Mixed Grassland / Portion of Boreal Transition: *Woodlands*

Parameter	Variable	% Total	Scoring Value	Scoring Score	Measure	Notes
Condition 15%	% Natural cover	10	1-10 % 10 -20 20 - 30 to 90 - 100	1 2 3 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0 - 0.28km/ km^2 0.28 - 0.81km/ km^2 .08 1-1.45km/ km^2 1.45 - 2.45km/ km^2 2.45 - 8.00km/ km^2	5 4 3 2 1	Average road density for each ecological system polygon	Calculated as the km per square km within a 500m search radius Scores based on natural breaks in the data
Diversity 5%	Simple diversity	5	1,2 3,4 5,6	1 3 5	Done on a pixel-by-pixel basis, then 'zonalmax' for the ecological system polygon was taken	Calculated using a 2-by-2 cell size window and the variety was recorded
Ecological Function 50%	Size of patch	15	0.81 - 4ha 4 -16ha 16 - 64ha 64 - 256ha > 256ha	3 6 9 12 15	Value per ecological system polygon	Based on a minimum of 0.81 ha patch size
	Shape (minimum habitat area)	20	30m -180m 180 - 360m 360 - 720m 720 - 1440m >1440m	0 5 10 15 20	Value per ecological system polygon	Calculated based on the largest diameter circle that can be drawn within an ecological system polygon
	Connectivity	15	0 - 250m 250 - 500m 500 - 1000m > 1km	15 10 5 0	Average value per ecological system polygon	Beyond 1.0km not considered connected enough to score.This varies with size of organism, so is a relative measure only.
Special Features 30%	Presence of primary species targets	15	1 2 -3 >3	5 10 15	Average value per ecological system polygon	Ecological system contains an EO for a primary target species
	Presence of additional features of conservation concern	10	1-3 4 -6 6- 9 >9	2 5 8 10	Count of additional EOs for an ecological system polygon	Ecological system contains an EO for additional features tracked (by CDC)
	Distance to protected area or conservation land	5	0 - 1.6km 1.6 - 3.2km 3.2 - 4.8km > 4.8km	5 3 1 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Aspen Parkland / Moist Mixed Grassland / Portion of Boreal Transition: *Large Wetlands*

Parameter	Variable	% Total	Scoring Value	Score	Measure	Notes
Condition 15%	% Natural cover	10	1-10 % 10 -20 20 - 30 to 90 - 100	1 2 3 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0-0.28km/ km^2 0.28- 0.81km/ km^2 .81–1.45km/ km^2 1.45 – 2.45km/km^2 2.45 – 8.00km/ km^2	5 4 3 2 1	Average road density for each ecological system polygon	Calculated as the km per square km within a 500m search radius Scores based on natural breaks in the data
Diversity 5%	Simple diversity	5	0,1 2,3 4,5 >5	0 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the ecological system polygon was taken	Calculated using a 2-by-2 cell size window and the variety was recorded
Ecological Function 45%	Size of patch	45	20 - 64ha 64 – 256ha > 256ha	15 30 45	Value per ecological system polygon	Based on a minimum of 20.2 ha patch size
Special Features 35%	Presence of primary species targets	15	1 2 -3 >3	5 10 15	Count of EO for an ecological system polygon	Ecological system contains an EO for a primary target species
	Presence of additional features of conservation concern	10	1-3 4 -6 6- 9 >9	2 5 8 10	Count of additional EOs for an ecological system polygon	Ecological system contains an EO for additional features tracked (by CDC)
	Distance to protected area or conservation land	10	0 – 1.6km 1.6 – 3.2km 3.2 – 4.8km 4.8 km- 9.6km > 9.6km	10 8 4 2 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Aspen Parkland / Moist Mixed Grassland / Portion of Boreal Transition: *Small Wetlands*

Parameter	Variable	% Total	Scoring Value	Scoring Score	Measure	Notes
Condition 35%	% Natural cover	30	1- 30% 30 - 50% 50 – 60% 60 – 70% 70 - 80% 80 - 100%	0 5 10 15 25 30	Average per Wetland Density Polygon (WDP)	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0-0.28km/km^2 0.28- 0.81km/km^2 .81–1.45km/km^2 1.45 – 2.45km/km^2 2.45 – 8.00km/km^2	5 4 3 2 1	Average per WDP	Average road density * based on natural breaks
Diversity 5%	Diversity	5	0,1 2,3 4,5 >5	0 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the WDP taken	Calculated using a 2-by-2 cell size window and the variety was recorded
Ecological Function 40%	Wetland Density	30	3.48 - 5.97 wetland/km^2 5.97 - 16.27 wetlands/km^2	20 30	Grouped similar based on five wetland density classes based on natural breaks in the data	Only used thesse two classes of wetland densities. Lower wetland density areas were ignored
	Size of WPD (wetland density polygon)	10	0.36 - 44,065ha 44,065 - 124,607ha >124,607ha	0 5 10	Area of top two natural breaks in wetland density data (above)	Based on natural breaks in the data
Special Features 20%	Presence of primary species targets	5	1 >1	1 5	Count of EO for a WDP	Ecological system contains an EO for a primary target species
	Presence of additional features of conservation concern	5	1 >1	2 5	Count of additional EOs for a WDP	Ecological system contains an EO for additional features tracked (by CDC)
	Distance to protected area or conservation land	10	0 – 1.6km 1.6 – 3.2km 3.2 – 4.8km 4.8 km- 9.6km > 9.6km	10 8 4 2 0	Average value for a WDP	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Aspen Parkland / Moist Mixed Grassland / Portion of Boreal Transition: *Mud/Sand/Saline*

Parameter	Variable	% Total	Scoring Value	Score	Measure	Notes
Condition 15%	% Natural cover	10	1 - 10% 10 - 20 20 – 30 to 90 - 100	1 2 13 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0 - 0.28km/km^2 0.28 - 0.81km/km^2 0.81–1.45km/km^2 1.45 – 2.45km/km^2 2.45 – 8.00km/km^2	5 4 3 2 1	Average road density for ecological system polygon	Calculated as the km per square km within a 500m search radius Scores based on natural breaks in the data
Diversity 5%	Simple diversity	5	0,1 2,3 4,5 >5	0 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the ecological system polygon taken	Calculated using a 2-by-2 cell size window and the variety was recorded
Ecological Function 45%	Size of patch	45	0.36 - 64ha 64 - 256ha >256ha	15 30 45	Value per ecological system polygon	Based on a minimum of 0.36ha patch size
Special Features 35%	Presence of primary species targets	15	1 2 - 3 >3	5 10 15	Count of EO for an ecological system polygon	Ecological system contains an EO for a primary target species
	Presence of additional features of conservation concern	10	1 - 3 4 - 6 6 - 9 >9	2 5 8 10	Count of additional EOs for an ecological system polygon	Ecological system contains an EO for additional species tracked (by CDC)
	Distance to protected area or conservation land	10	0 – 1.6km 1.6 – 3.2km 3.2 – 4.8km 4.8 km- 9.6km > 9.6km	10 8 4 2 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Mixed Grassland / Cypress Upland: *Grasslands and Woodlands*

Parameter	Variable	% Total	Scoring Value	Score	Measure	Notes
Condition 15%	% Natural cover	10	1 - 10% 10 - 20 20 – 30 to 90 - 100	1 2 3 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0 - 0.25km/km^2 0.25 - 0.59km/km^2 0.59 - 1.35km/km^2 >1.35km/km^2	5 4 2 0	Average road density for each ecological system polygon	Calculated as the km per square km within a 500m search radius
Diversity 5%	Simple diversity	5	0 1 - 3 4 - 7 7 - 14 >14	0 1 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the ecological system polygon taken	Calculated using a 2-by-2 cell size window and the variety was recorded
Ecological Function 50%	Size of patch	15	16 - 64ha 65 - 256ha 256 - 1024ha 1024 - 4096ha >4096ha	3 6 9 12 15	Value per ecological system polygon	Based on a minimum of 0.36ha patch size
	Shape (minimum habitat area)	20	30 - 180m 180 - 360m 360- 720m 720 - 1440m >1440	0 5 10 15 20	Value per ecological system polygon	Based on a minimum of 16ha patch size Calculated based on the largest diameter circle that can be drawn within an ecological system polygon
	Connectivity score	15	0 - 250m 250 - 500m 500 - 1000m >1 km	15 10 5 0	Average value per ecological system polygon	Beyond 1.0 km not considered connected enough to score. Conectivity varies with organism, so this is only a relative measure
Special Features 30%	Presence features of conservation concern	15	1 2 - 3 >3	5 10 15	Count of EO for an ecological system polygon	Ecological system contains an EO for a primary target species, or other features tracked by the CDC
	Presence of additional features of conservation concern	10	1 - 3 4 - 6 6 - 9 >9	2 6 8 10	Count of additional EO targets for an ecological system polygon	Ecological system contains migratory bird concentration site or a snake hibernacula
	Distance to protected area or conservation land	5	0 – 1.6km 1.6 - 3.2km 3.2 - 4.8km >4.8km-	5 3 1 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Mixed Grassland / Cypress Upland: *Large Wetlands*

Parameter	Variable	% Total	Scoring Value	Score	Measure	Notes
Condition 15%	% Natural cover	10	1 - 10% 10 - 20 20 – 30 to 90 - 100	1 2 3 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0 - 0.25km/km^2 0.25 - 0.59m/km^2 0.59 - 1.35km/km^2 >1.35km/km^2	5 4 2 0	Average road density for each ecological system polygon	Calculated as the km per square km within a 500m search radius
Diversity 5%	Simple diversity	5	0 1 - 3 4 - 7 7 - 14 >14	0 1 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the ecological system polygon taken	Calculated using a 2 by 2 cell size window and the variety was recorded
Ecological Function 45%	Size of patch	45	20 - 64ha 65 - 256ha >256ha	15 30 45	Value per ecological system polygon	Based on a minimum of 16ha patch size
Special Features 35%	Presence of features of conservation concern	15	1 2 - 3 >3	5 10 15	Count of EO for an ecological system polygon	Ecological system contains an EO for a primary target species, or other features tracked by the CDC
	Species concentration site	10	1 - 3 4 - 6 6 - 9 >9	2 6 8 10	Count of additional EO targets for an ecological system polygon	Ecological system contains migratory bird concentration site or a snake hibernacula
	Distance to protected area or conservation land	10	0 – 1.6km 1.6 - 3.2km 3.2 - 4.8km 4.8 - 9.6km >9.6km	10 8 4 2 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Mixed Grassland / Cypress Upland: *Small Wetlands*

Parameter	Variable	% Total	Scoring Value	Score	Measure	Notes
Condition 35%	% Natural cover	30	0 - 30% 30 - 50 50 – 60 60 - 70 50 - 80 80 - 100	0 5 10 15 25 30	Average per Wetland Density Polygon (WDP)	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0 - 0.25km/km^2 0.25 - 0.59km/km^2 0.59 - 13.5km/km^2 >13.5km/km^2	5 4 2 0	Average per WDP	Calculated as the km per square km within a 500m search radius
Diversity 5%	Simple diversity	5	0 1 - 3 4 - 7 7 - 14 >14	0 1 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the WDP taken polygon taken	Calculated using a 2 by 2 cell size window and the variety was recorded
Ecological Function 40%	**Wetland density	30	3.48 - 5.97 wetlands/km^2 5.97 - 16.27km/km^2	20 30	Grouped similar based on five wetland density classes based on natural breaks in data	Only used thes two classes of wetland densities. Lower wetland densitty areas were ignored
	Size of WPD (wetland density polygon)	10	16 - 10,704ha 10,704 - 36,691ha 36,691- 119,107ha	0 5 10	Area of top two natural breaks in wetland densitty data (above)	Based on natural breaks in the data
Special Features 20%	Presence features of conservation concern	5	1 >1	1 5	Count of EO for a WDP	Ecological system contains an EO for a primary target species, or other features tracked by the CDC
	Species concentration site	5	1 >1	2 5	Count of additional EO targets for a WDP	Ecological system contains migratory bird concentration site or a snake hibernacula
	Distance to protected area or conservation land	10	0 – 1.6km 1.6 - 3.2km 3.2 - 4.8km 4.8 - 9.6km >9.6km	10 8 4 2 0	Average value for a WDP	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Mixed Grassland / Cypress Upland: *Mud / Sand / Saline*

Parameter	Variable	% Total	Scoring Value	Score	Measure	Notes
Condition 15%	% Natural cover	10	1 - 10% 10 - 20 20 – 30 to 90 - 100	1 2 3 10	Average for the ecological system polygon	Calculated as the as the average percentage natural cover within 2km 1 point per 10%
	Road density	5	0 - 0.25km/km^2 0.25 - 0.59km/km^2 0.59 - 1.35km/km^2 >1.35km/km^2	5 4 2 0	Average per ecological system polygon	Average road density *based on natural breaks in the data
Diversity 5%	Simple diversity	5	0 1 - 3 4 - 7 7 - 14 >14	0 1 2 4 5	Done on a pixel-by-pixel basis, then zonalmax for the ecological system polygon taken	Calculated using a 2 by 2 cell size window and the variety was recorded
Ecological Function 45%	Size of patch	45	0.36 - 64ha 64 - 256ha >256ha	15 30 45		
Special Features 20%	Presence of features of conservation concern	15	1 2 - 3 >3	5 10 15	Count of EO for an ecological system polygon	Ecological system contains an EO for a primary target species, or other features tracked by the CDC
	Species concentration site	10	1 - 3 4 - 6 6 - 9 >9	2 5 8 10	Count of additional EO targets for an ecological system polygon	Ecological system contains a migratory bird concentration site or a snake hibernacula
	Distance to protected area or conservation land	10	0 – 1.6km 1.6 – 3.2km 3.2 – 4.8km 4.8 - 9.6km >9.6km	10 8 4 2 0	Average value for an ecological system polygon	Assumption – Patches closer to existing protected areas have higher biodiversiy value than those farther away. Dependent on scale of organisms within ecological system.
TOTAL		**100**		**100 pts**		

Appendix C
Ecoregion Crosswalk Tables and Ecodistrict List

In general, Canadian ecoregions are equivalent to those developed by the Ecological Stratification Working Group (ESWG 1995), as indicated below, and the U.S. ecoregions are equivalent to those used by The (U.S.) Nature Conservancy, based on Bailey (1994; equivalent to U.S. ecological "sections"). Canadian ecodistricts are also based on the ESWG framework, as detailed below by each provincial jurisdiction, and the U.S. ecodistricts are generally equivalent to U.S. "subsections", as detailed below by each state jurisdiction.

Ecoregions

Aspen Parkland
(Includes ESWG units 156, 161-164)

Moist Mixed Grassland
(Includes ESWG units 157, 158)

Mixed Grassland
(ESWG unit 159)

Cypress Upland
(ESWG unit 160)

Portion of **Boreal Transition**
(Includes ESWG units 154, part of 149)

Ecodistricts

NCC terminology in bold; equivalent or overlapping provincial/state or other agency terminology in brackets.

ALBERTA
(Alberta Sustainable Resource Development et al. 2005)

- **Cypress Upland** (Montane, Mixedgrass and Dry Mixedgrass Natural sub-regions)
- **Mixed Grassland** (primarily Dry Mixed Grass Natural sub-region)
- **Moist Mixed Grassland** (primarily Mixedgrass, Foothills Fescue, and Northern Fescue Natural sub-regions + small areas of Central Parkland and Montane Natural sub-regions)
- **Aspen Parkland** (primarily Foothills Parkland and Central Parkland Natural sub-regions + small areas of Dry Mixedwood Natural sub-regions)

SASKATCHEWAN
(Acton et al. 1998)

- **Cypress Upland** (Cypress Upland)
- **Mixed Grassland** (Mixed Grassland)
- **Moist Mixed Grassland** (Moist Mixed Grassland)
- **Aspen Parkland** (Aspen Parkland)

MANITOBA
(Smith et al. 1998)

- **Aspen Parkland** (Aspen Parkland, portion of Lake Manitoba Plain, and islands of Boreal transition ecoregions)

MONTANA
(Woods et al. 2002)

- **Moist Mixed Grassland** (TNC – Fescue-Mixed Grass Prairie; Montana – Montana Valley and Foothill grasslands)

NORTH DAKOTA
(Bryce *et al.*1996)
(www.npwrc.usgs.gov/resource/habitat-/ndsdeco/nodak.htm)

- **Moist Mixed Grassland** (Northern Dark Brown Prairie)
- **Aspen Parkland** (Northern Black Prairie; Turtle Mountains; portion of the Glacial Lake Deltas and Glacial Lake Basins)

No.	Name	Ecoregion
709	Swan River Plain	Boreal Transition
716	Riding Mountain	Boreal Transition
727	Leduc	Aspen Parkland
728	Andrew	Aspen Parkland
729	Lloydminister Plain	Aspen Parkland
730	Vermilion	Aspen Parkland
731	Daysland	Aspen Parkland
732	Cooking Lake	Aspen Parkland
733	Whitewood Hills	Aspen Parkland
734	Lower Battle River Plain	Aspen Parkland
735	Maymont Plain	Aspen Parkland
736	Waldheim Plain	Aspen Parkland
737	Red Deer	Aspen Parkland
738	Sedgewick	Aspen Parkland
739	Edgerton-Ribstone Plain	Aspen Parkland
740	Bashaw	Aspen Parkland
741	Cudworth Plain	Aspen Parkland
742	Hafford Plain	Aspen Parkland
743	Provost Plain	Aspen Parkland
744	Pine Lake	Aspen Parkland
745	Quill Lake Plain	Aspen Parkland
746	Olds	Aspen Parkland
747	Whitesand Plain	Aspen Parkland
748	Touchwood Hills Upland	Aspen Parkland
749	Yorkton Plain	Aspen Parkland
750	Black Diamond	Aspen Parkland
751	St. Lazare Plain	Aspen Parkland
752	Melville Plain	Aspen Parkland
753	Hamiota	Aspen Parkland
754	Indian Head Plain	Aspen Parkland
755	Moose Mountain Upland	Aspen Parkland
756	Kipling Plain	Aspen Parkland
757	Shilo	Aspen Parkland
758	Stockton	Aspen Parkland
759	Carberry	Aspen Parkland
760	Gainsborough-Northern Black Prairie	Aspen Parkland
761	Moose Mountain	Aspen Parkland
762	Moose Mountain Creek Plain	Aspen Parkland
763	Oak Lake Plain – Glacial Lake Basins	Aspen Parkland
764	Hilton	Aspen Parkland
765	Killarney – Northern Black Prairie	Aspen Parkland
766	Manitou	Aspen Parkland

No.	Name	Ecoregion
839	Grandview	Aspen Parkland
840	Dauphin	Aspen Parkland
841	Alonsa	Aspen Parkland
843	Ste. Rose	Aspen Parkland
844	McCreary	Aspen Parkland
847	Gladstone	Aspen Parkland
850	MacGregor	Aspen Parkland
854	Pembina	Aspen Parkland
855	Turtle Mountains	Aspen Parkland
ND1	Northern Black Prairie 1	Aspen Parkland
ND2	Pembina Escarpment	Aspen Parkland
767	Tramping Lake Plain	Moist Mixed Grassland
768	Senlac Hills	Moist Mixed Grassland
769	Castor	Moist Mixed Grassland
770	Goose Lake Plain	Moist Mixed Grassland
771	Neutral Hills	Moist Mixed Grassland
772	Saskatoon Plain	Moist Mixed Grassland
773	Estow Plain	Moist Mixed Grassland
774	Minichinas Upland	Moist Mixed Grassland
775	Bear Hills	Moist Mixed Grassland
776	Moosewood Sand Hills	Moist Mixed Grassland
777	Sullivan Lake	Moist Mixed Grassland
778	Biggar Plain	Moist Mixed Grassland
779	Endiang	Moist Mixed Grassland
780	Rosetown Plain	Moist Mixed Grassland
781	Drumheller	Moist Mixed Grassland
782	Arm River Plain	Moist Mixed Grassland
783	Strasbourg Plain	Moist Mixed Grassland
784	Last Mountain Lake Plain	Moist Mixed Grassland
785	Allan Hills	Moist Mixed Grassland
786	Wintering Hills	Moist Mixed Grassland
787	Majorville Upland	Moist Mixed Grassland
788	Standard Plain	Moist Mixed Grassland
789	Eyebrow Plain	Moist Mixed Grassland
790	Blackfoot Plain	Moist Mixed Grassland
791	Vulcan Plain	Moist Mixed Grassland
792	Regina Plain	Moist Mixed Grassland
793	Lethbridge Plain	Moist Mixed Grassland
794	Griffin Plain	Moist Mixed Grassland
796	Trossachs Plain	Moist Mixed Grassland
797	Milk River Upland	Moist Mixed Grassland
798	Delacour Plain	Moist Mixed Grassland
799	Willow Creek Upland	Moist Mixed Grassland
800	Cardston Plain	Moist Mixed Grassland

No.	Name	Ecoregion
801	Twin Butte	Moist Mixed Grassland
802	Del Bonita Plateau Foothill Grassland	Moist Mixed Grassland
MT1	Foothill Grassland	Moist Mixed Grassland
MT2	North Central Brown Glaciated Plains	Moist Mixed Grassland
MT3	Rocky Mountain Front Foothill Potholes 1	Moist Mixed Grassland
MT4	Rocky Mountain Front Foothill Potholes 2	Moist Mixed Grassland
MT5	Rocky Mountain Front Foothill Potholes 3	Moist Mixed Grassland
803	Kerrobert Plain	Mixed Grassland
804	Sounding Creek Plain	Mixed Grassland
805	Sibbald Plain	Mixed Grassland
806	Berry Creek Plain	Mixed Grassland
807	Bad Hills	Mixed Grassland
808	Eston Plain	Mixed Grassland
809	Oyen Plain	Mixed Grassland
810	Coteau Hills	Mixed Grassland
811	Acadia Plain	Mixed Grassland
812	Brooks Plain	Mixed Grassland
813	Beechy Hills	Mixed Grassland
814	Rainy Hills Upland	Mixed Grassland
815	Bindloss Plain	Mixed Grassland

No.	Name	Ecoregion
816	Chaplin Plain	Mixed Grassland
817	Hazlet Plain	Mixed Grassland
818	Bow City Plain	Mixed Grassland
819	Great Sand Hills	Mixed Grassland
820	Antelope Creek Plain	Mixed Grassland
821	Schuler Plain	Mixed Grassland
822	Dirt Hills	Mixed Grassland
823	Vauxhall Plain	Mixed Grassland
824	Gull Lake Plain	Mixed Grassland
825	Swift Current Plain	Mixed Grassland
826	Wood River Plain	Mixed Grassland
827	Maple Creek Plain	Mixed Grassland
828	Foremost Plain	Mixed Grassland
829	Purple Springs Plain	Mixed Grassland
830	Coteau Lakes Upland	Mixed Grassland
831	Lake Alma Upland	Mixed Grassland
832	Wood Mountain Plateau	Mixed Grassland
833	Wild Horse Plain	Mixed Grassland
834	Climax Plain	Mixed Grassland
835	Old Man on His Back Plateau	Mixed Grassland
836	Sweetgrass	Mixed Grassland
837	Cypress Slope	Cypress Upland
838	Cypress Hills	Cypress Upland

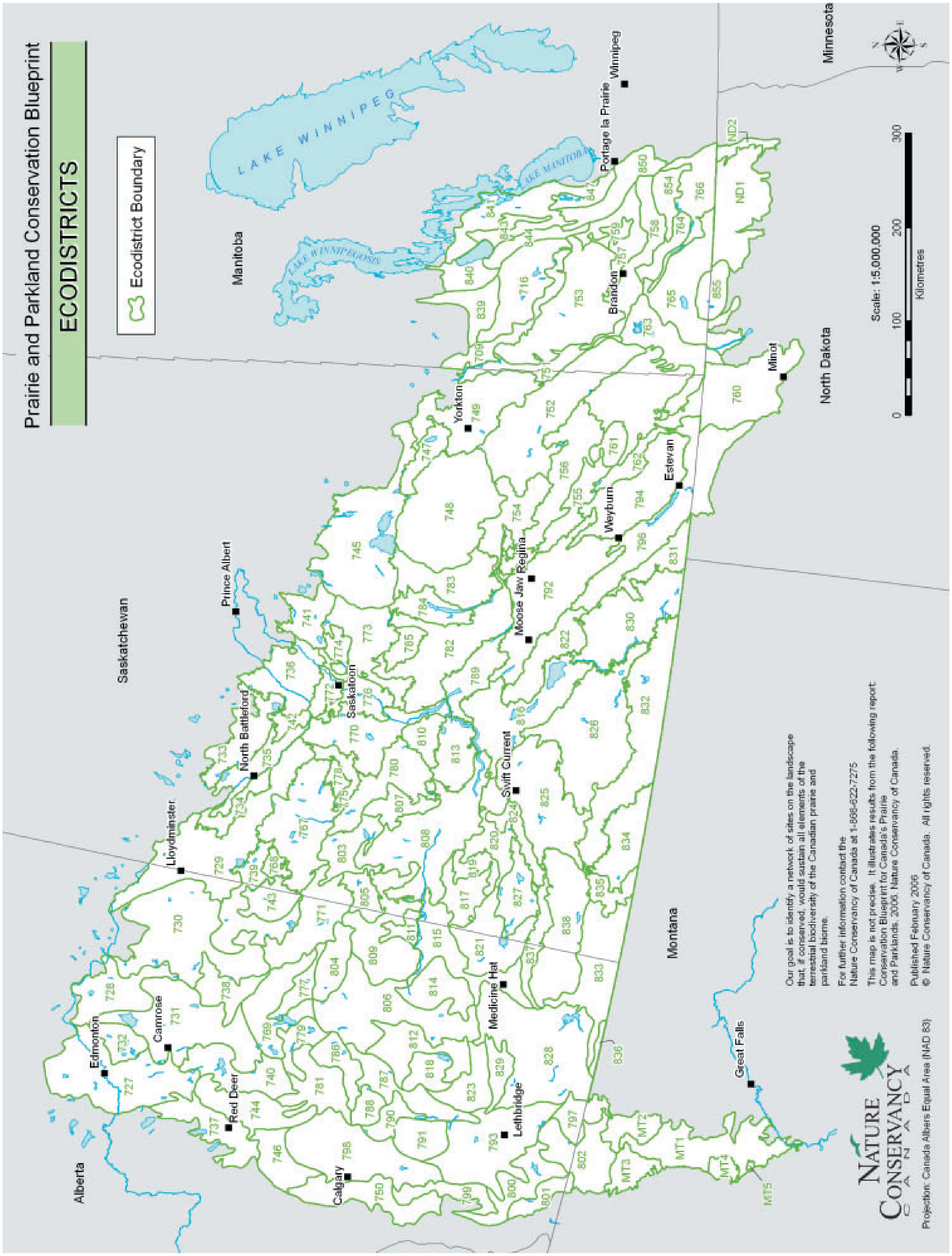
APPENDIX D
Blueprint Maps

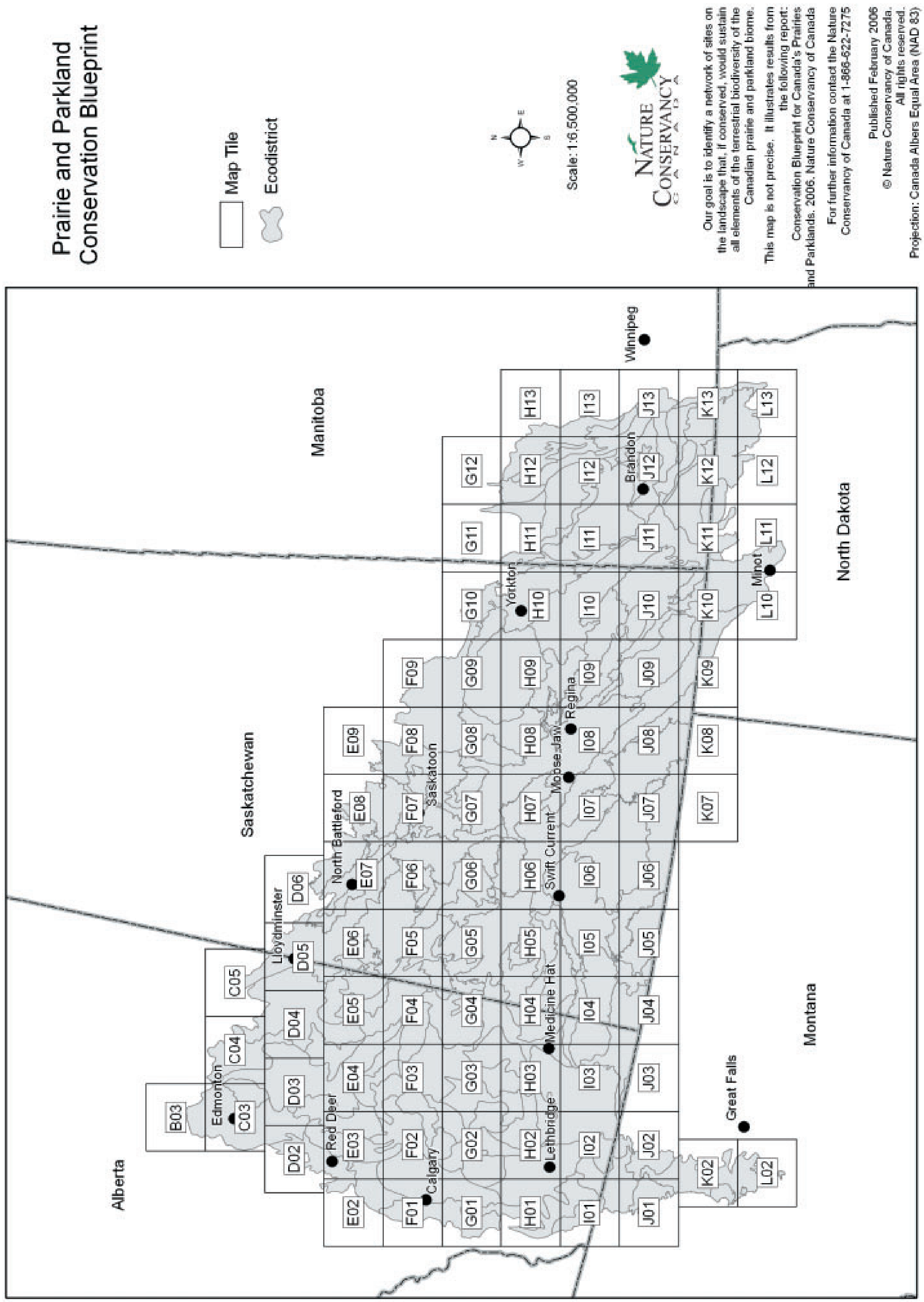
The following section contains a series of tiled maps graphically depicting the natural features and blueprint results for the entire prairie-parkland biome. The purpose for these maps is to assist the reader of this blueprint report or those without access to the digital maps/data, to graphically examine the results of this project. They have been designed to be easy to flip from map to map through the series in order to find areas of interest. Tiles have been mapped with enough overlap so not to lose any of the details along the maps edge.

The prairie biome in Canada and neighbouring United States consists of four distinct ecoregions of the **Aspen Parkland**, **Moist Mixed Grassland**, **Mixed Grassland**, and **Cypress Upland**. These ecoregions' boundaries are drawn on the maps for reference. It was decided to go with this format rather than mapping individual ecodistricts (sub-divisions of ecoregions), which can be irregular in shape and size. This cut down on the total number of maps required to illustrate this project, while maintaining a consistent mapping scale.

The series consists of an index map and 89 map tiles at a scale of 1:500,000. At this scale the Blueprint's portfolio of sites, native land cover, as well as the major hydrological and human features, can be easily identified. In addition, each ecodistrict is named on its corresponding map tile. These names correspond with those used in the Blueprint statistics for those ecodistricts, summarized in the Results section (see section 5, Table 5.2, and Figure 2) and in Appendix E.

Ecodistrict Map




Prairie and Parkland Conservation Blueprint
Map Tile
Ecodistrict
Scale: 1:6,500,000
Nature Conservancy Canada
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For further information contact the Nature Conservancy of Canada at 1-866-622-7275
Published February 2006
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Projection: Canada Albers Equal Area (NAD 83)
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Edmonton
Red Deer
Calgary
Lethbridge
Medicine Hat
Lloydminster
North Battleford
Saskatoon
Swift Current
Moose Jaw
Regina
Yorkton
Brandon
Winnipeg
Minot
Great Falls
B03
C03
C04
C05
D02
D03
D04
D05
D06
E02
E03
E04
E05
E06
E07
E08
E09
F01
F02
F03
F04
F05
F06
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H13
I01
I02
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I11
I12
I13
J01
J02
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J12
J13
K02
K07
K08
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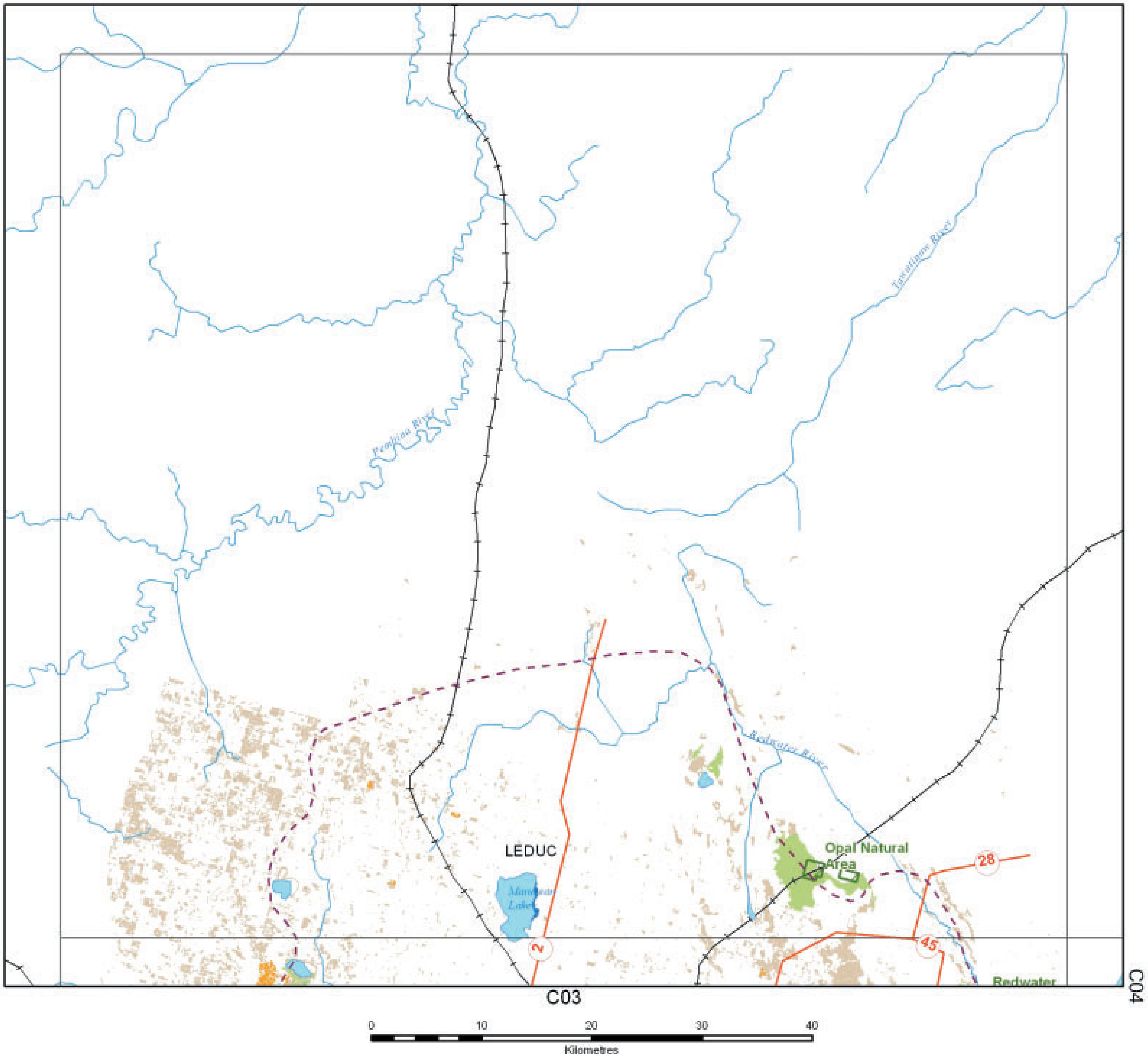
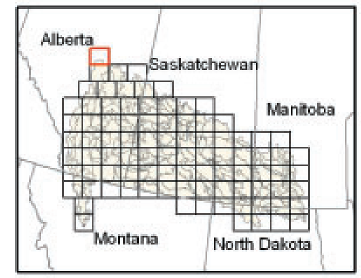
200
300
400
Kilometres



Prairie and Parkland Conservation Blueprint

Map Tile: B03



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N W E S

Scale: 1:500,000

Nature Conservancy Canada

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Published February 2006

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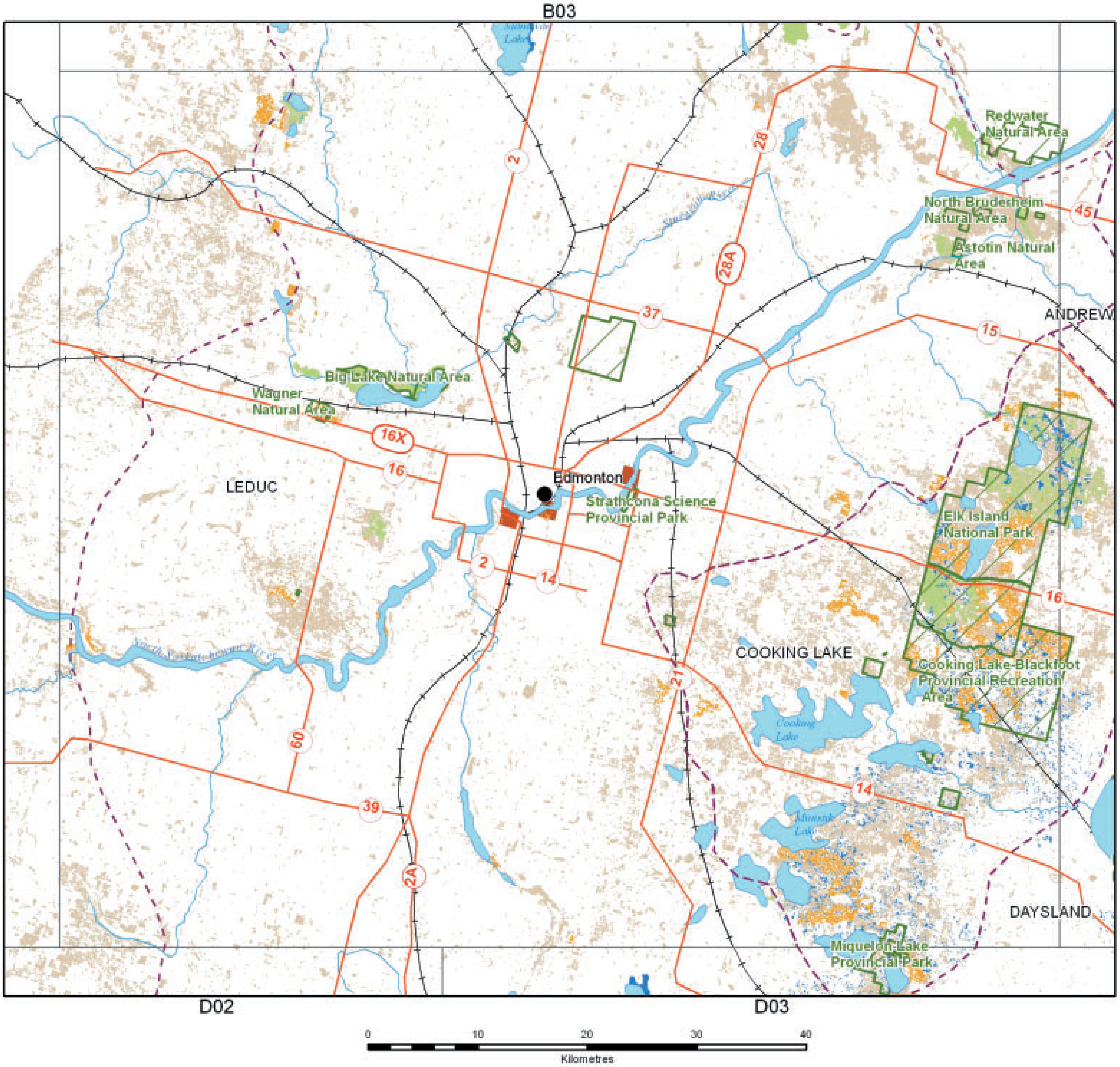
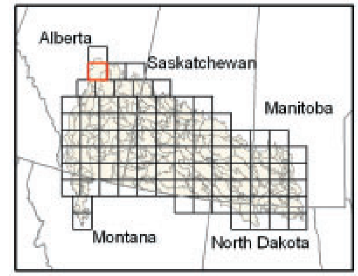


Prairie and Parkland Conservation Blueprint

Map Tile: C03



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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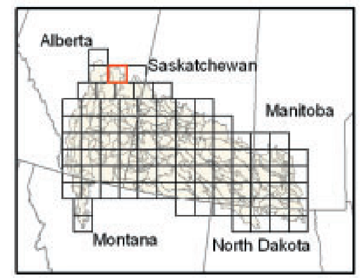
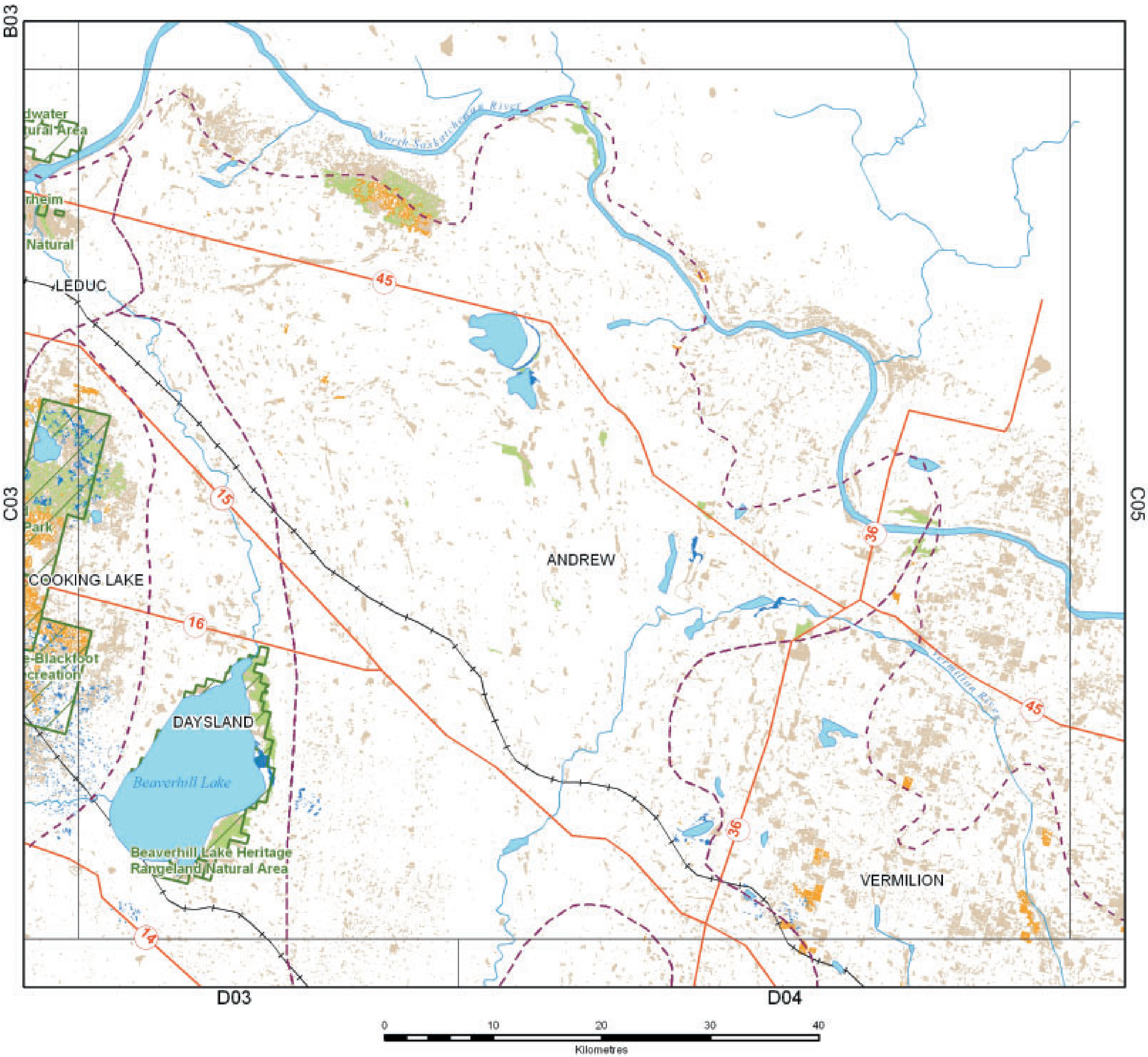
Published February 2006

Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: C04





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

NATURE CONSERVANCY CANADA

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Published February 2006

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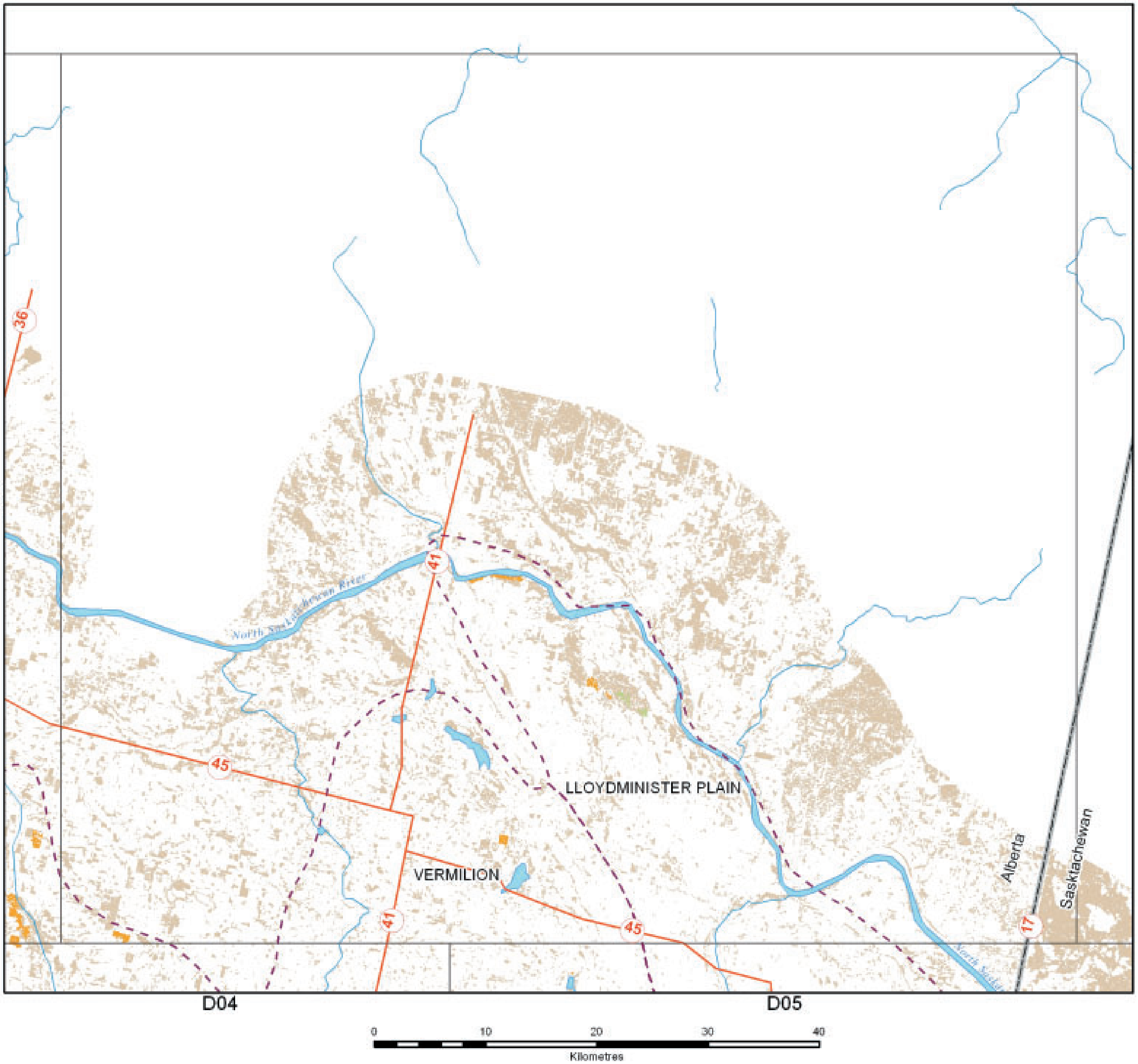
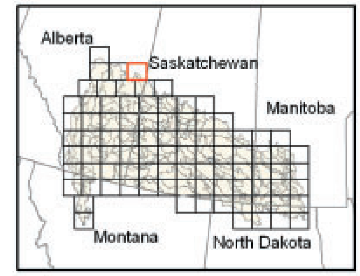


Prairie and Parkland Conservation Blueprint

Map Tile: C05



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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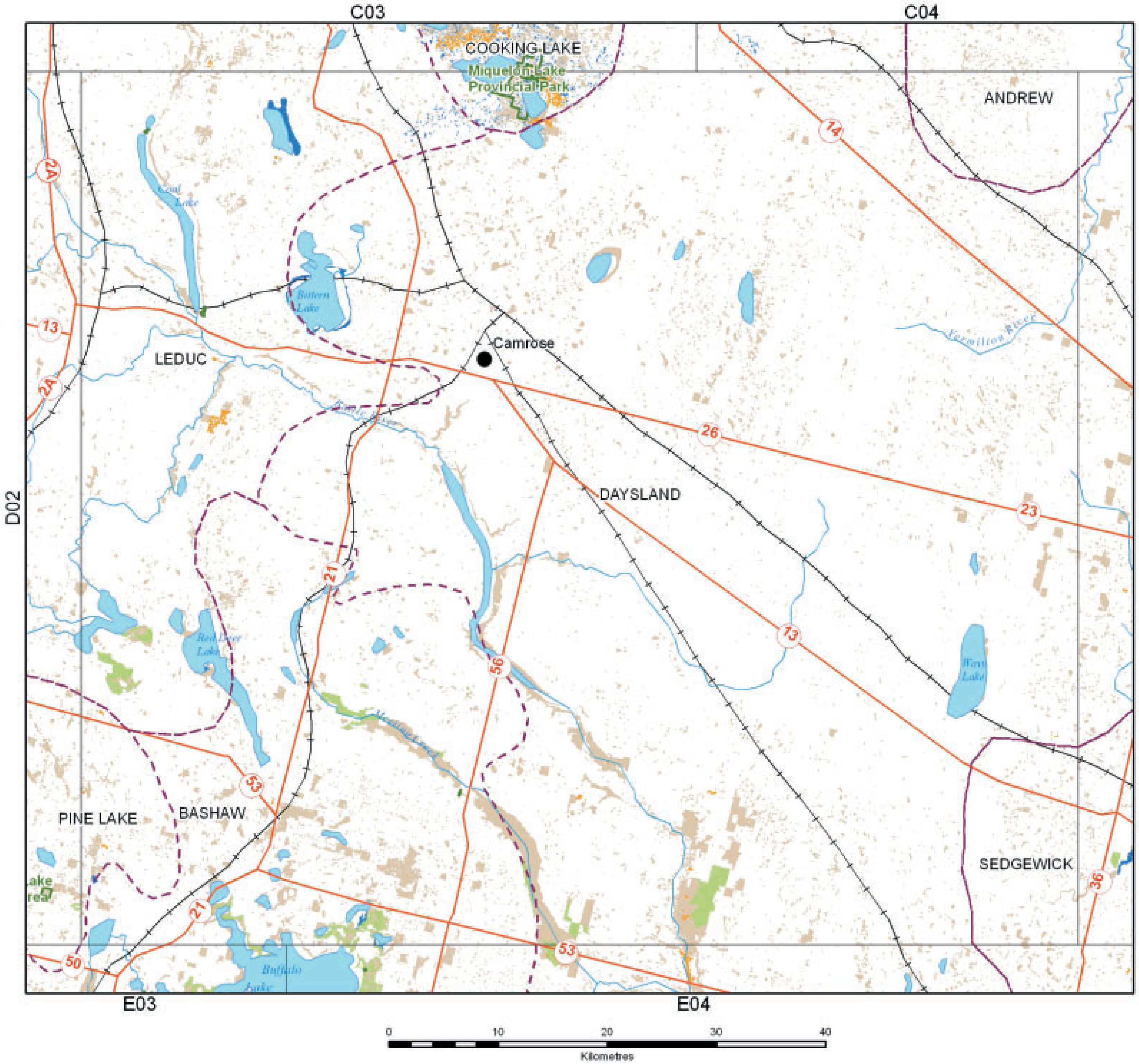
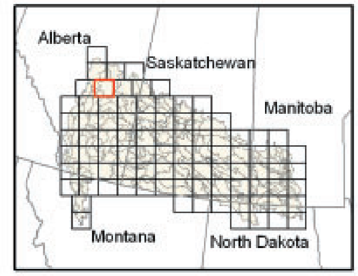


Prairie and Parkland Conservation Blueprint

Map Tile: D03



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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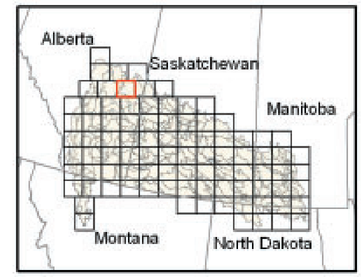
Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: D04



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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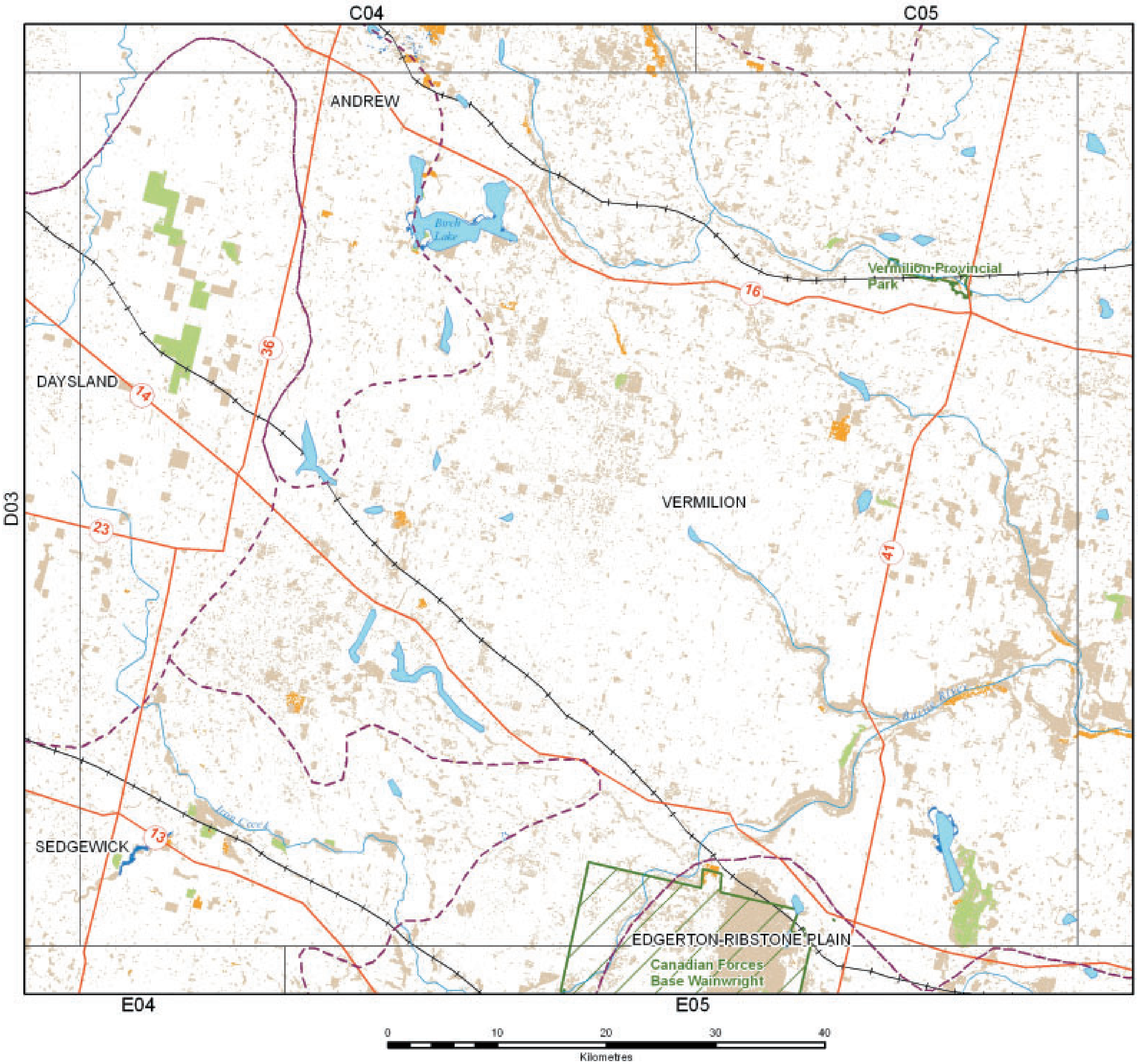

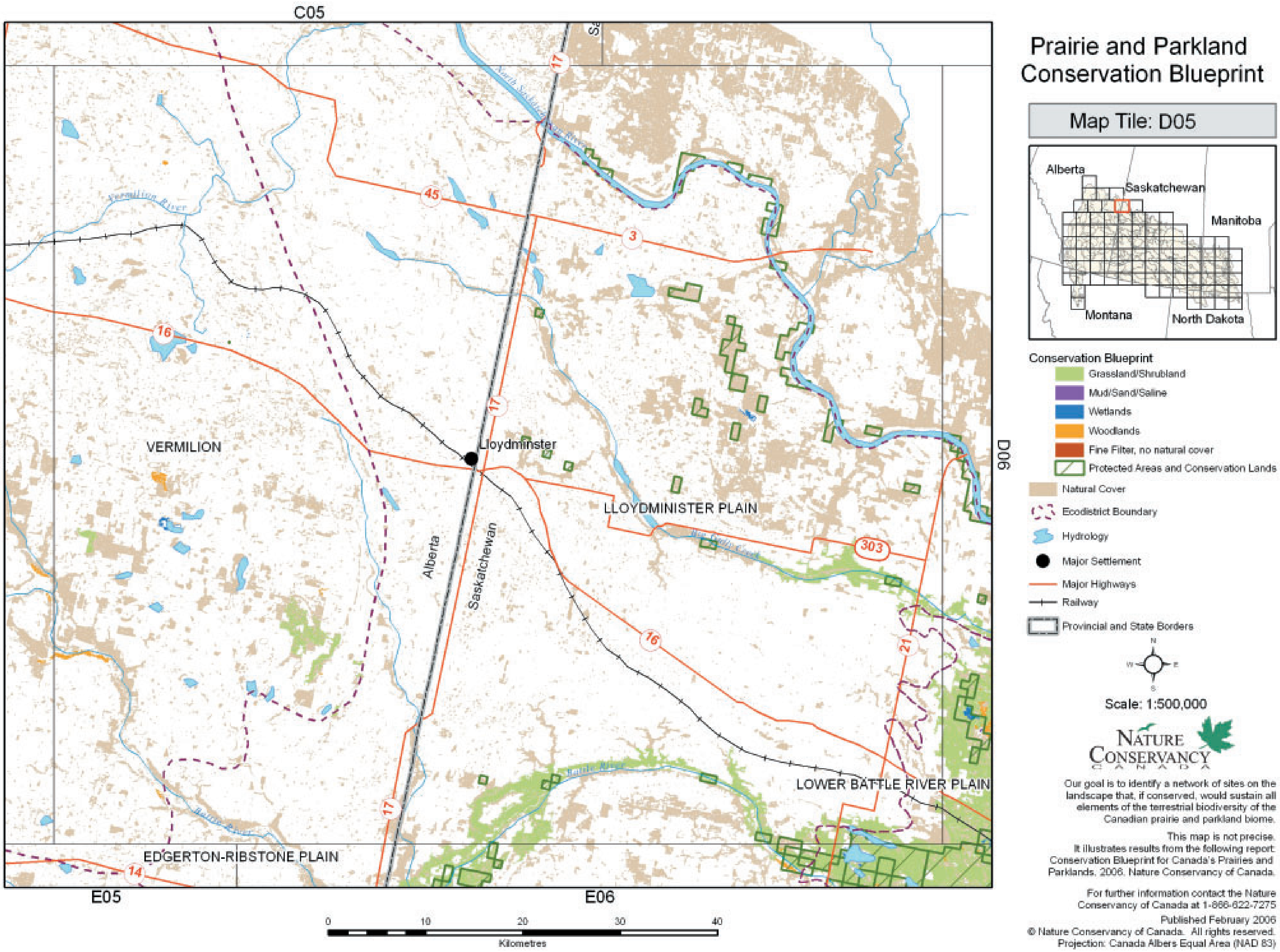
C05
D04
D06
E05
E06
VERMILION
Lloydminster
LLOYDMINISTER PLAIN
LOWER BATTLE RIVER PLAIN
EDGERTON-RIBSTONE PLAIN
Alberta
Saskatchewan
Vermilion River
North Saskatchewan River
Battle River
17
45
3
16
303
21
14
0 10 20 30 40
Kilometres
Prairie and Parkland Conservation Blueprint
Map Tile: D05
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
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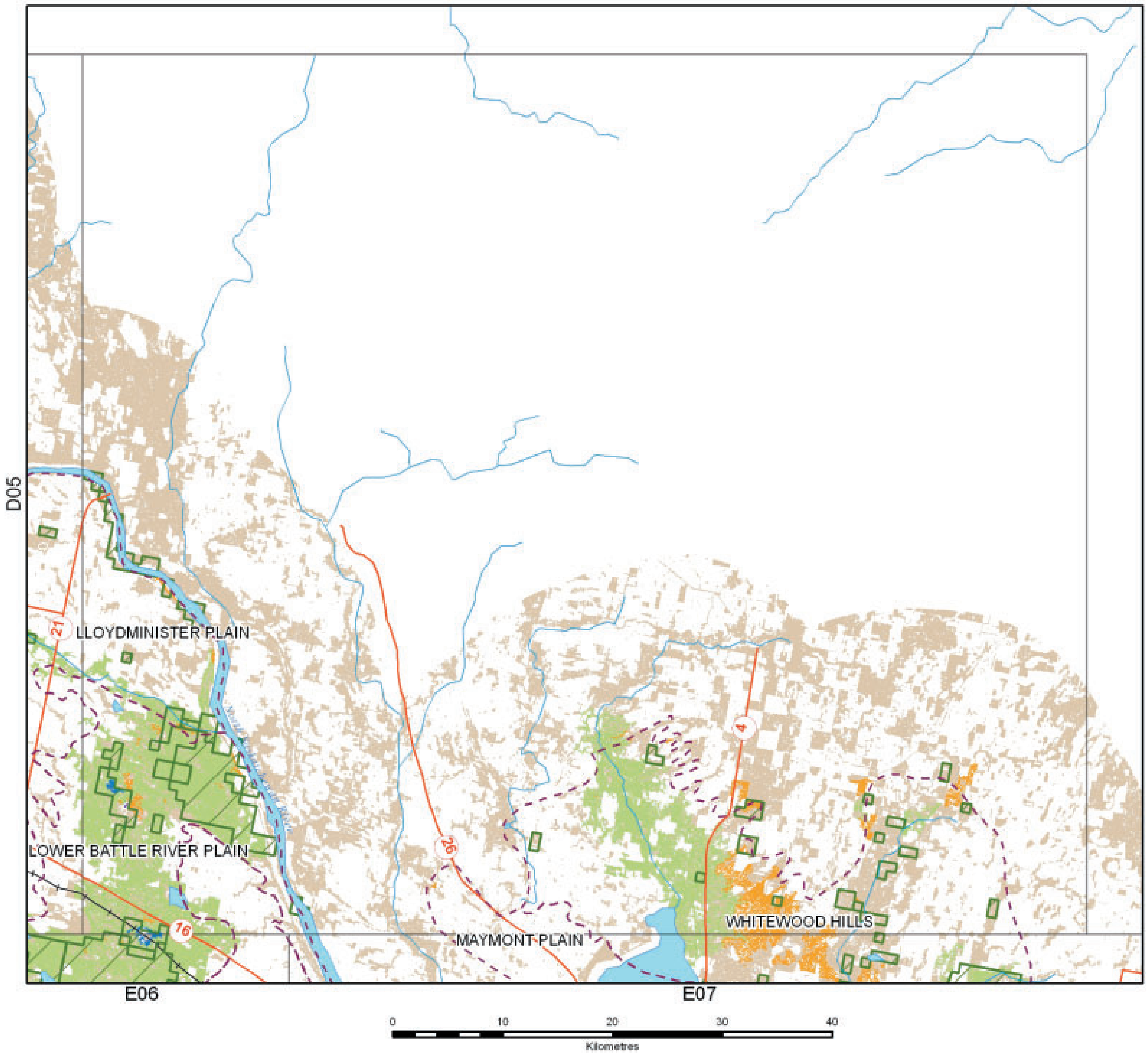
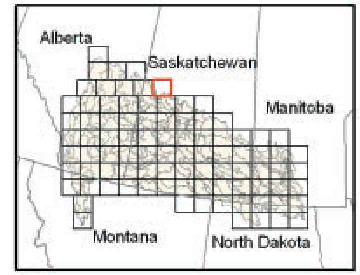


Prairie and Parkland Conservation Blueprint

Map Tile: D06



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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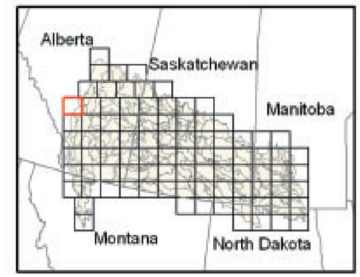
Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: E02



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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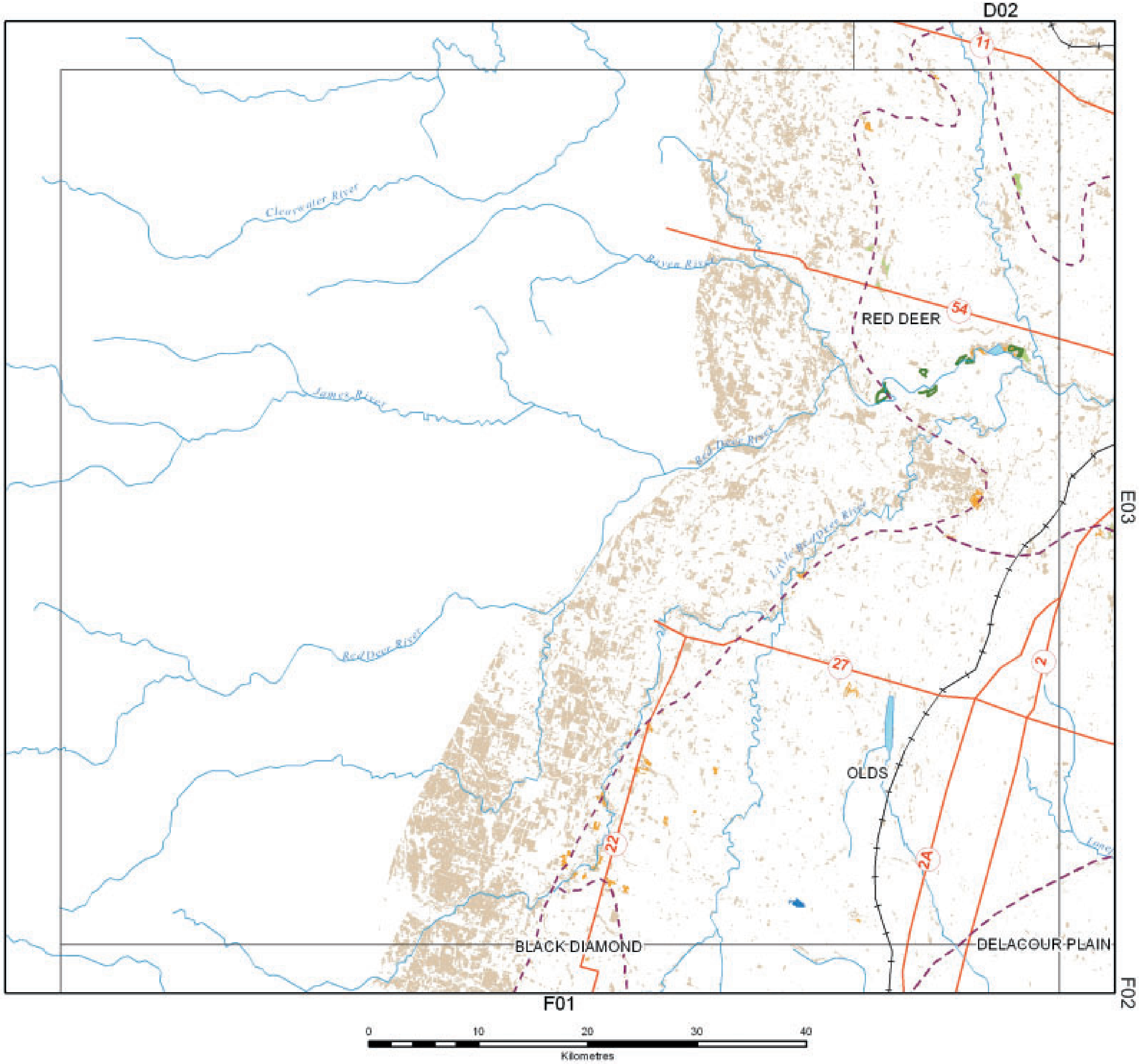
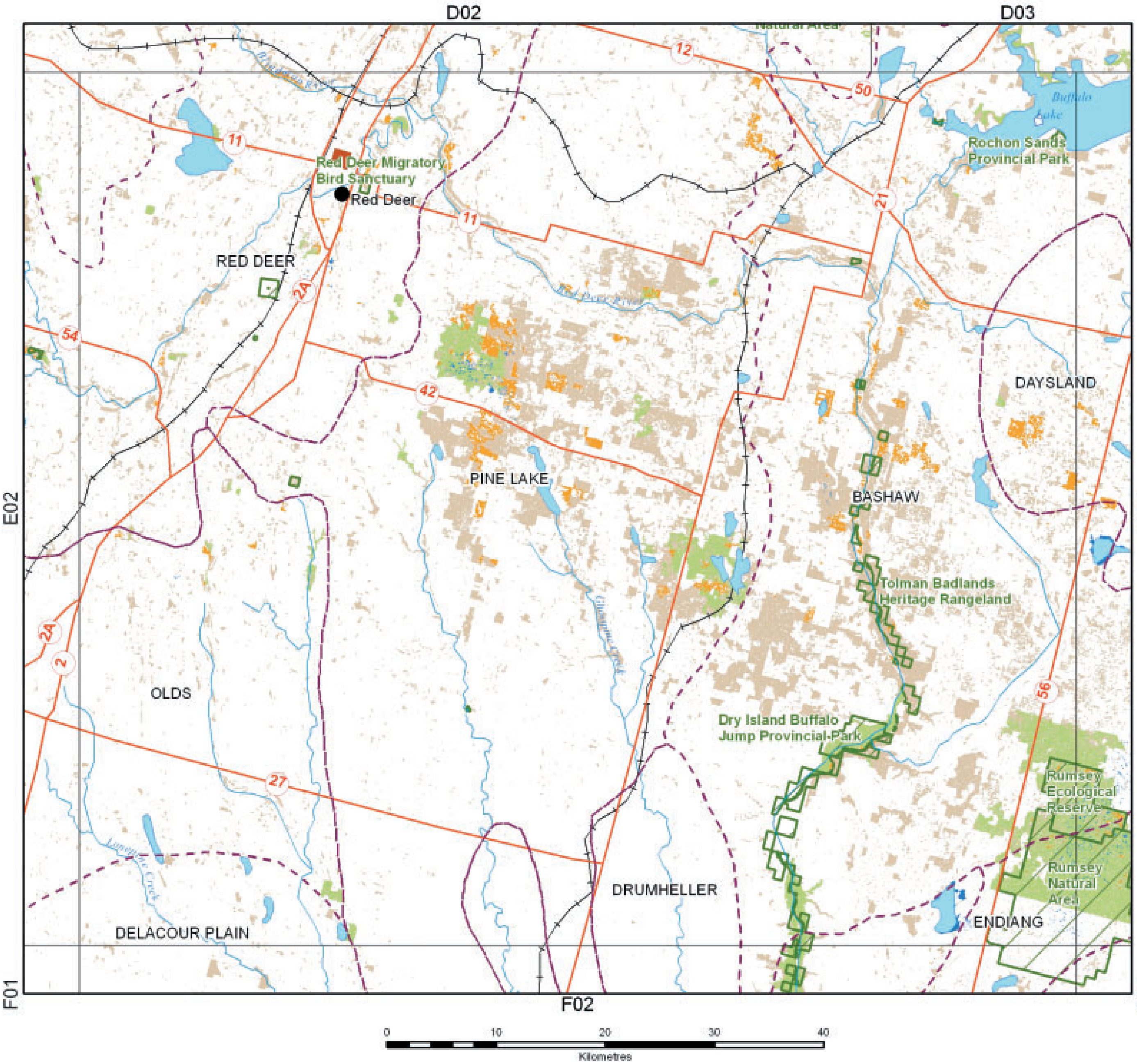
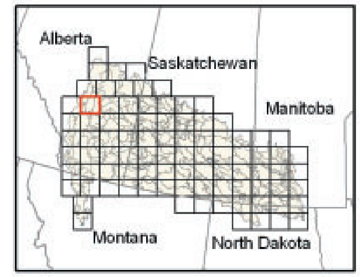




Prairie and Parkland Conservation Blueprint

Map Tile: E03



Conservation Blueprint

- Grassland/Shrubland
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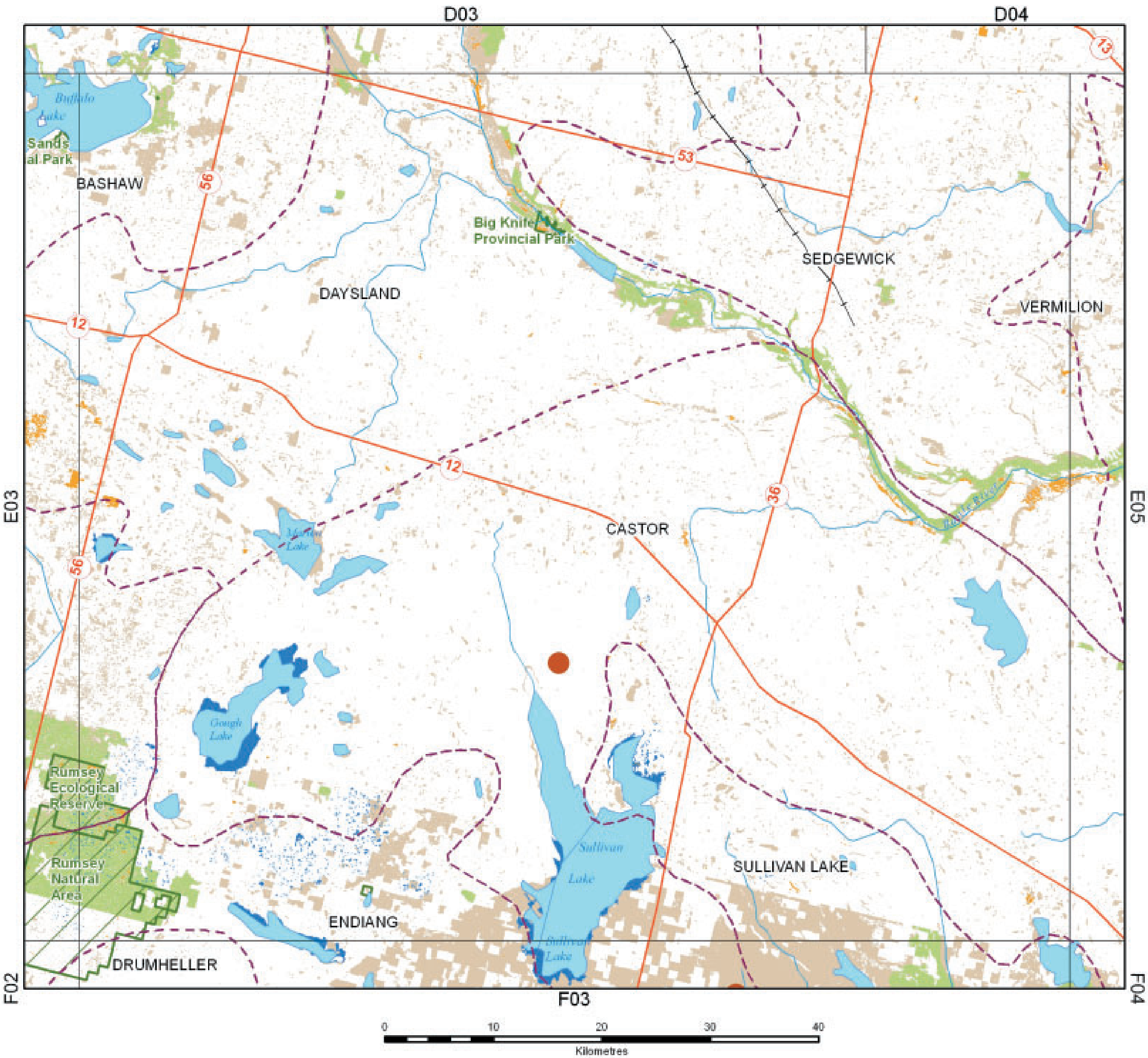
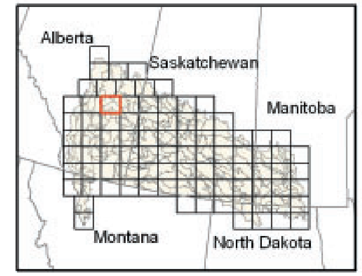


Prairie and Parkland Conservation Blueprint

Map Tile: E04



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

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- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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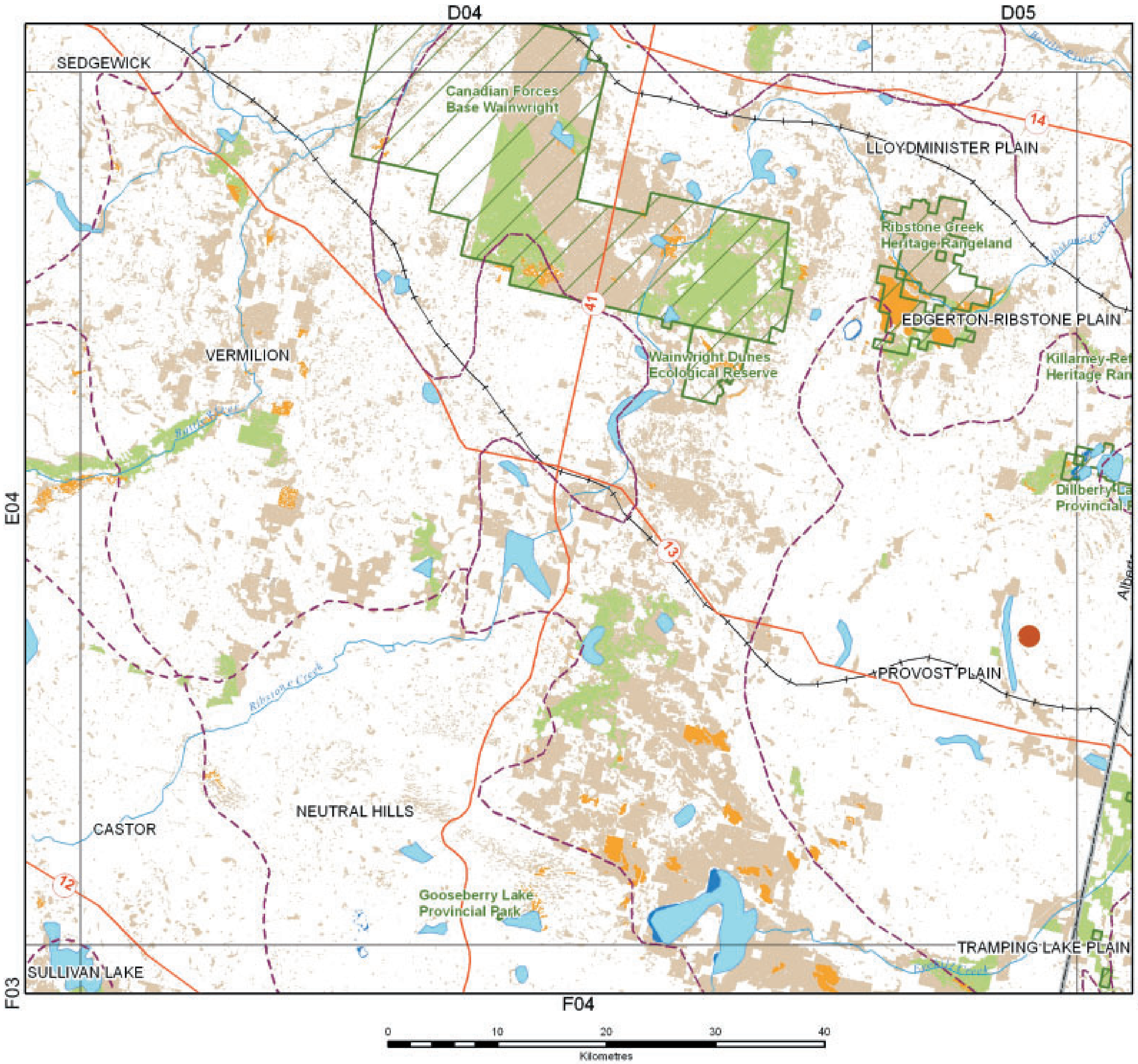
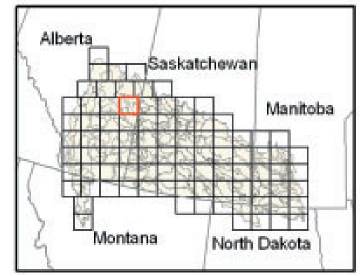


Prairie and Parkland Conservation Blueprint

Map Tile: E05



Conservation Blueprint

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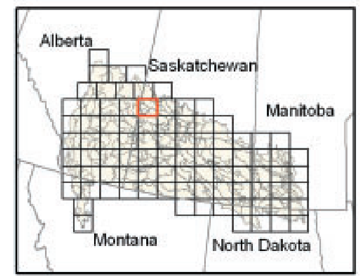
Published February 2006

Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: E06



Conservation Blueprint
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- Wetlands
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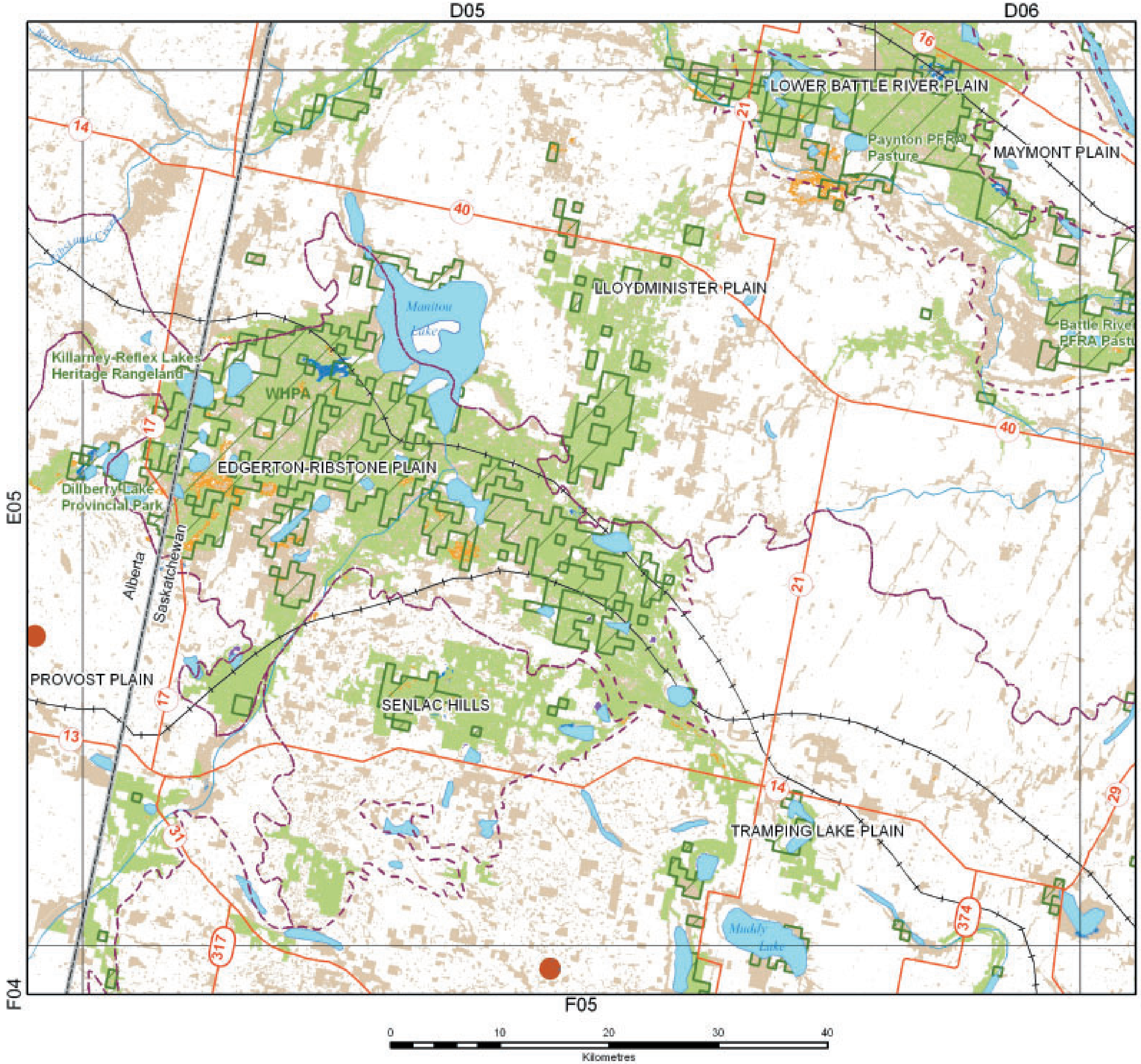
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000



NATURE CONSERVANCY CANADA

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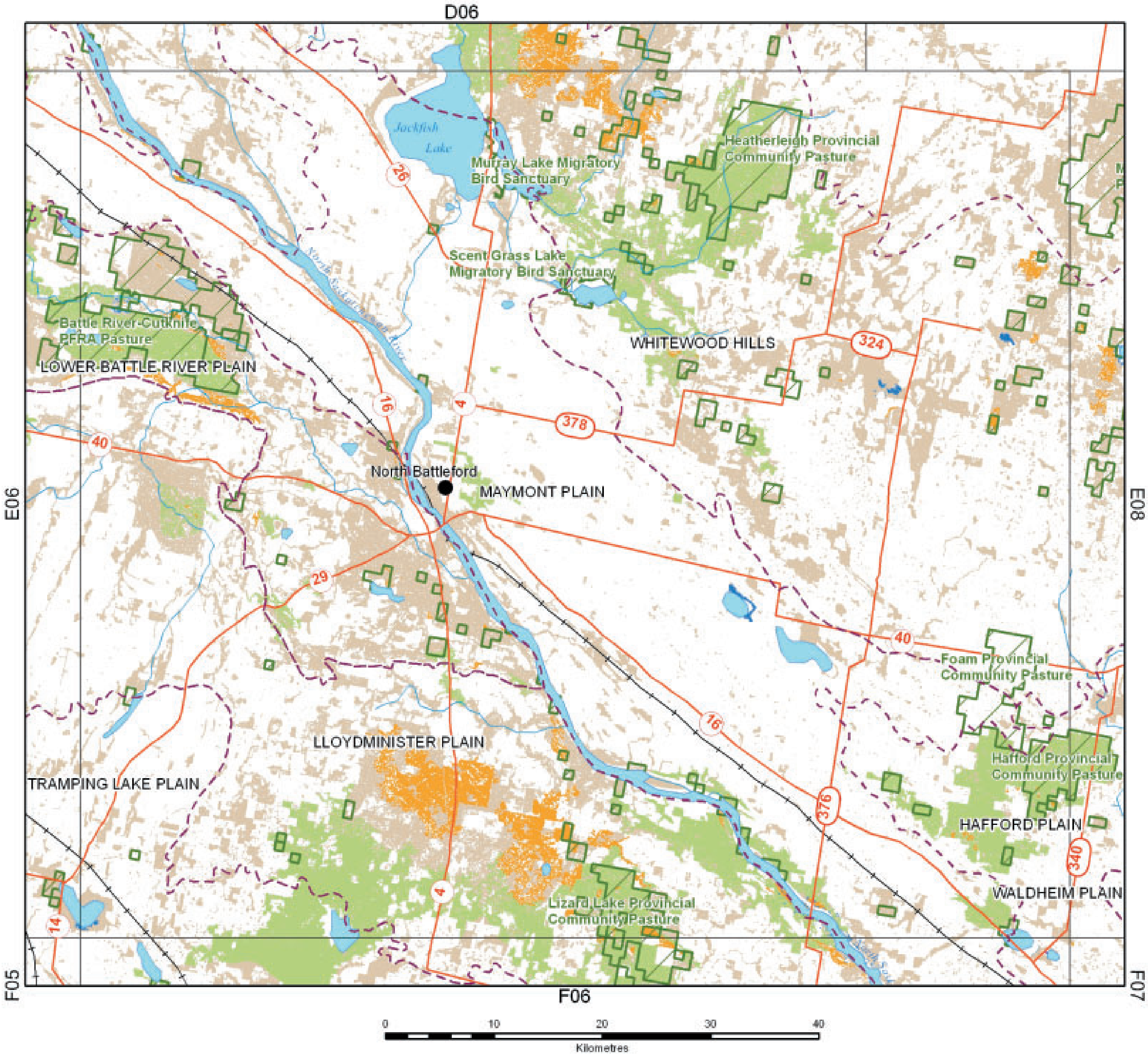
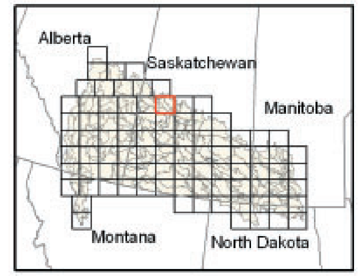


Prairie and Parkland Conservation Blueprint

Map Tile: E07



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
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- Railway
- Provincial and State Borders

Scale: 1:500,000

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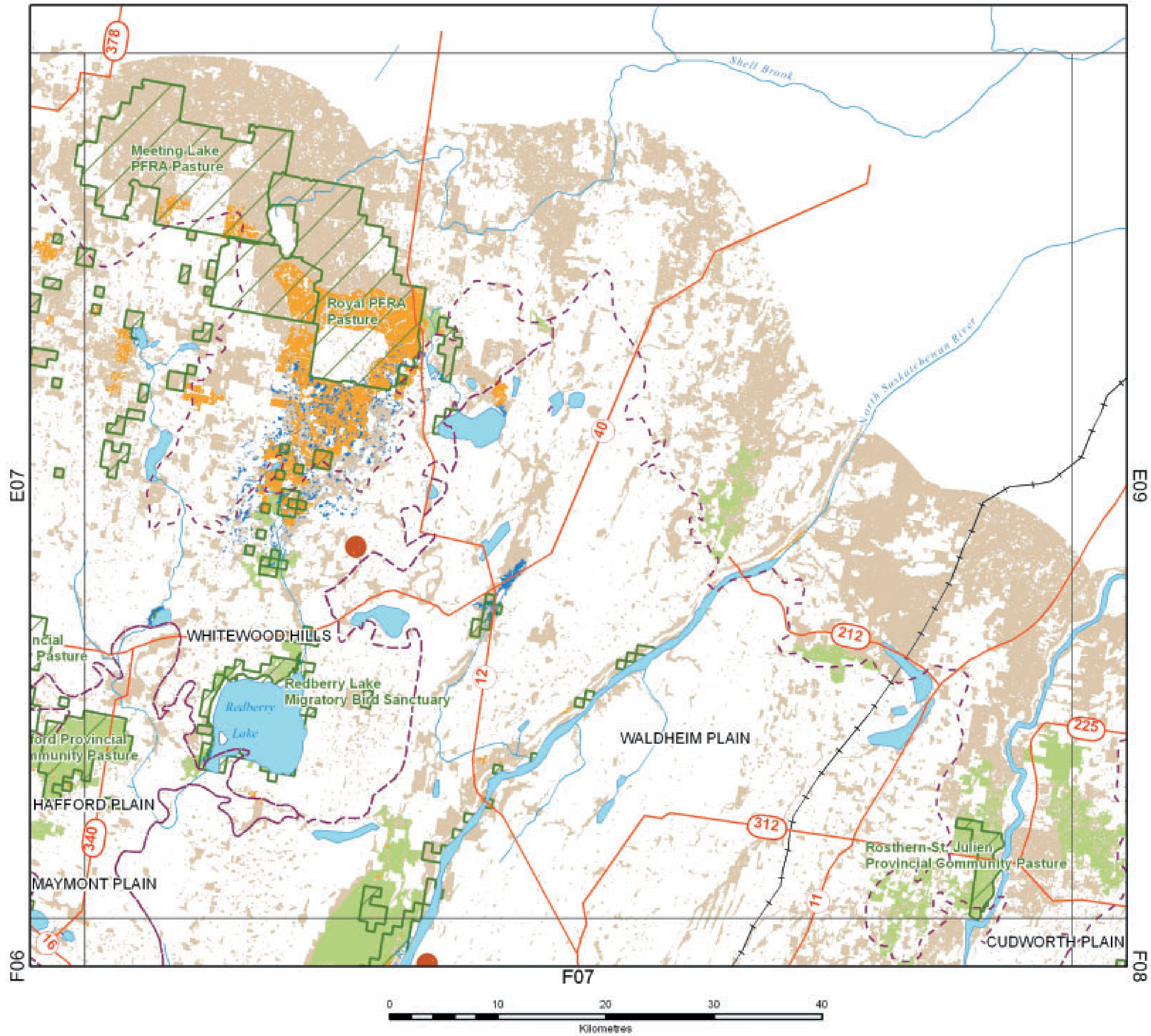
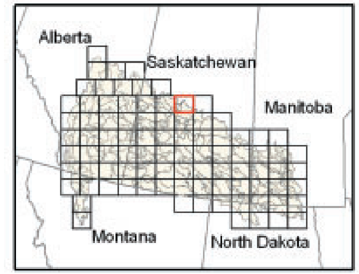


Prairie and Parkland Conservation Blueprint

Map Tile: E08



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

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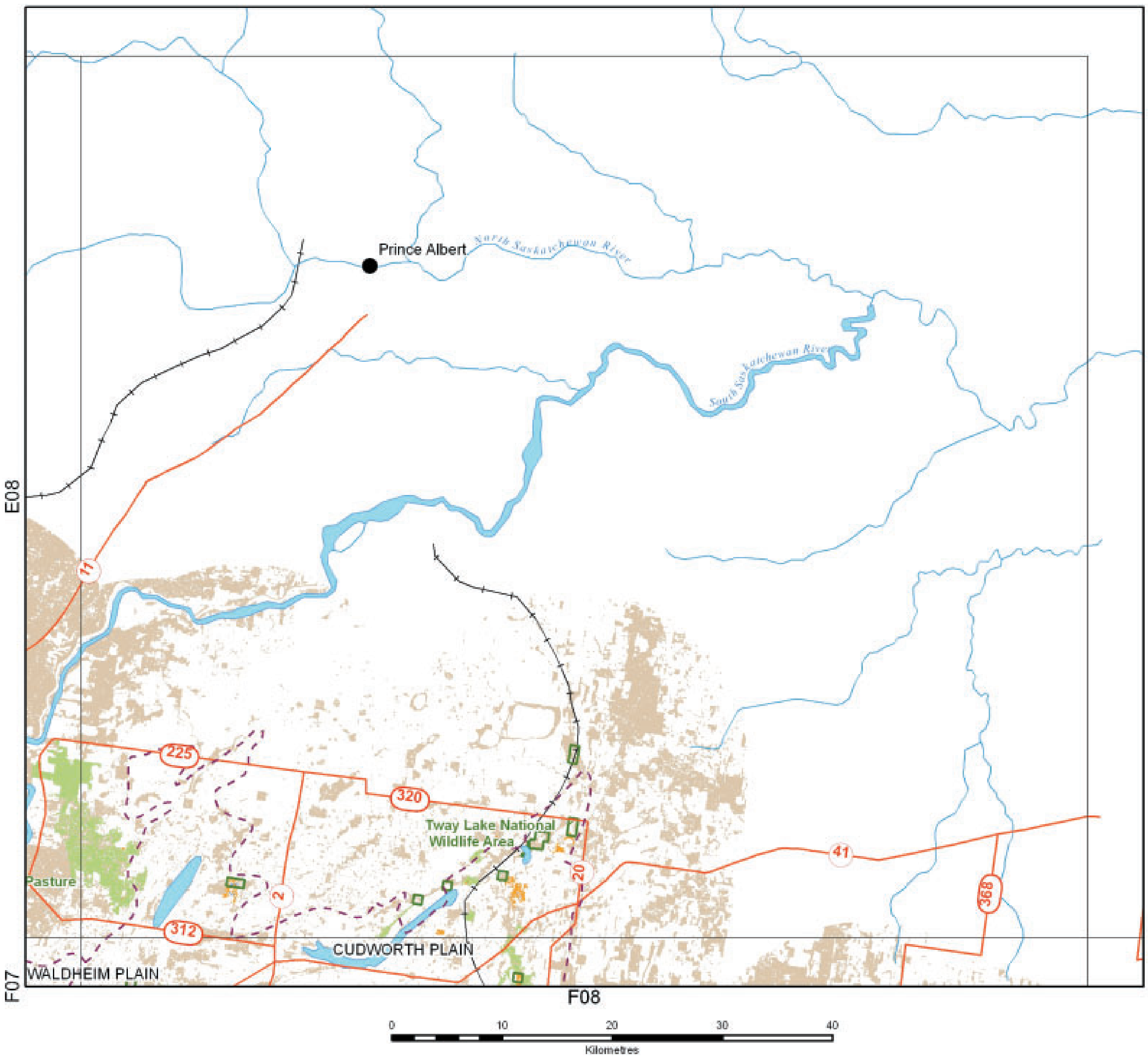
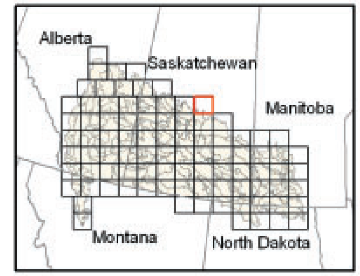
Prairie and Parkland Conservation Blueprint

Map Tile: E09





Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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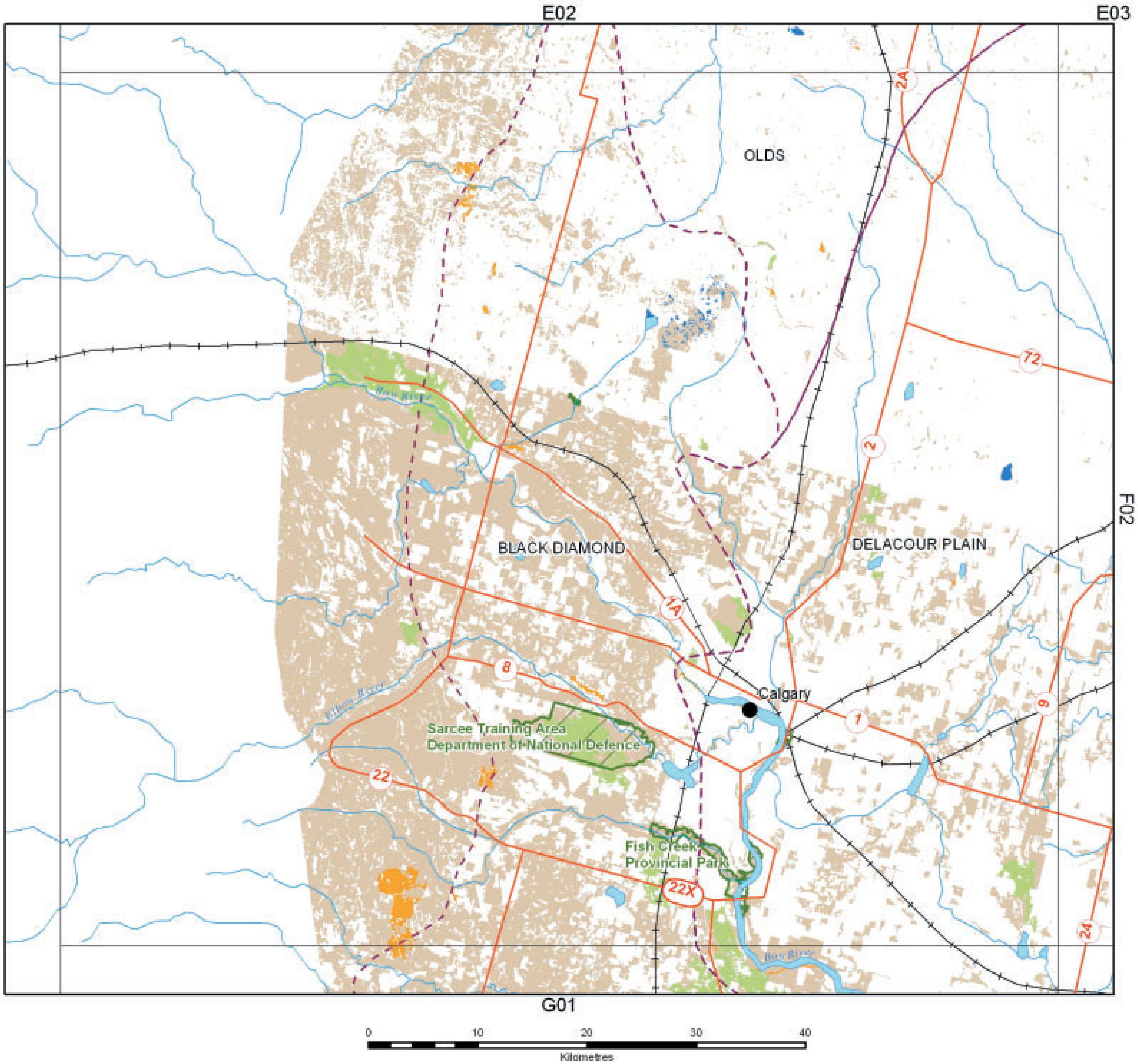
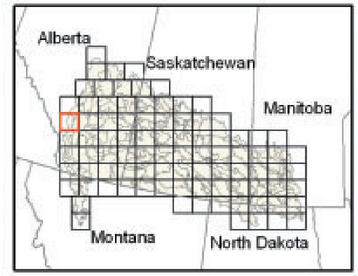
Published February 2006

Projection: Canada Albers Equal Area (NAD 83)



Prairie and Parkland Conservation Blueprint

Map Tile: F01



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
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- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
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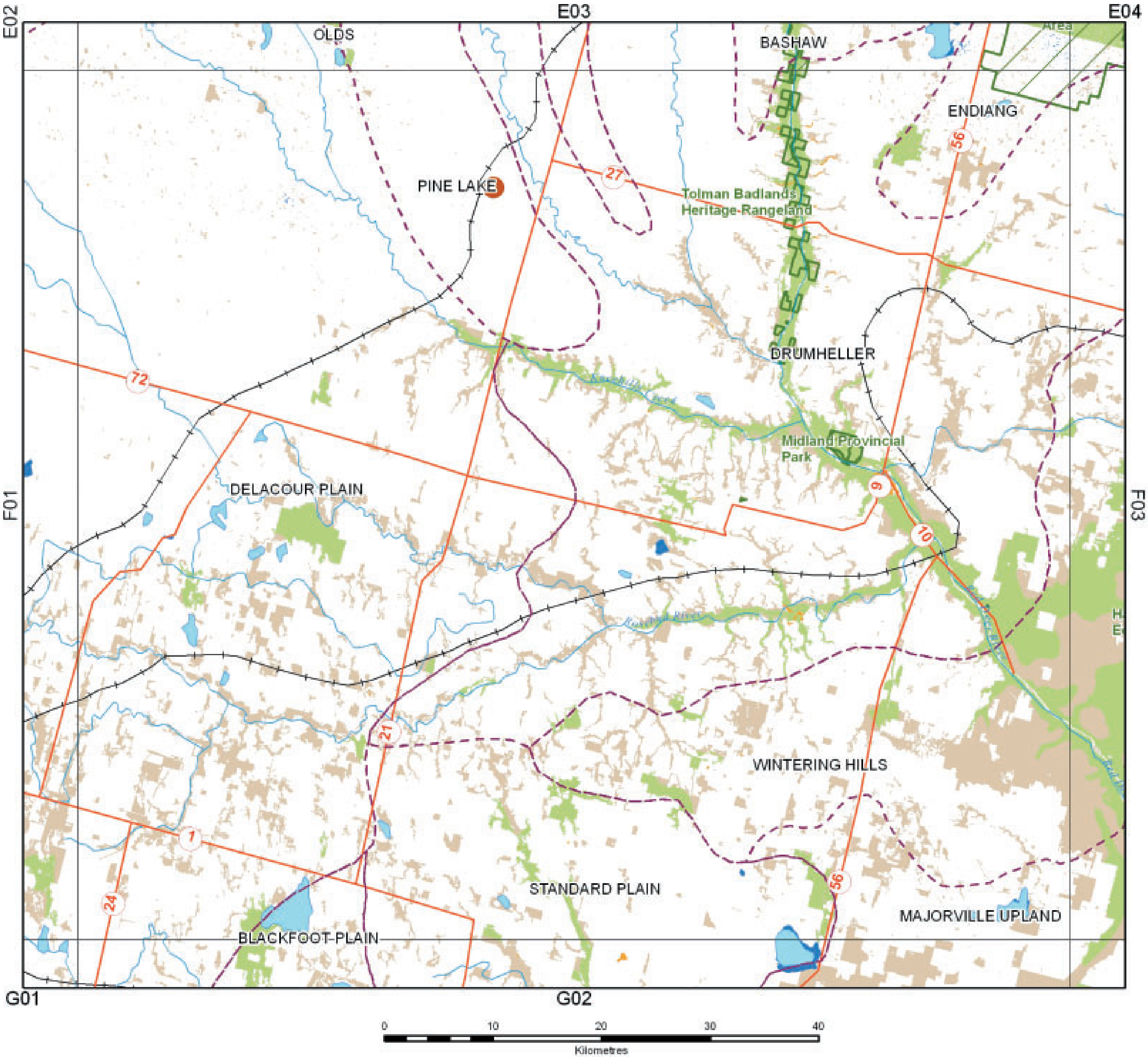
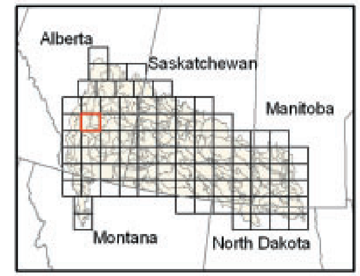


Prairie and Parkland Conservation Blueprint

Map Tile: F02



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
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Scale: 1:500,000

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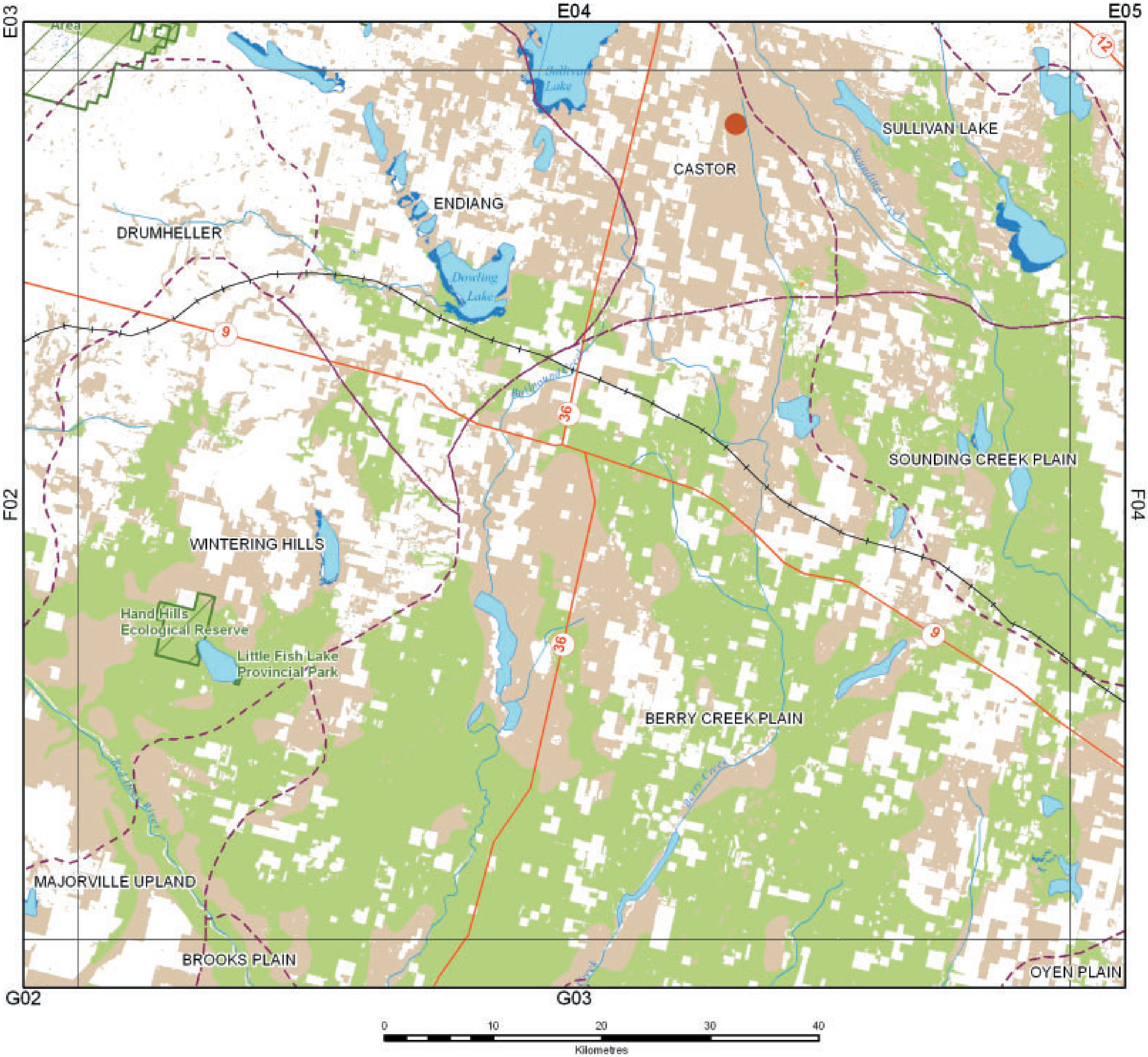
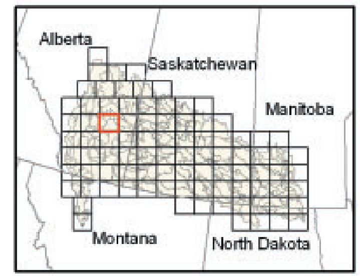


Prairie and Parkland Conservation Blueprint

Map Tile: F03



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

NATURE CONSERVANCY CANADA

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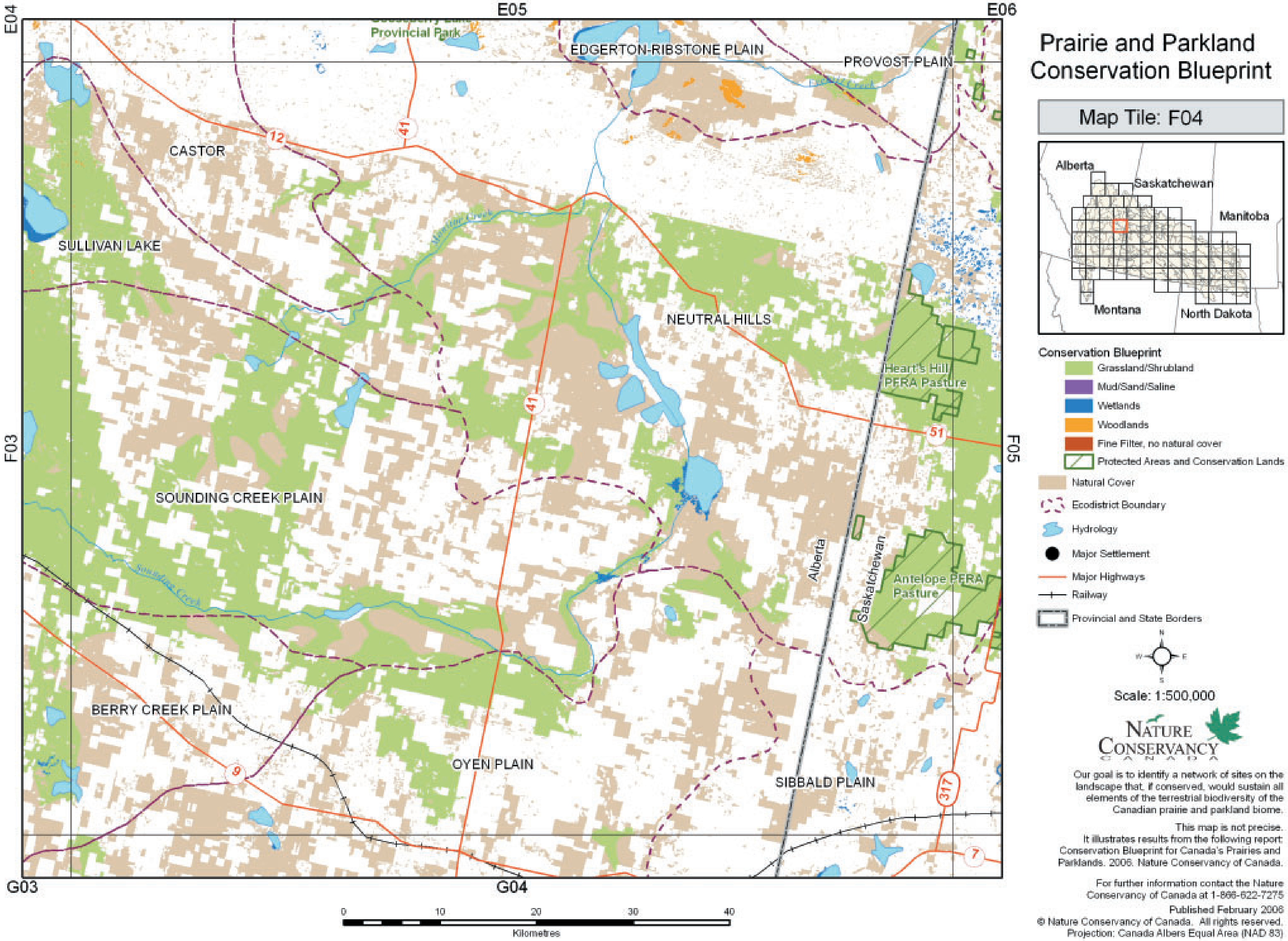
Prairie and Parkland
Conservation Blueprint
Map Tile: F04
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
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Provincial and State Borders
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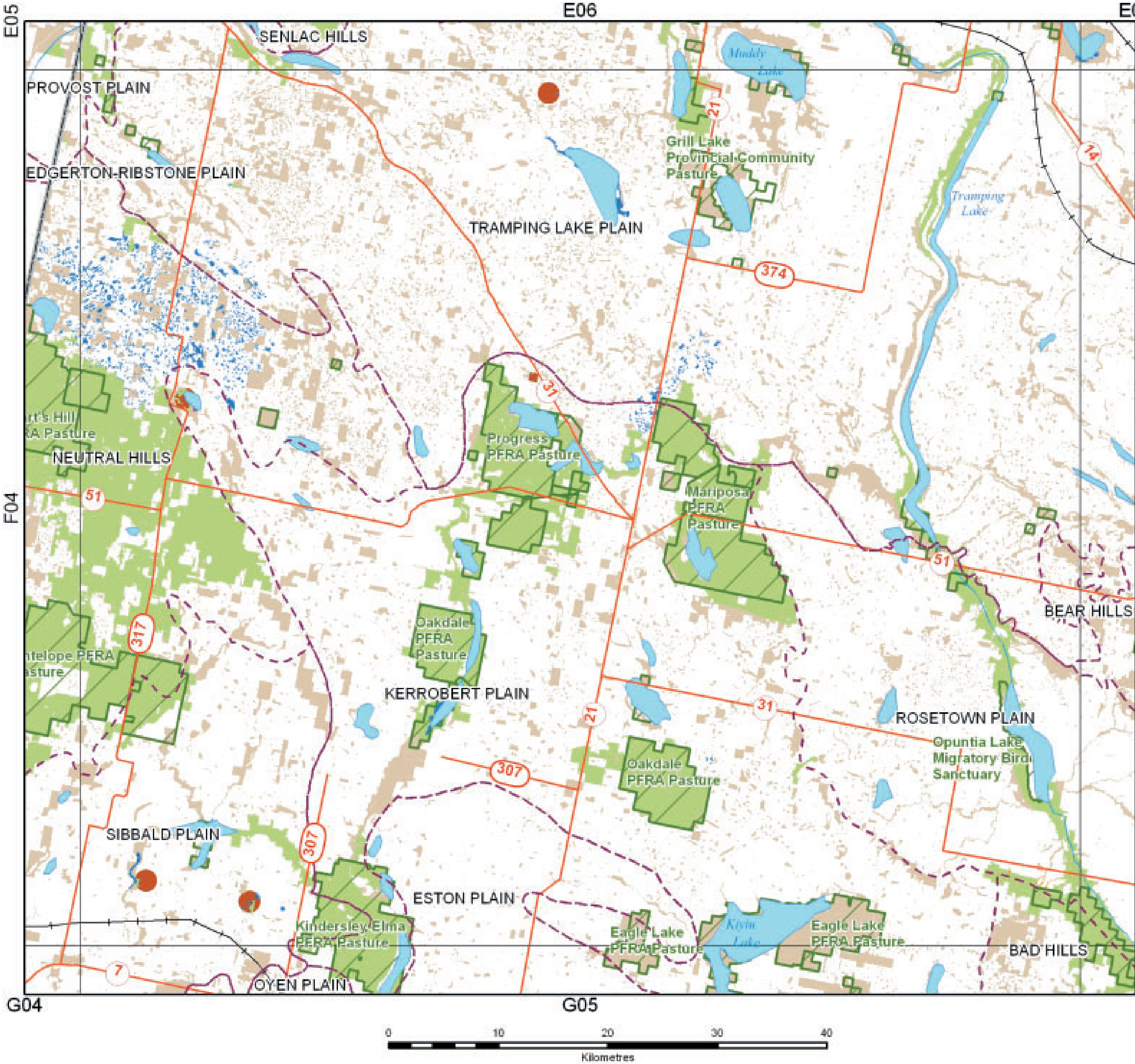
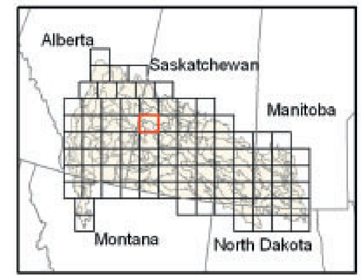
Projection: Canada Albers Equal Area (NAD 83)
E04
E05
E06
F03
F05
G03
G04
Provincial Park
EDGERTON-RIBSTONE PLAIN
PROVOST PLAIN
CASTOR
SULLIVAN LAKE
NEUTRAL HILLS
Heart's Hill PFRA Pasture
SOUNDING CREEK PLAIN
Alberta
Saskatchewan
Antelope PFRA Pasture
BERRY CREEK PLAIN
OYEN PLAIN
SIBBALD PLAIN
12
41
51
9
317
7
0
10
20
30
40
Kilometres



Prairie and Parkland Conservation Blueprint

Map Tile: F05



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
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- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N W E S

Scale: 1:500,000

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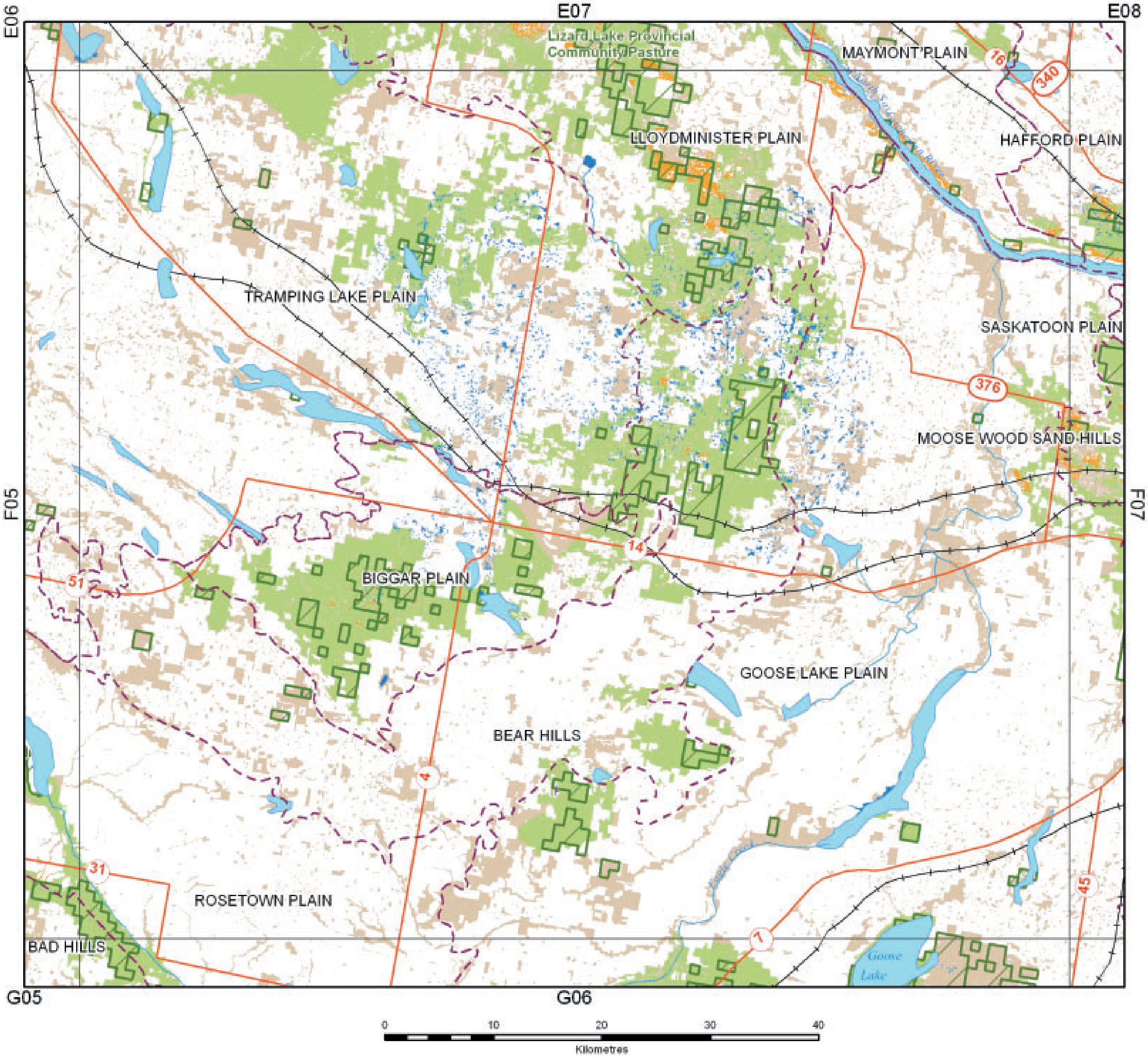
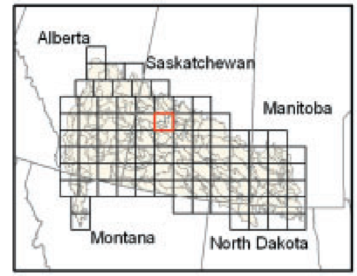


Prairie and Parkland Conservation Blueprint

Map Tile: F06



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
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N E S W

Scale: 1:500,000

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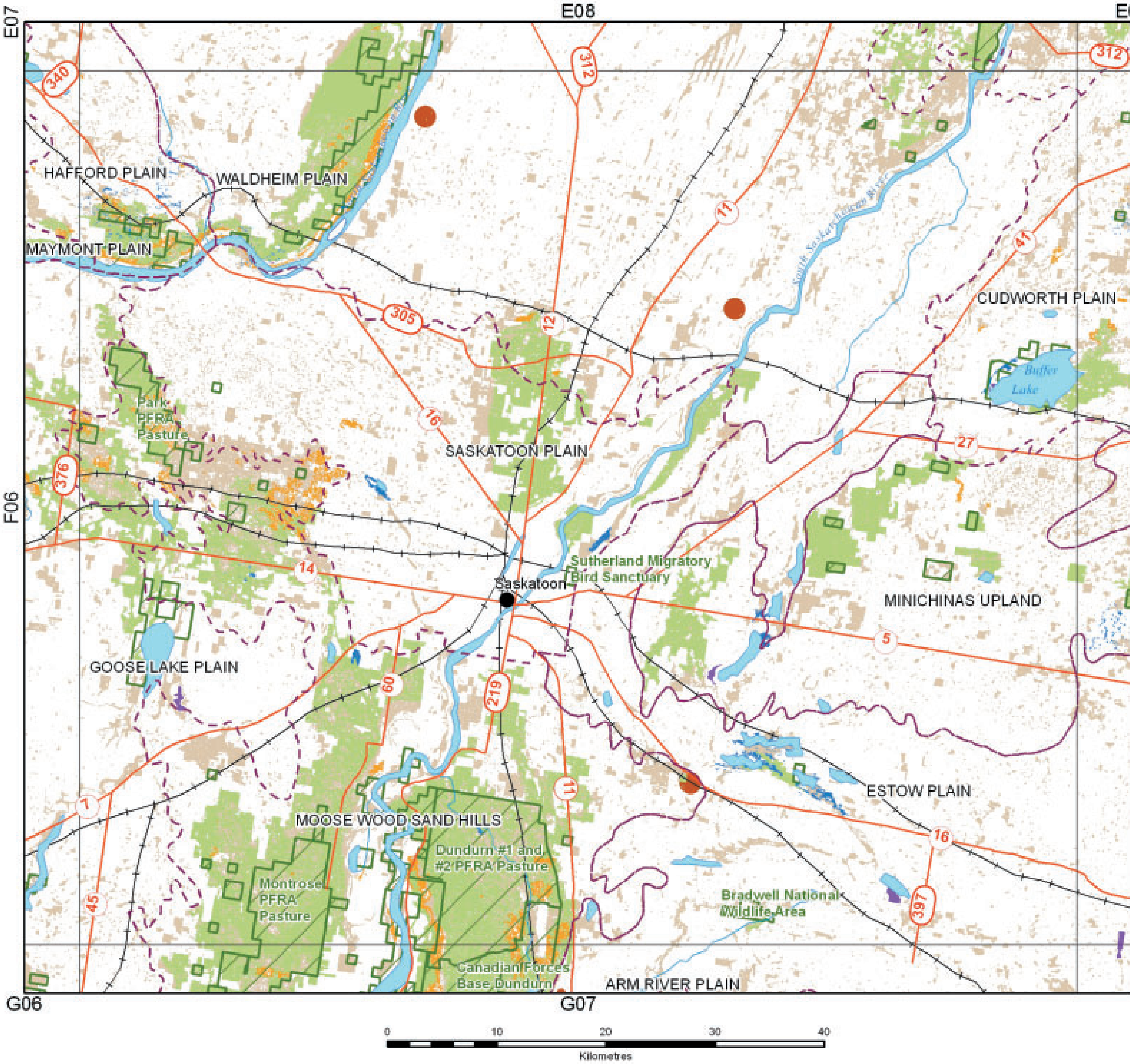
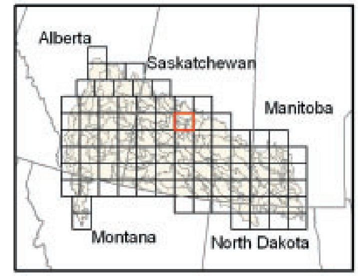


Prairie and Parkland Conservation Blueprint

Map Tile: F07



Conservation Blueprint
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- Wetlands
- Woodlands
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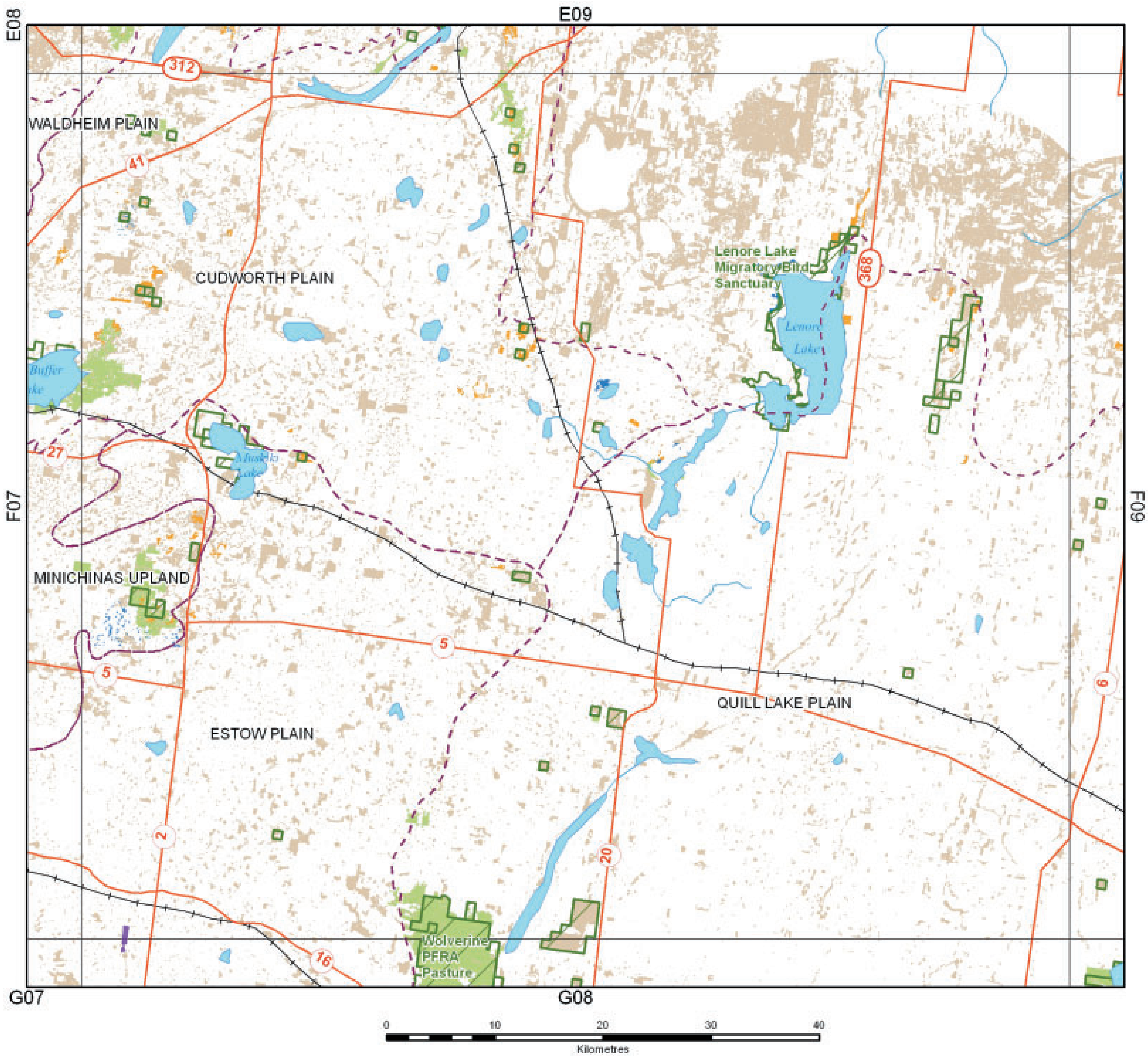
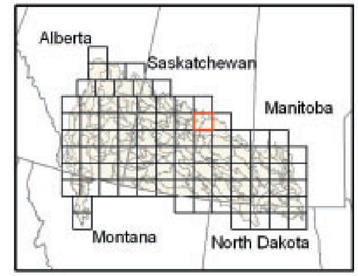


Prairie and Parkland Conservation Blueprint

Map Tile: F08



Conservation Blueprint

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- Mud/Sand/Saline
- Wetlands
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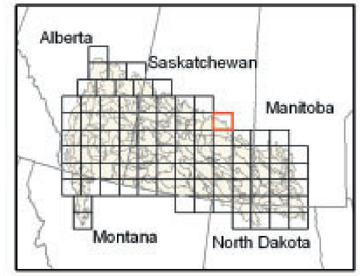
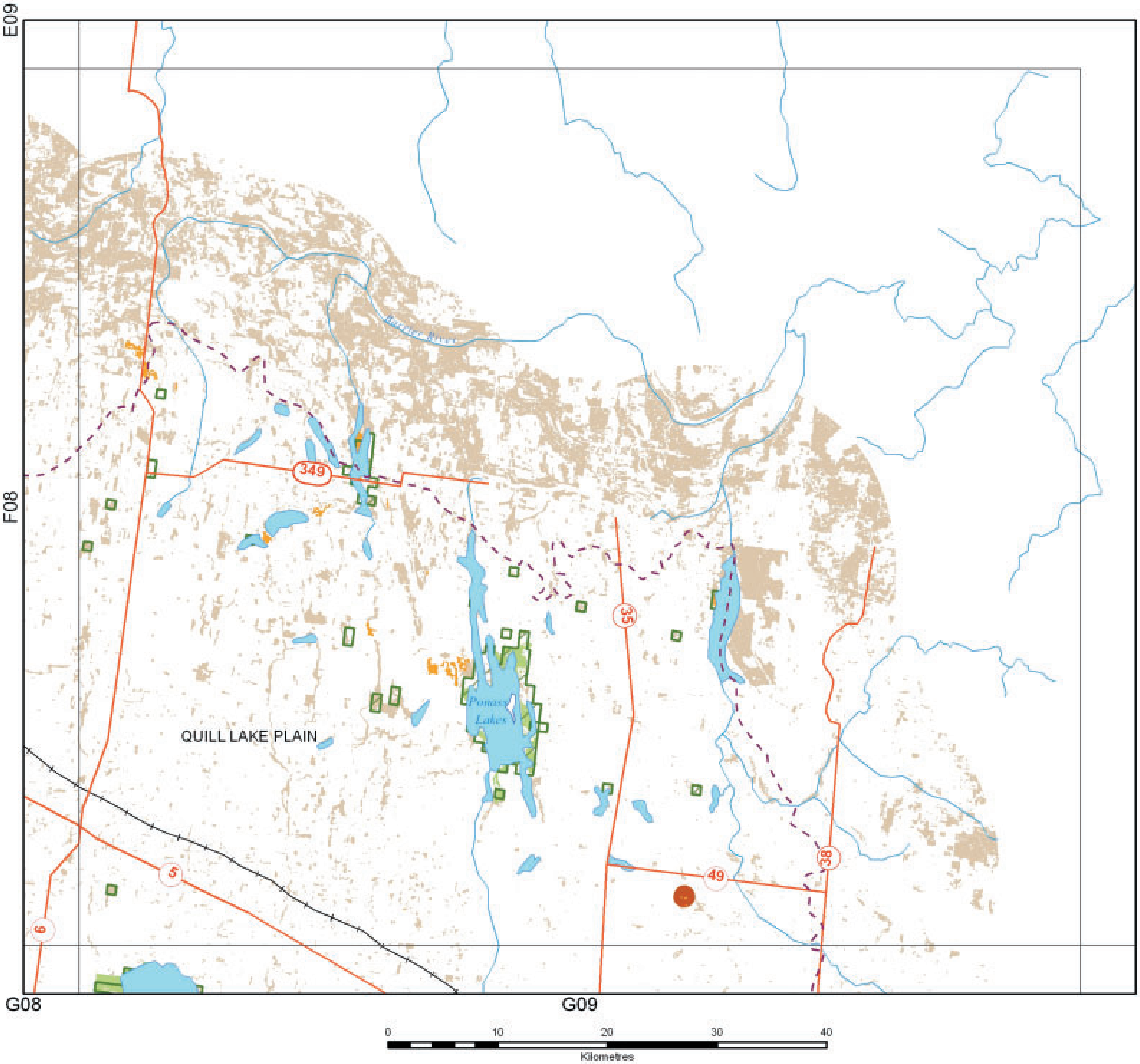
Prairie and Parkland Conservation Blueprint

Map Tile: F09





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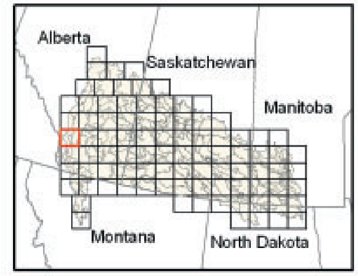
Prairie and Parkland Conservation Blueprint

Map Tile: G01



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- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
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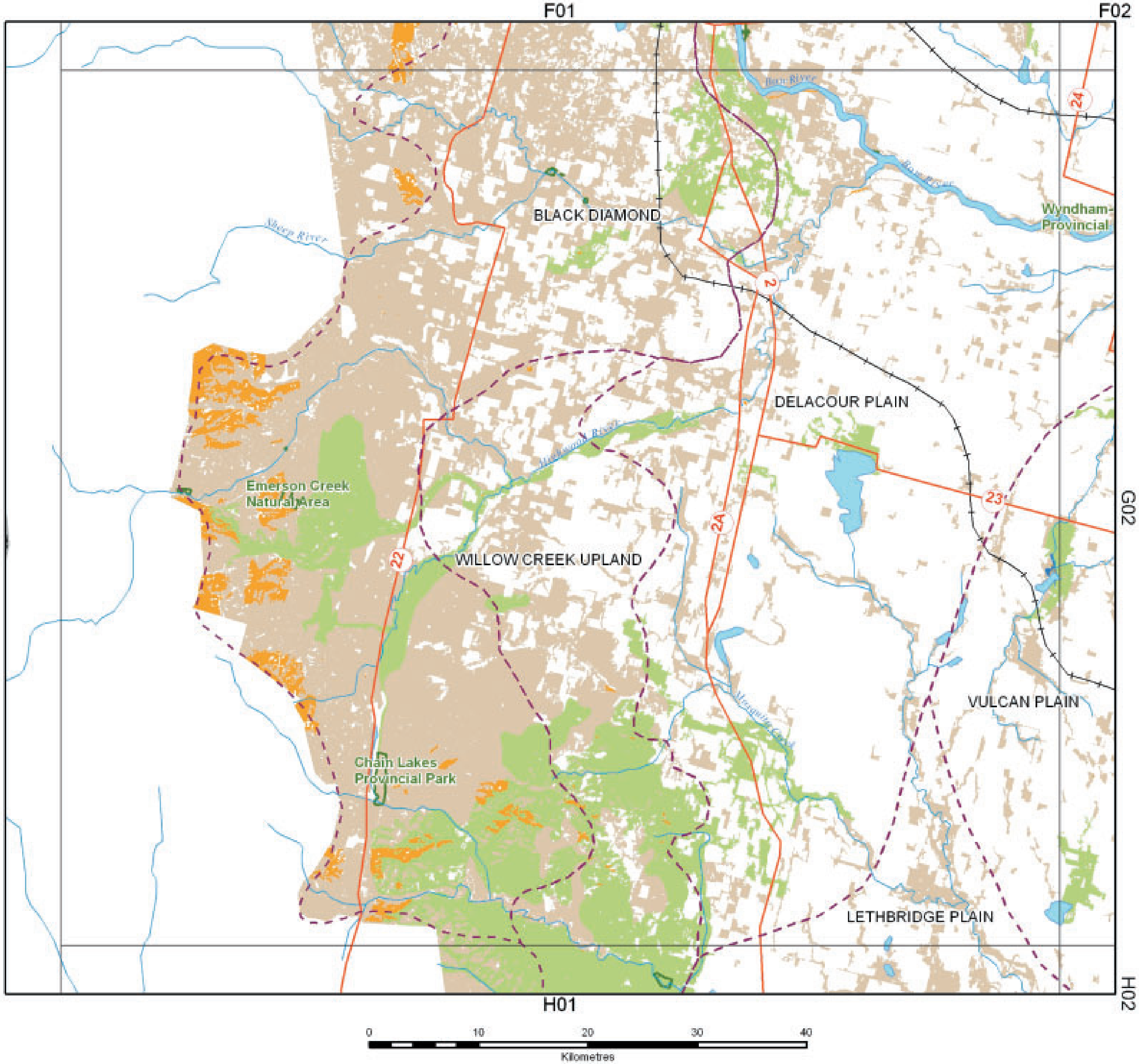
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders



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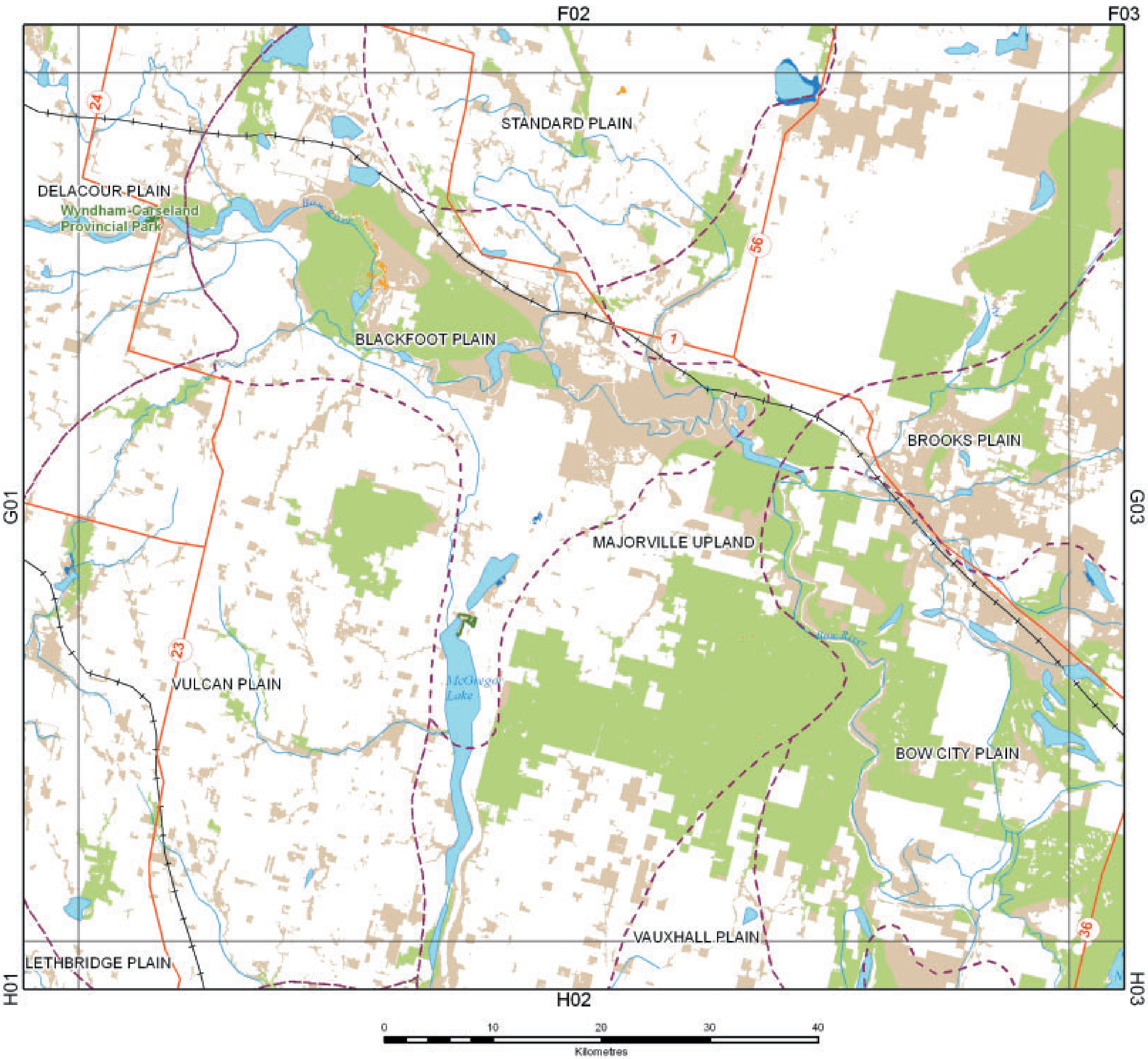
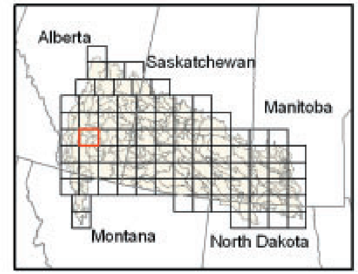


Prairie and Parkland Conservation Blueprint

Map Tile: G02



Conservation Blueprint

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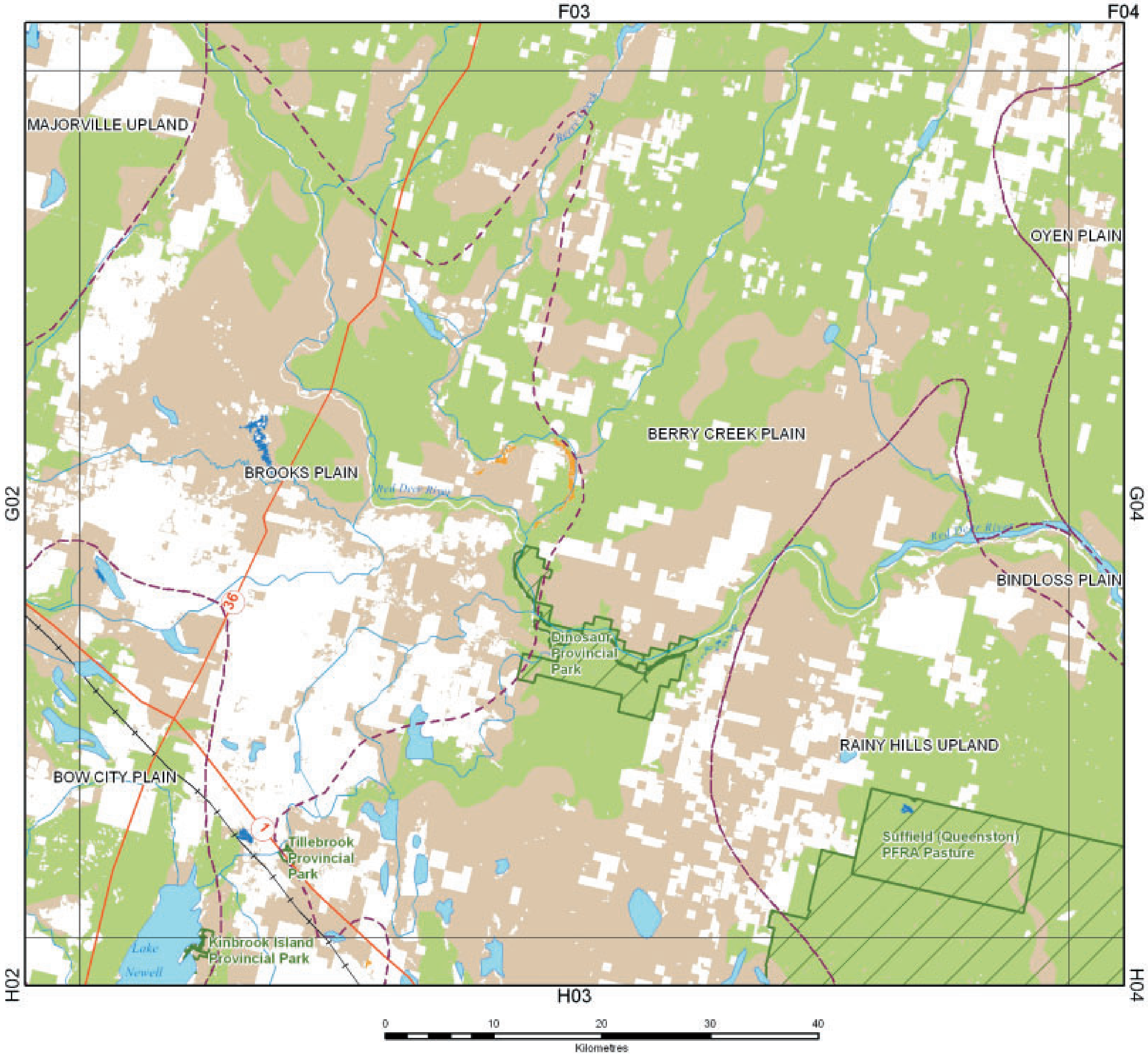
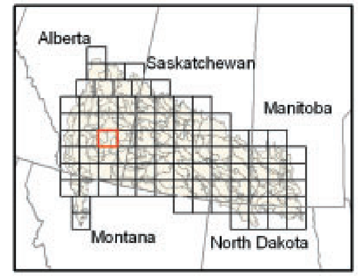


Prairie and Parkland Conservation Blueprint

Map Tile: G03



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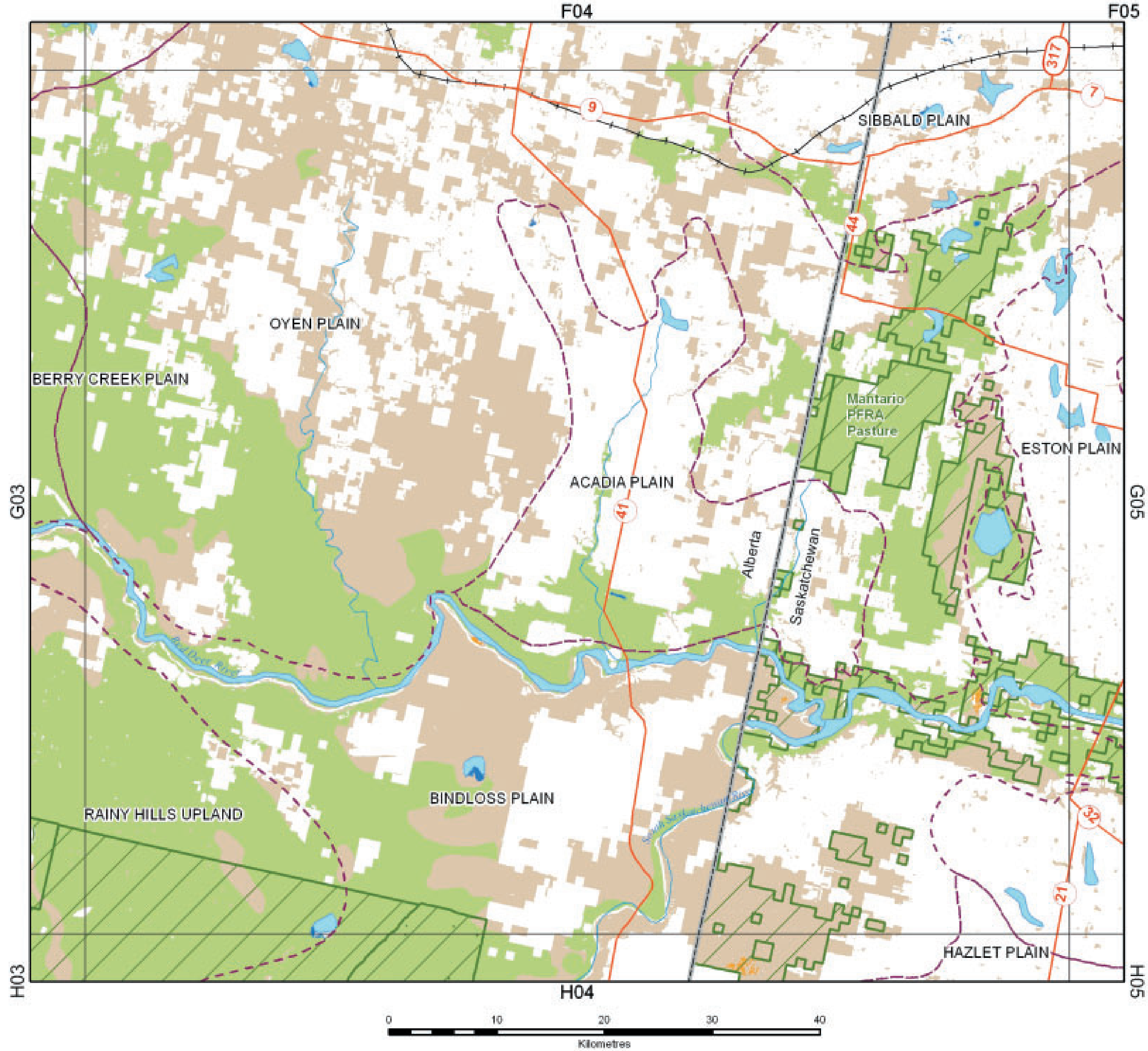
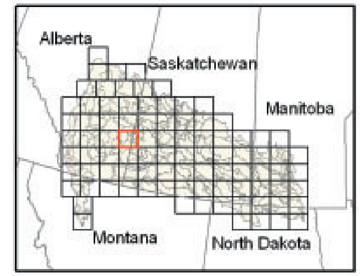


Prairie and Parkland Conservation Blueprint

Map Tile: G04



Conservation Blueprint
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- Wetlands
- Woodlands
- Fine Filter, no natural cover
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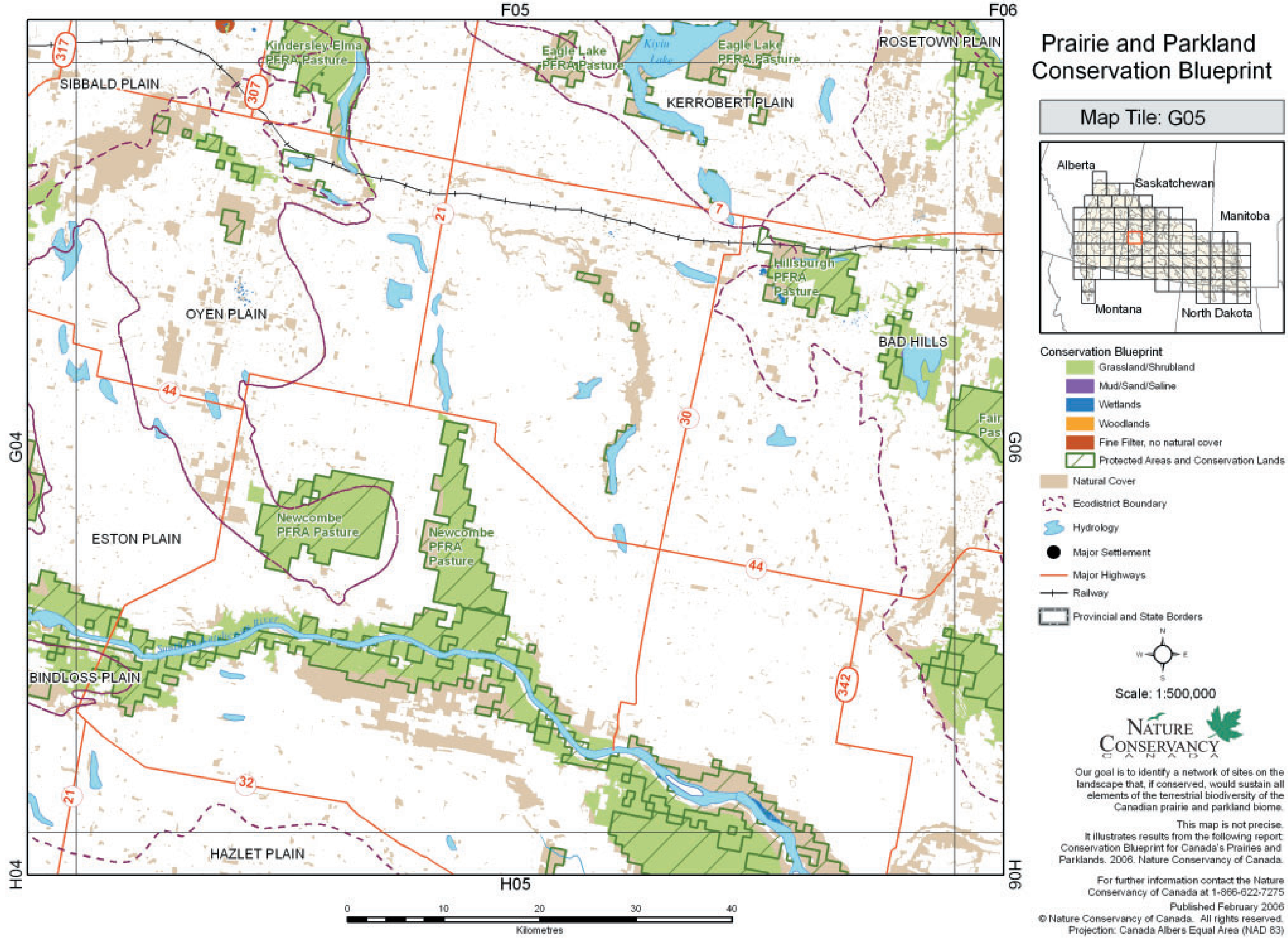
F05
F06
G04
G06
H04
H05
H06
Prairie and Parkland Conservation Blueprint
Map Tile: G05
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
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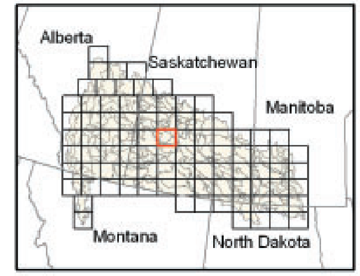
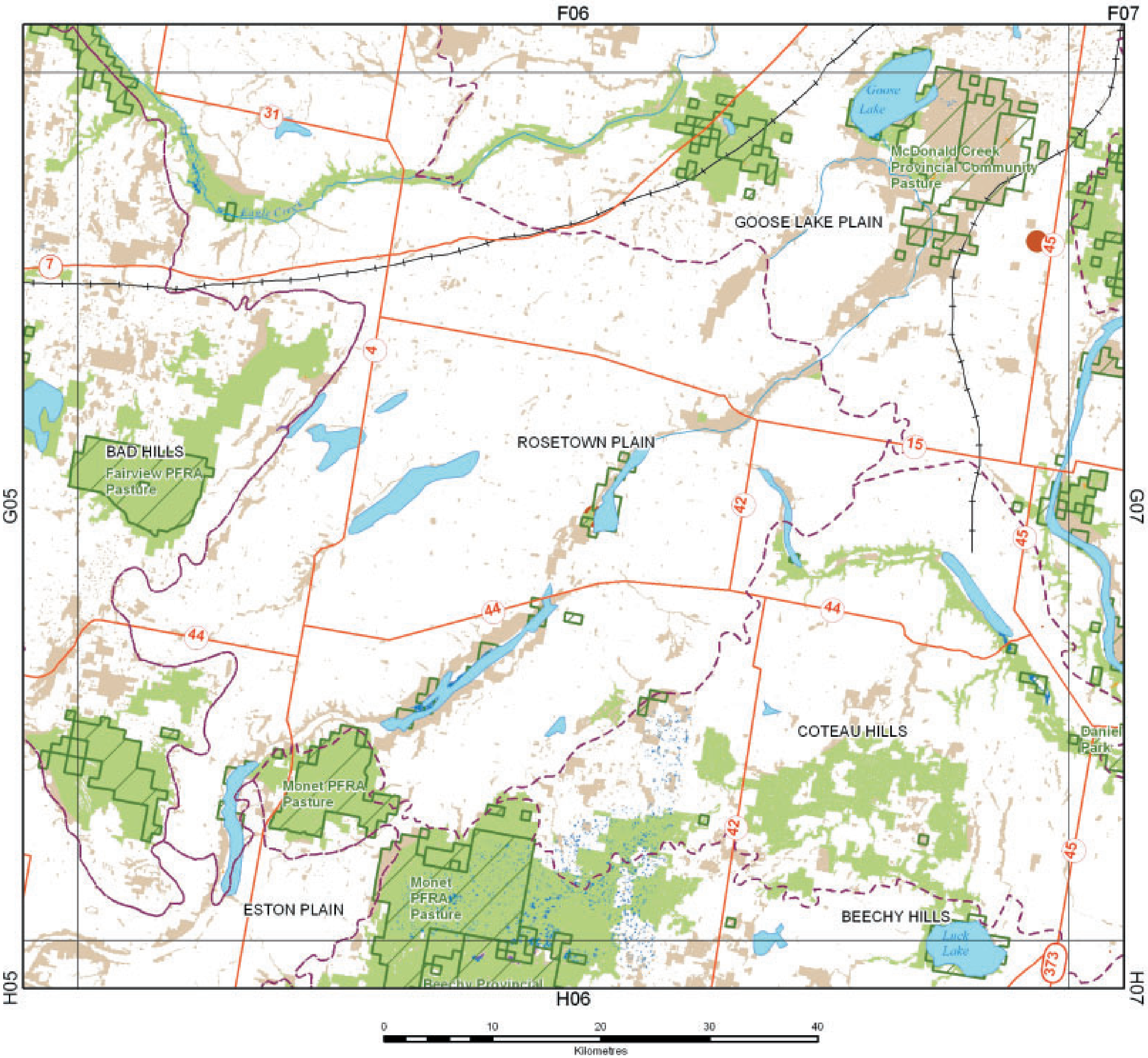
Projection: Canada Albers Equal Area (NAD 83)
SIBBALD PLAIN
ROSETOWN PLAIN
KERROBERT PLAIN
OYEN PLAIN
BAD HILLS
ESTON PLAIN
BINDLOSS PLAIN
HAZLET PLAIN
Kindersley-Elma PFRA Pasture
Eagle Lake PFRA Pasture
Eagle Lake PFRA Pasture
Hillsburgh PFRA Pasture
Newcombe PFRA Pasture
Newcombe PFRA Pasture
317
307
21
7
44
30
44
342
32
21
0
10
20
30
40
Kilometres

Prairie and Parkland Conservation Blueprint

Map Tile: G06





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
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- Provincial and State Borders

N E S W

Scale: 1:500,000

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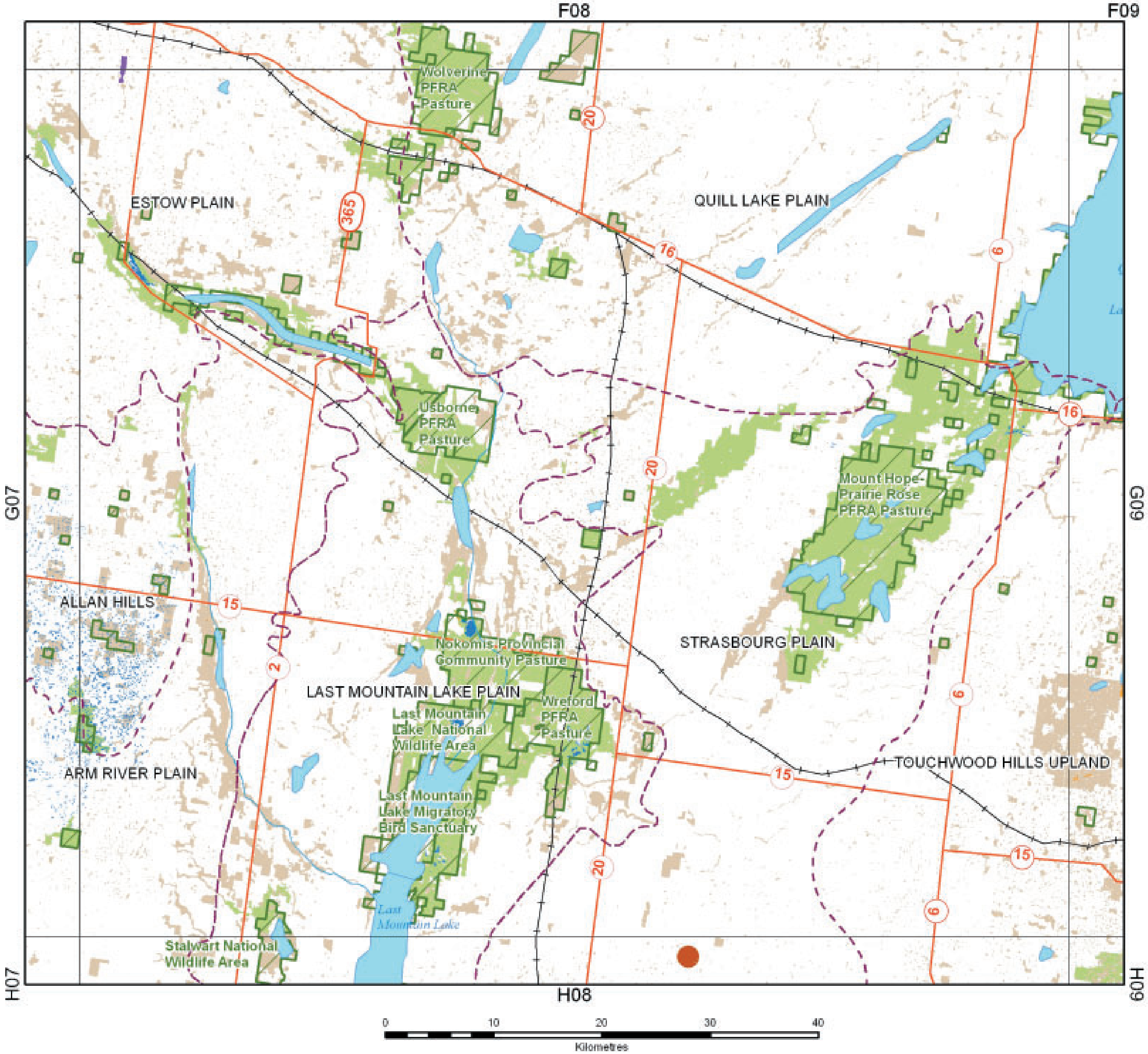
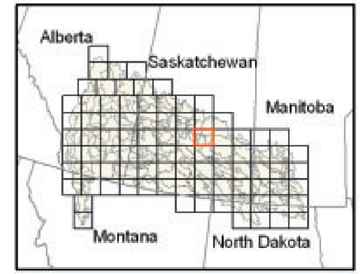


Prairie and Parkland Conservation Blueprint

Map Tile: G08



Conservation Blueprint

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- Mud/Sand/Saline
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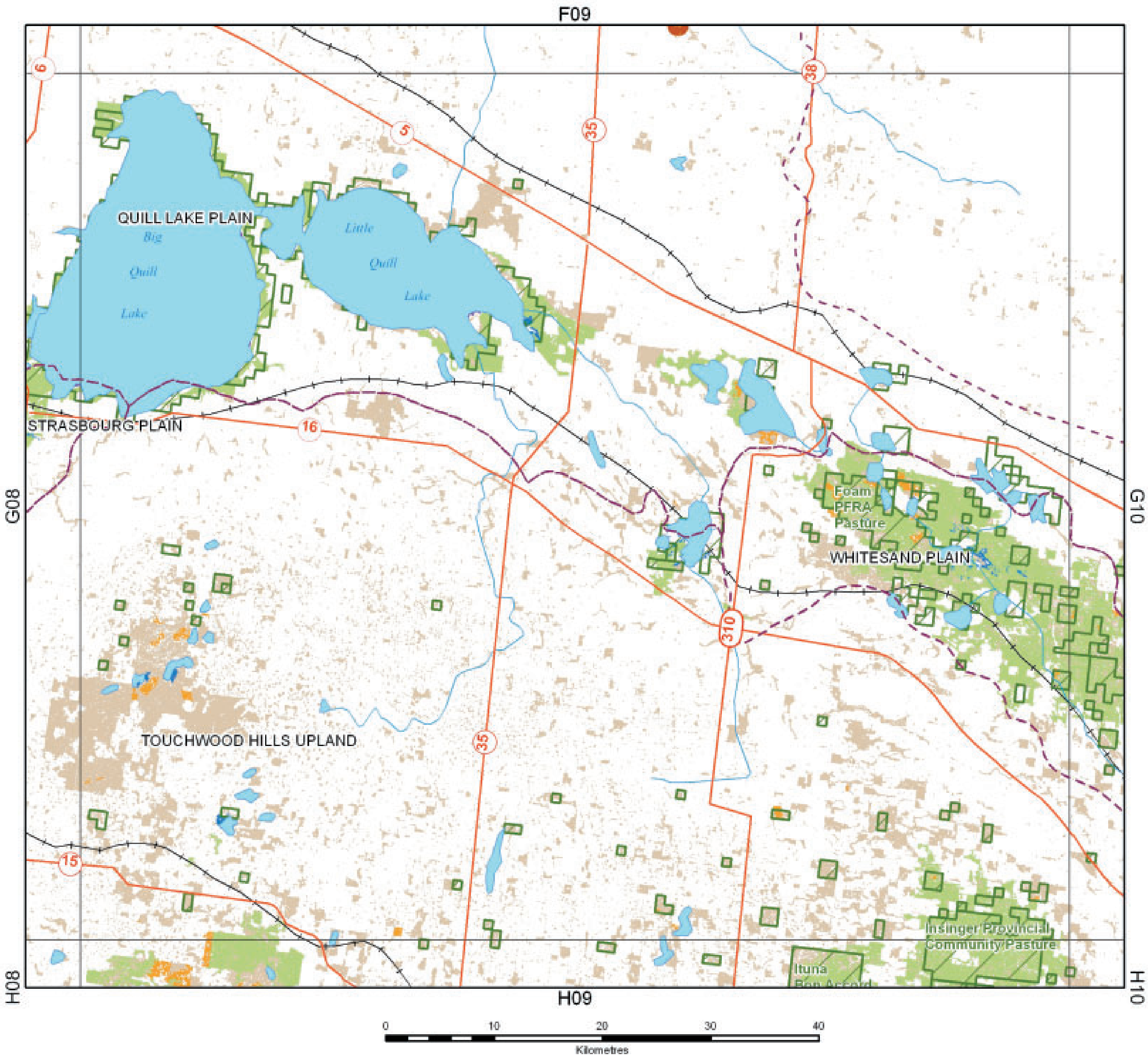
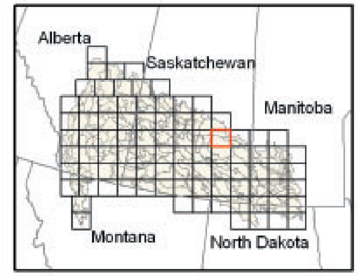


Prairie and Parkland Conservation Blueprint

Map Tile: G09



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

NATURE CONSERVANCY CANADA

Our goal is to identify a network of sites on the landscape that, if conserved, would sustain all elements of the terrestrial biodiversity of the Canadian prairie and parkland biome.

This map is not precise. It illustrates results from the following report: Conservation Blueprint for Canada's Prairies and Parklands. 2006. Nature Conservancy of Canada.

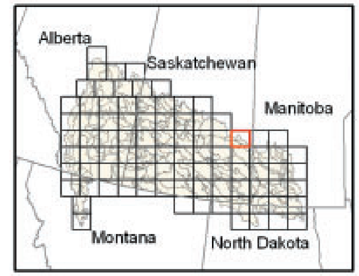
For further information contact the Nature Conservancy of Canada at 1-866-622-7275

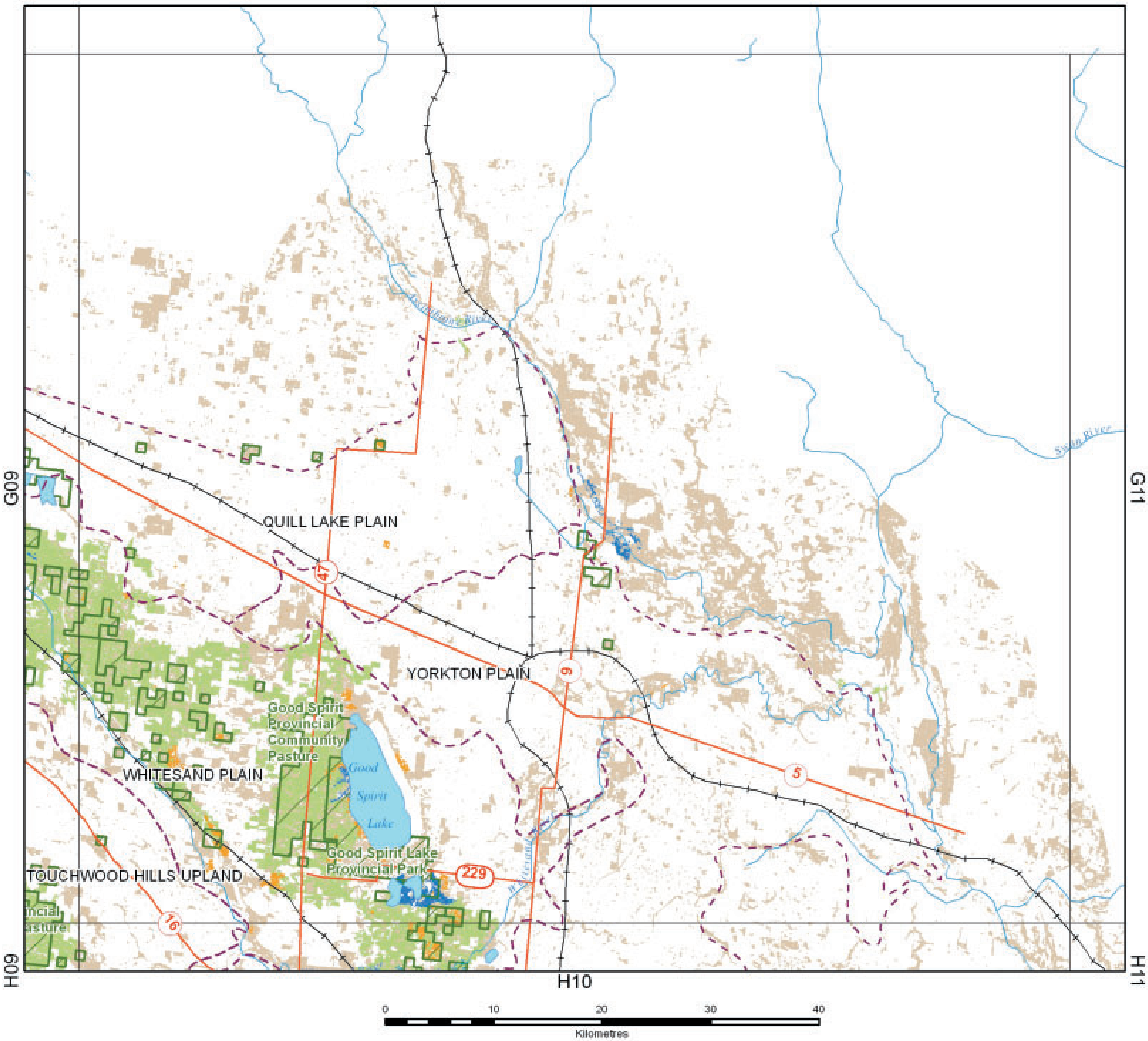
Published February 2006

Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: G10





Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

Nature Conservancy Canada

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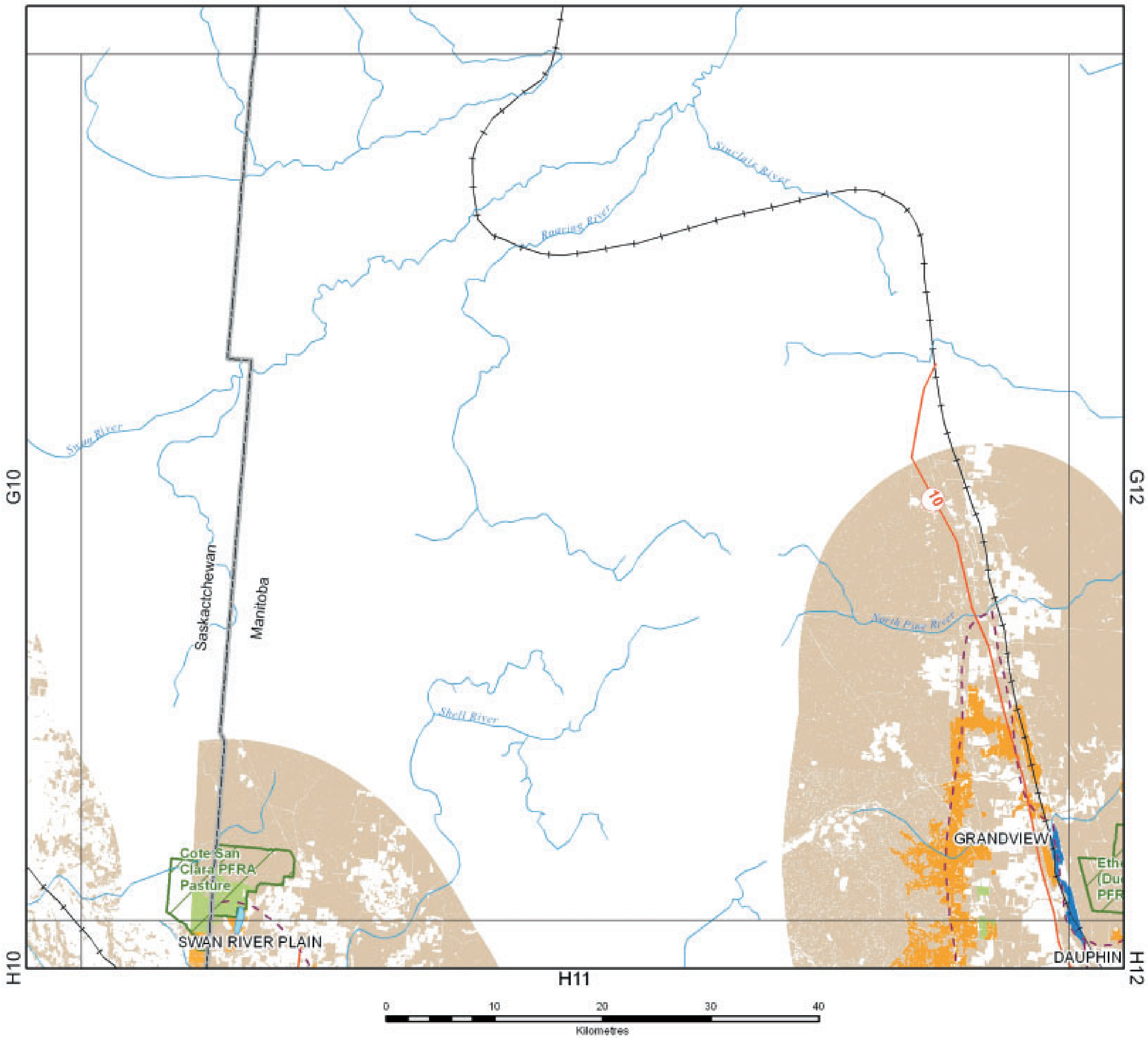
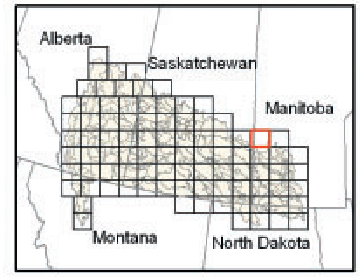


Prairie and Parkland Conservation Blueprint

Map Tile: G11



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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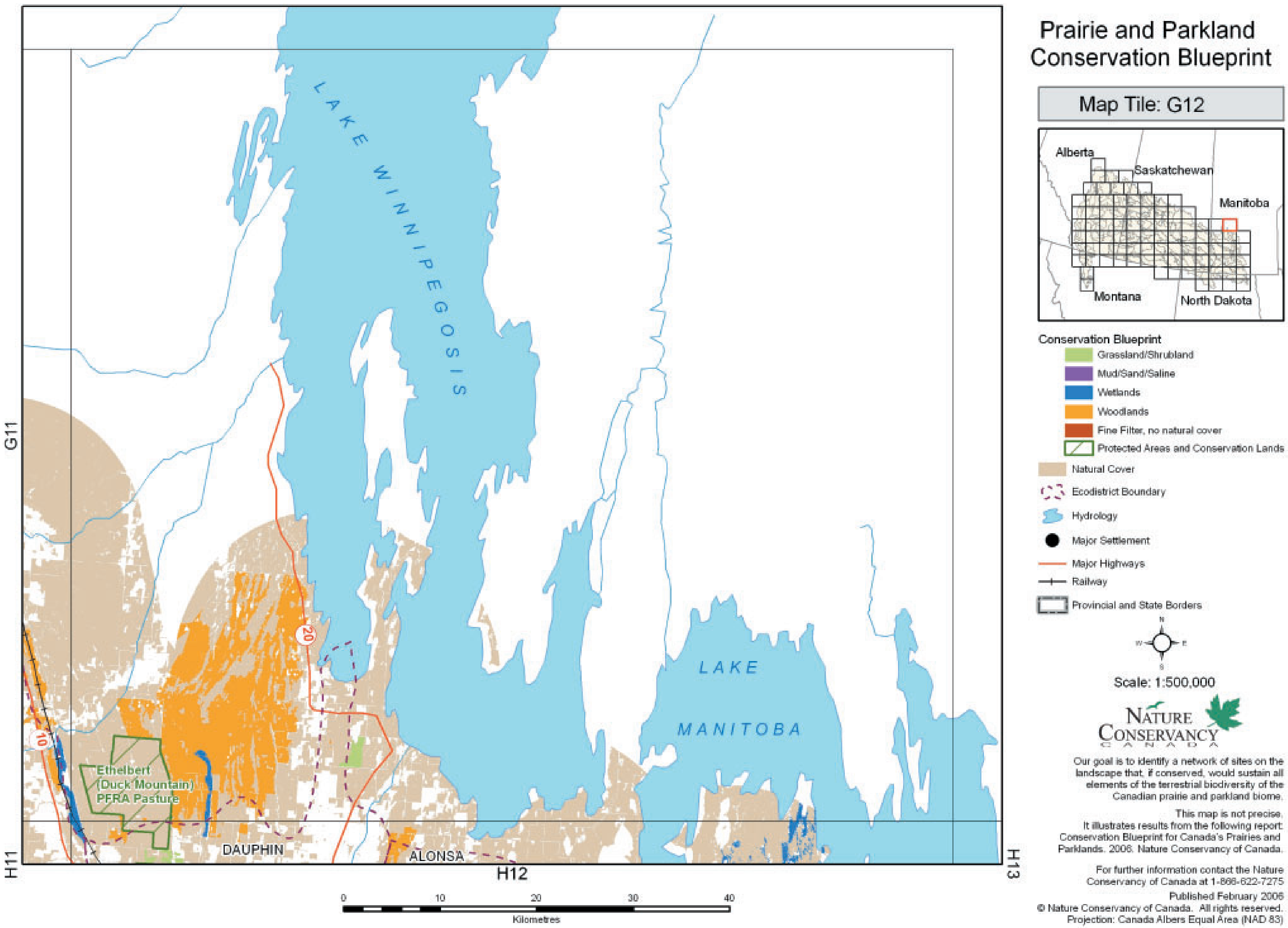
Projection: Canada Albers Equal Area (NAD 83)



Prairie and Parkland Conservation Blueprint
Map Tile: G12
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
NATURE CONSERVANCY CANADA
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Published February 2006
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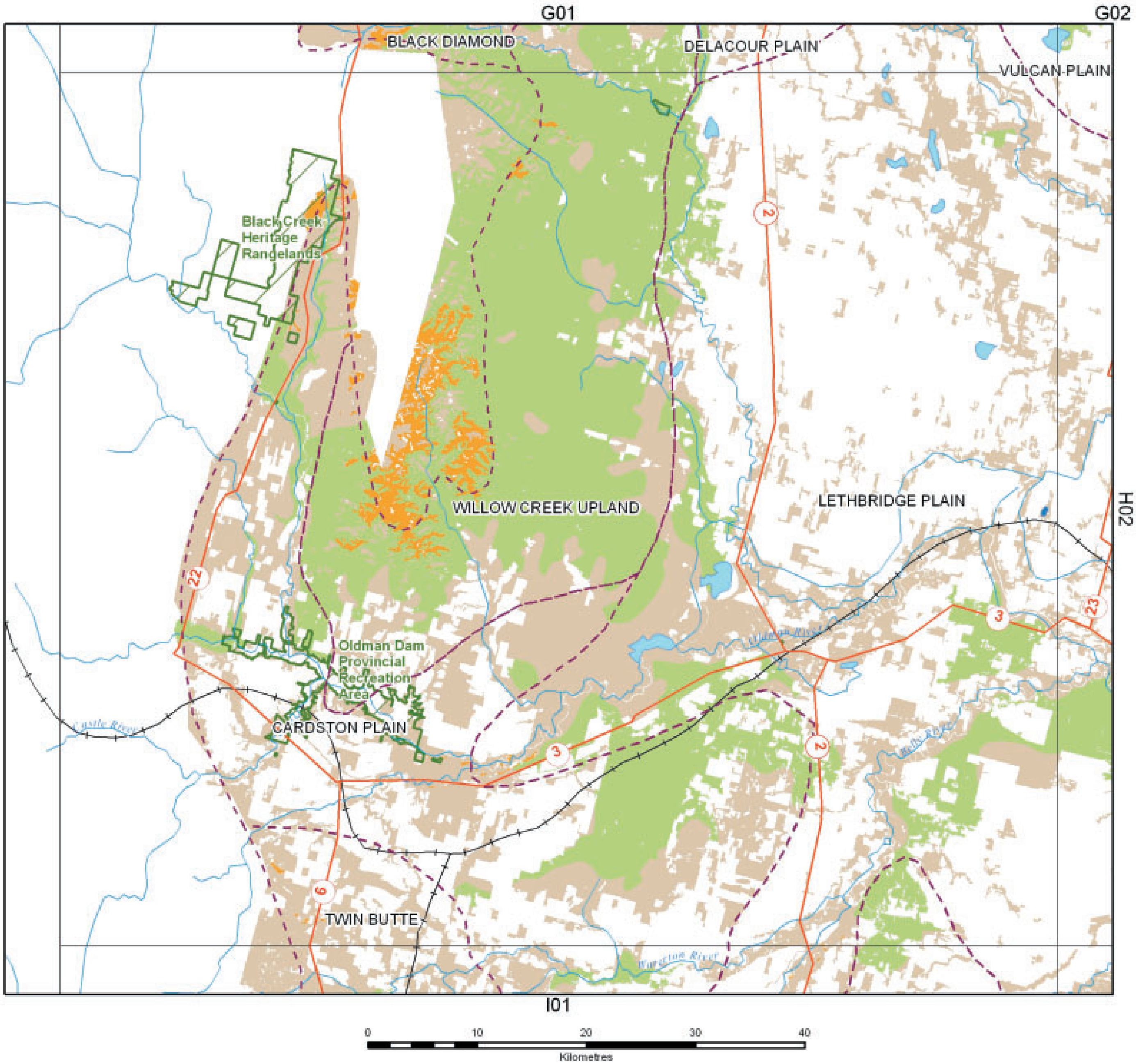
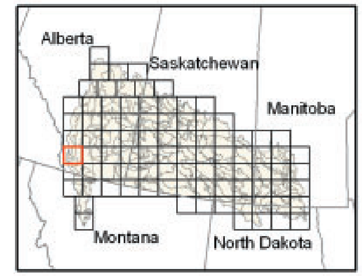
Projection: Canada Albers Equal Area (NAD 83)
LAKE WINNIPEGOSIS
LAKE MANITOBA
Ethelbert (Duck Mountain) PFRA Pasture
DAUPHIN
ALONSA
20
10
G11
H11
H12
H13
0
10
20
30
40
Kilometres



Prairie and Parkland Conservation Blueprint

Map Tile: H01



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

NATURE CONSERVANCY CANADA

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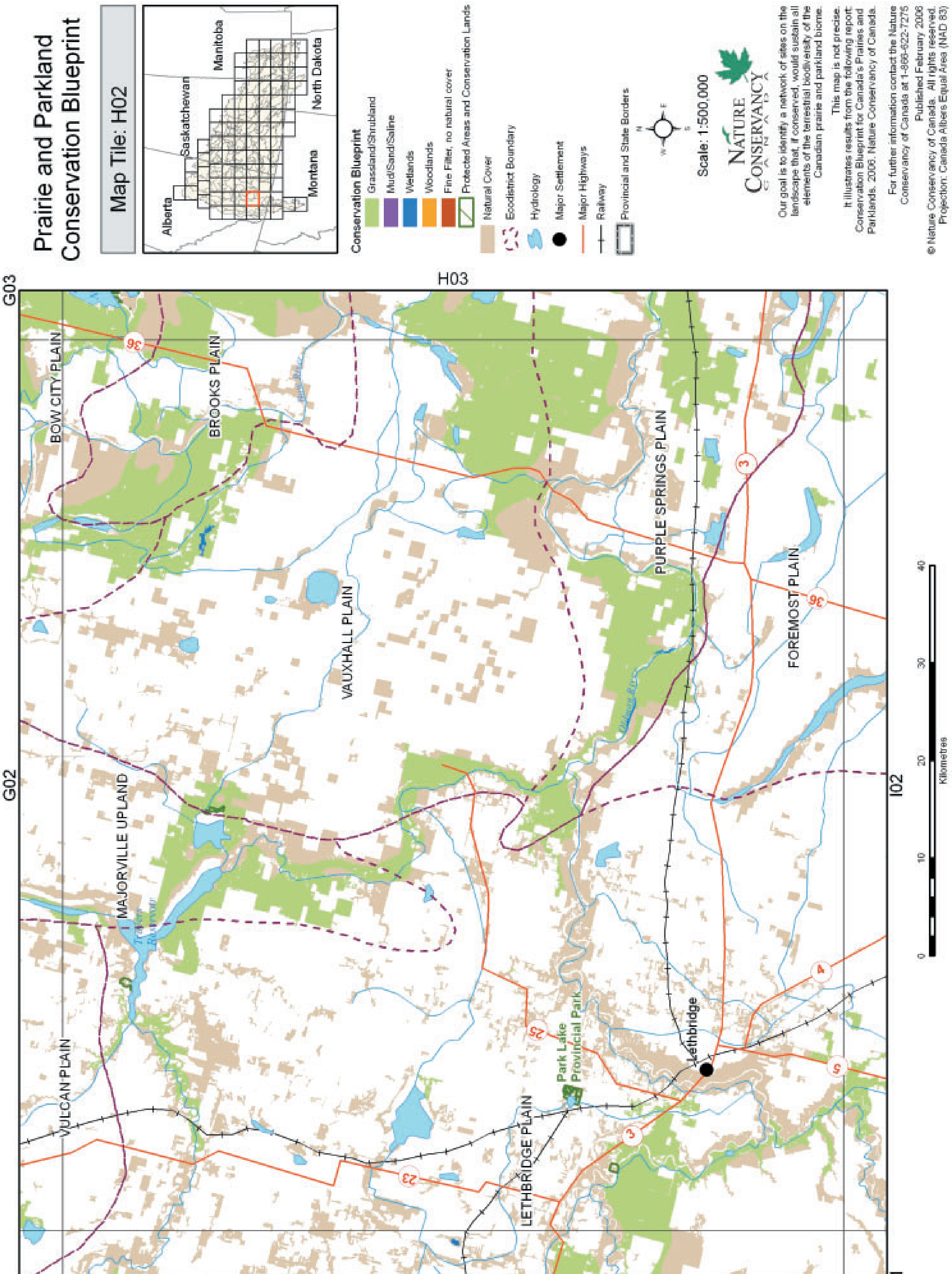
Projection: Canada Albers Equal Area (NAD 83)


Prairie and Parkland Conservation Blueprint
Map Tile: H02
Alberta
Saskatchewan
Manitoba
North Dakota
Montana
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
NATURE CONSERVANCY CANADA
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Published February 2006
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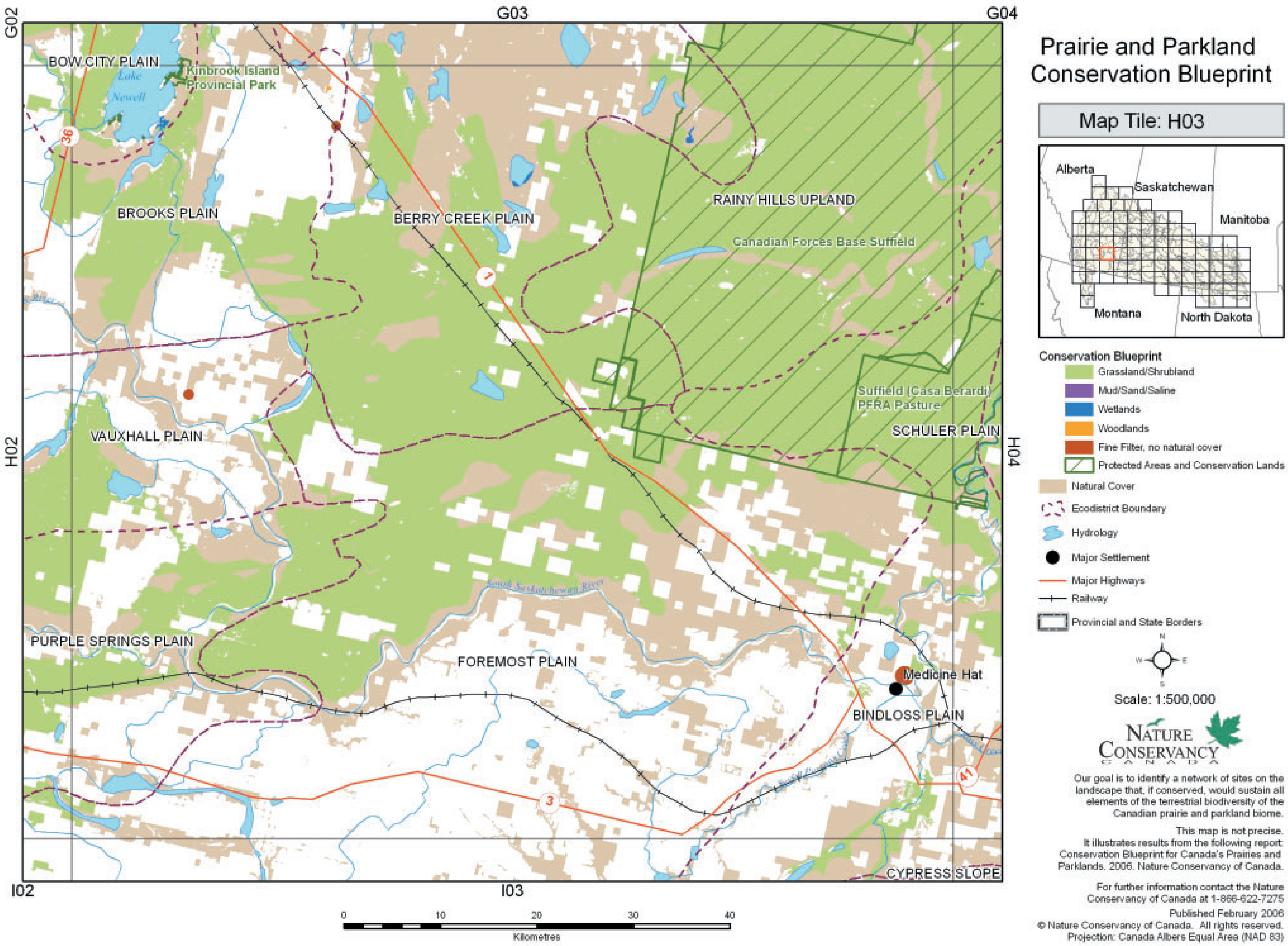
Projection: Canada Albers Equal Area (NAD 83)
G03
H03
G02
I02
G01
H01
I01
BOW CITY PLAIN
BROOKS PLAIN
VAUXHALL PLAIN
PURPLE SPRINGS PLAIN
FOREMOST PLAIN
MAJORVILLE UPLAND
VULCAN PLAIN
LETHBRIDGE PLAIN
Park Lake Provincial Park
Lethbridge
36
3
25
23
4
5
0
10
20
30
40
Kilometres



G02
G03
G04
H02
H04
I02
I03
BOW CITY PLAIN
Lake Newell
Kinbrook Island Provincial Park
BROOKS PLAIN
BERRY CREEK PLAIN
RAINY HILLS UPLAND
Canadian Forces Base Suffield
Suffield (Casa Berardi) PFRA Pasture
SCHULER PLAIN
VAUXHALL PLAIN
PURPLE SPRINGS PLAIN
FOREMOST PLAIN
South Saskatchewan River
Medicine Hat
BINDLOSS PLAIN
CYPRESS SLOPE
36
1
3
41
0
10
20
30
40
Kilometres
Prairie and Parkland Conservation Blueprint
Map Tile: H03
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
N
W
E
S
Scale: 1:500,000
Nature Conservancy Canada
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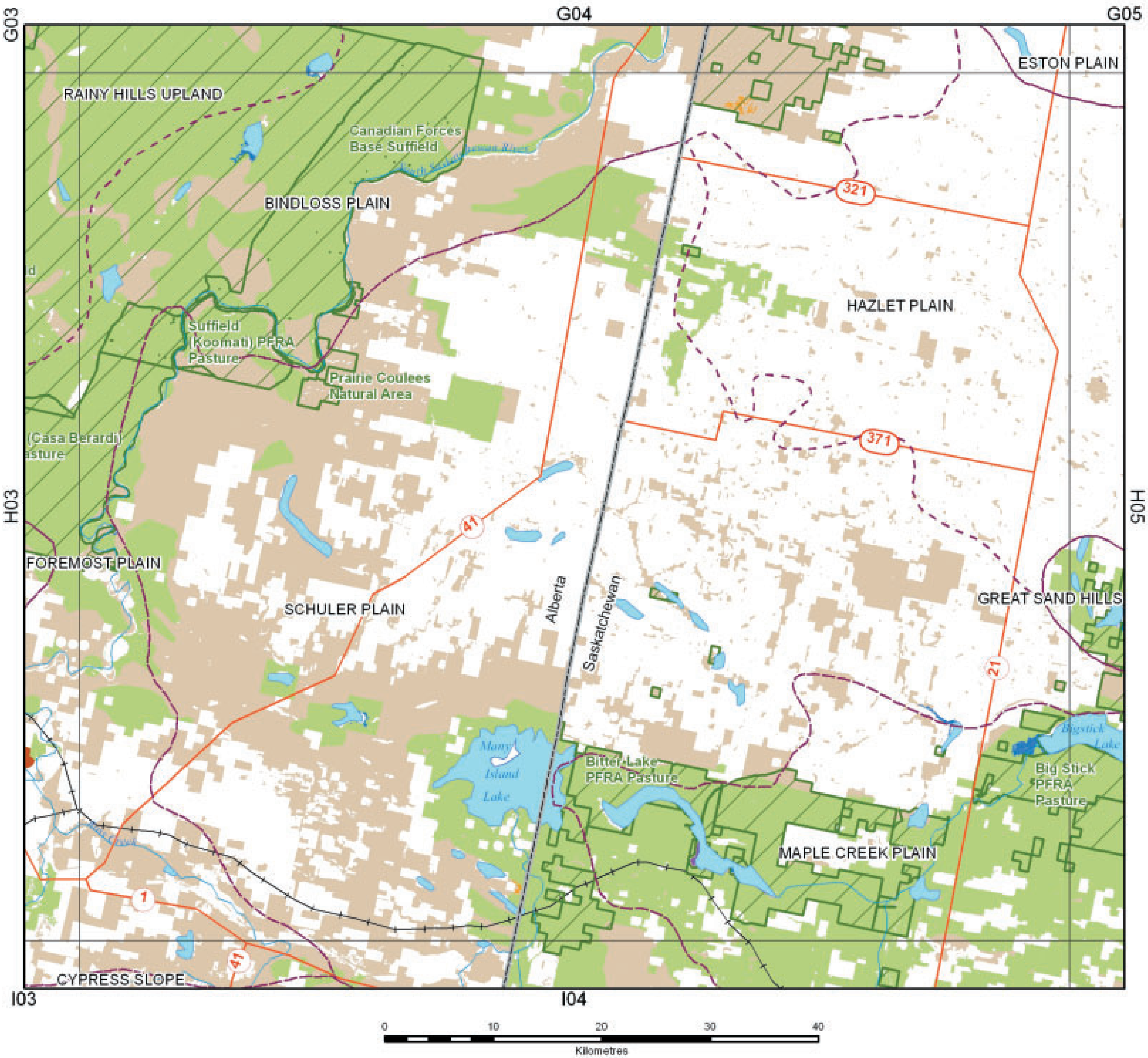
Projection: Canada Albers Equal Area (NAD 83)



Prairie and Parkland Conservation Blueprint

Map Tile: H04

Alberta
Saskatchewan
Manitoba
Montana
North Dakota

Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N
W
E
S

Scale: 1:500,000

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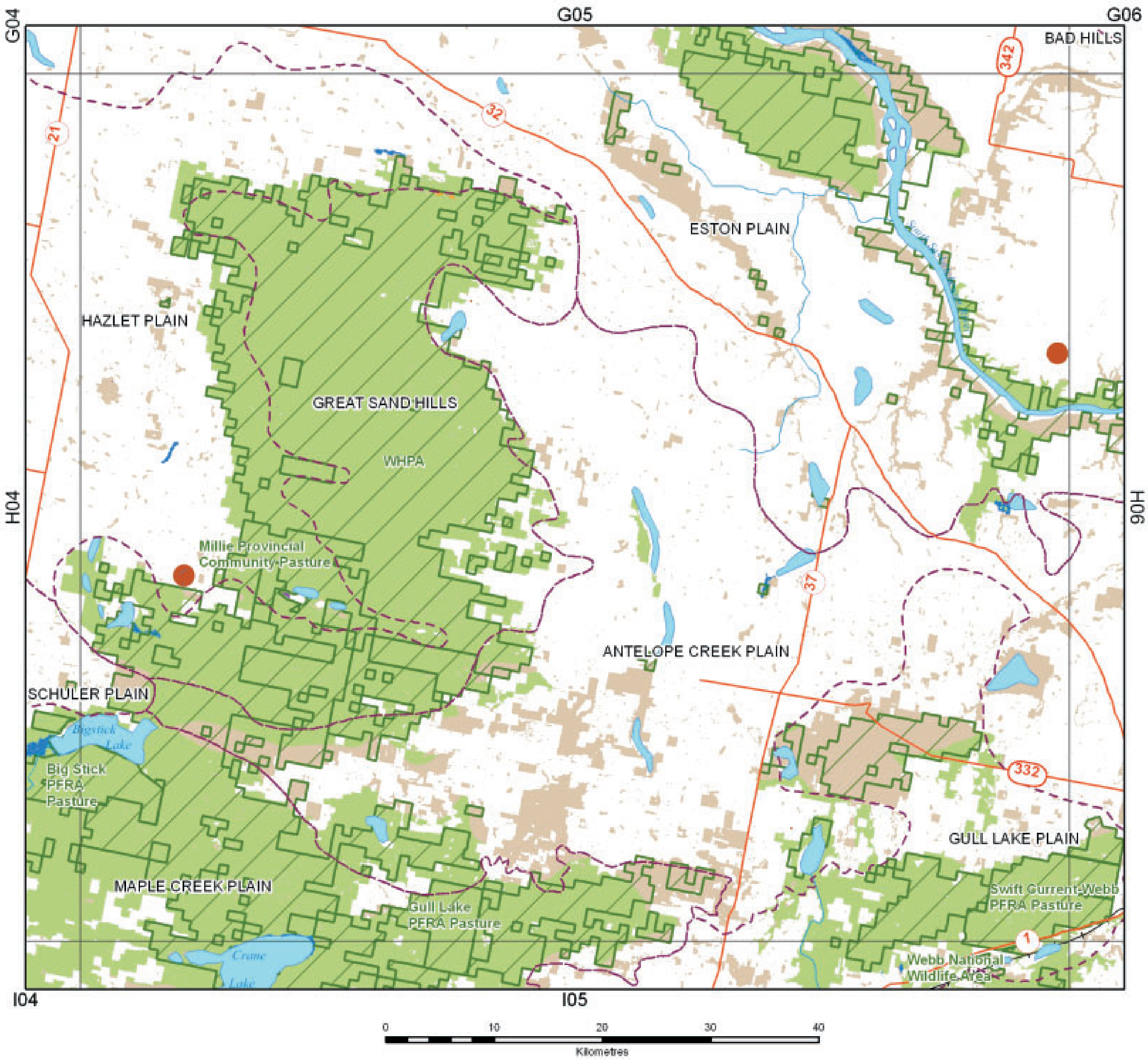
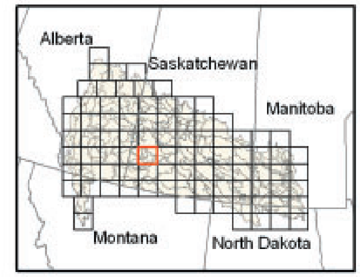
Projection: Canada Albers Equal Area (NAD 83)



Prairie and Parkland Conservation Blueprint

Map Tile: H05



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

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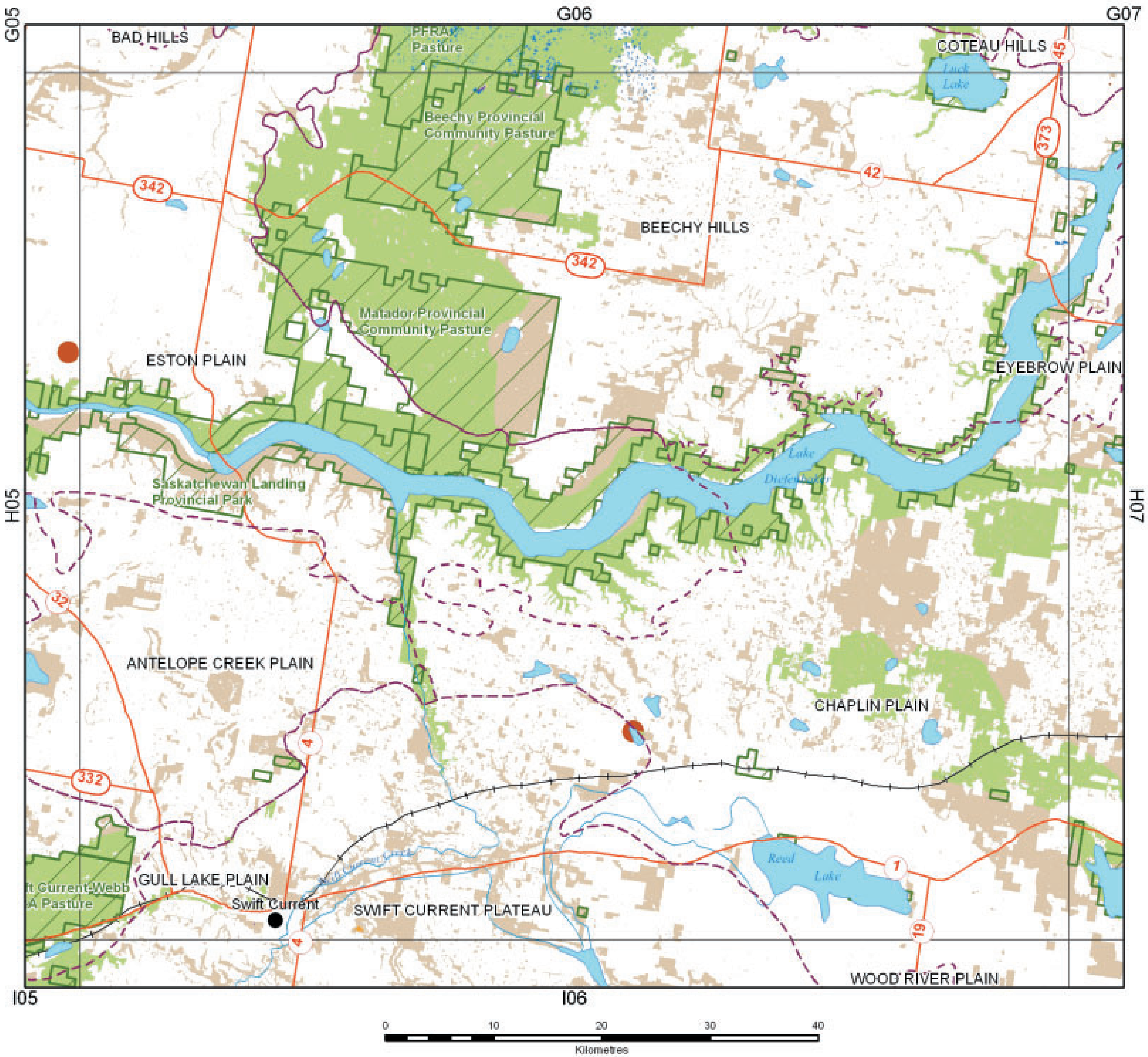
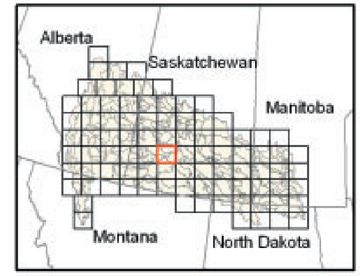


Prairie and Parkland Conservation Blueprint

Map Tile: H06



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

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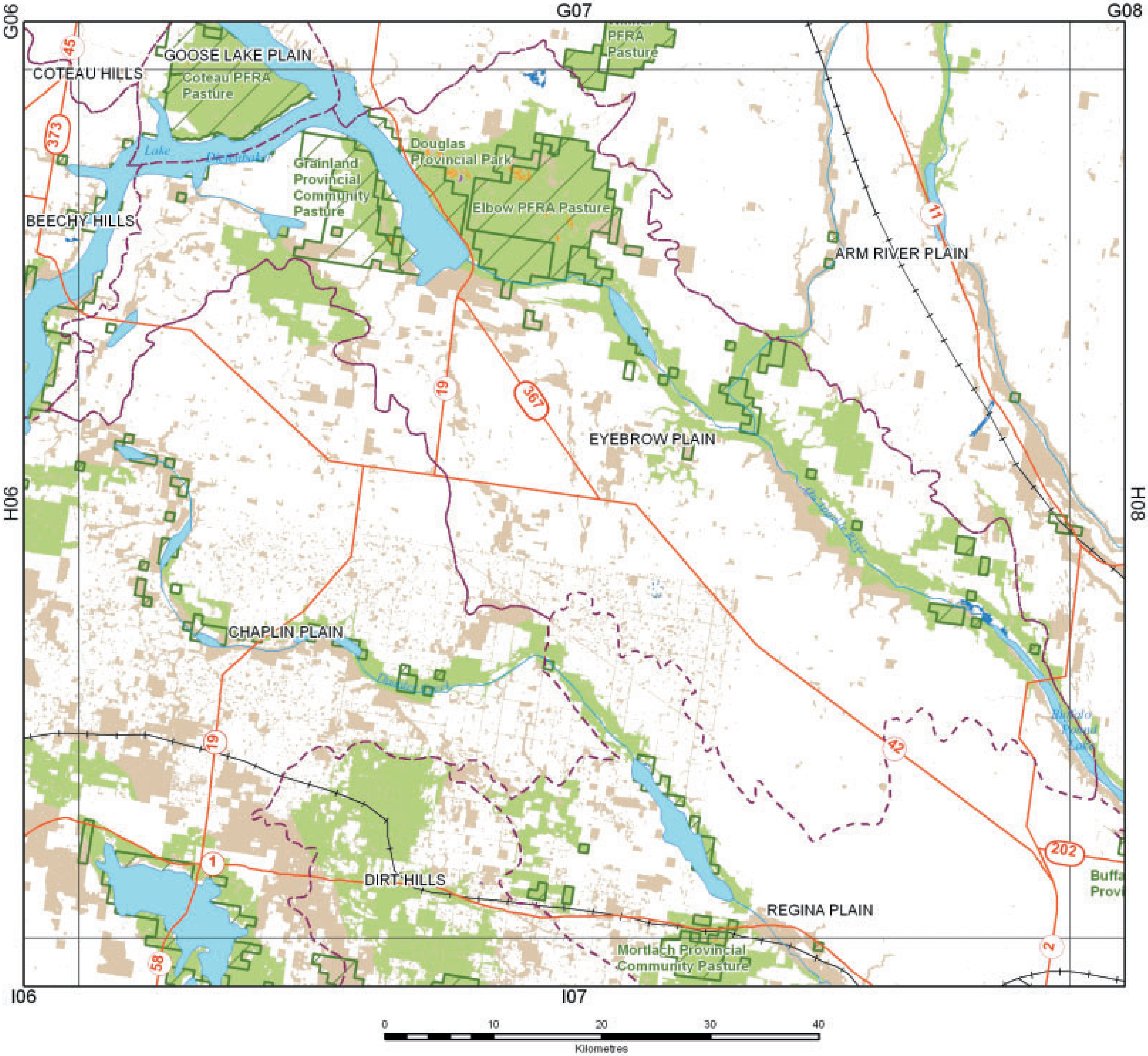
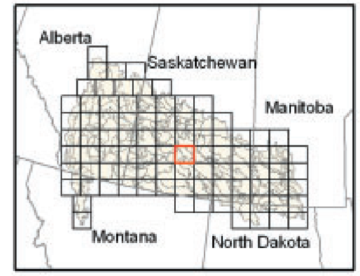


Prairie and Parkland Conservation Blueprint

Map Tile: H07



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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Published February 2006

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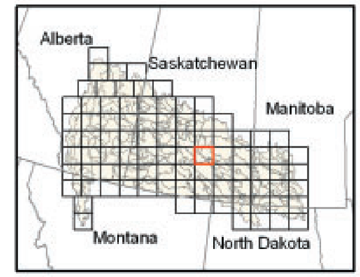
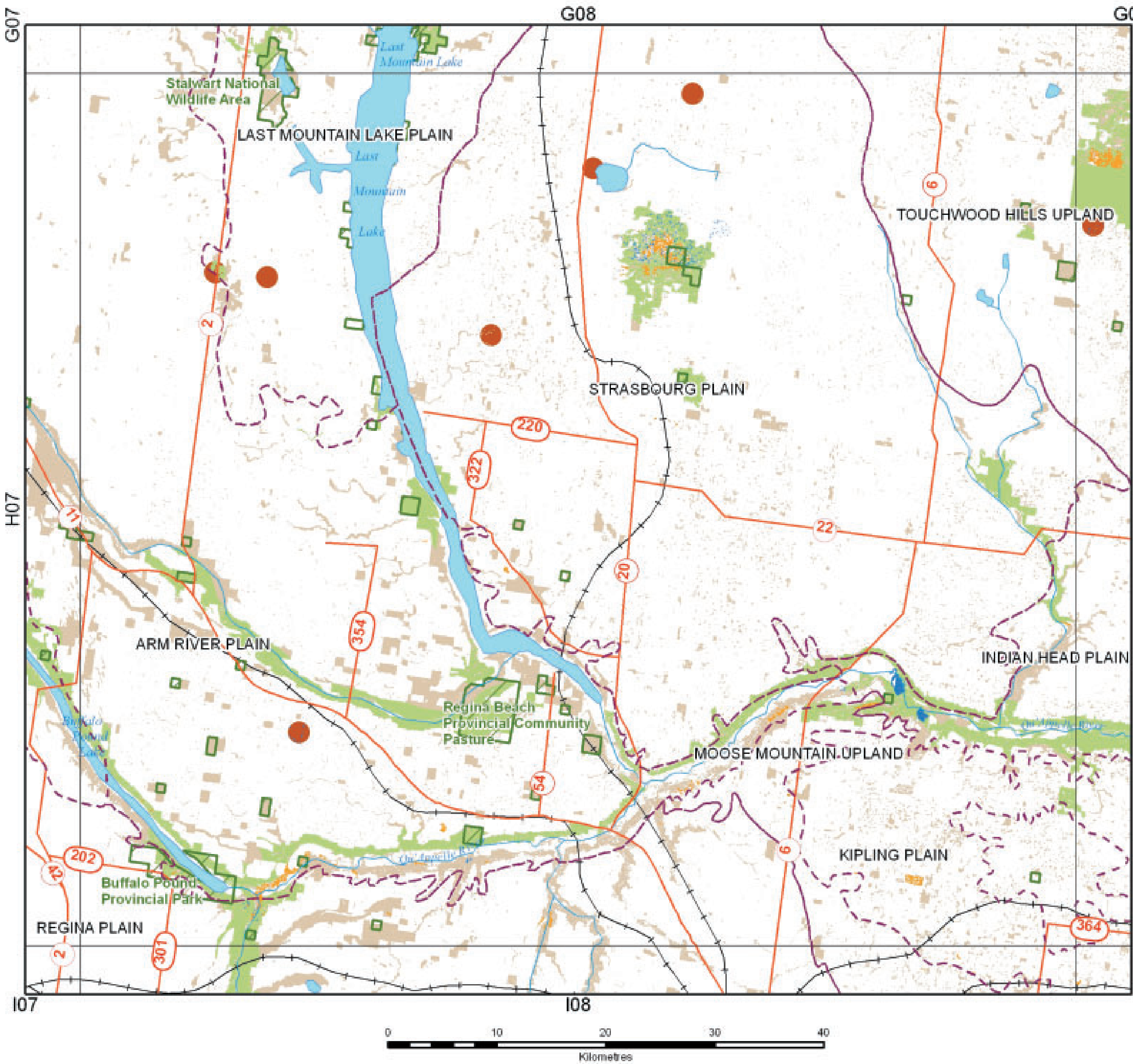
Prairie and Parkland Conservation Blueprint

Map Tile: H08



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders



Scale: 1:500,000

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Published February 2008

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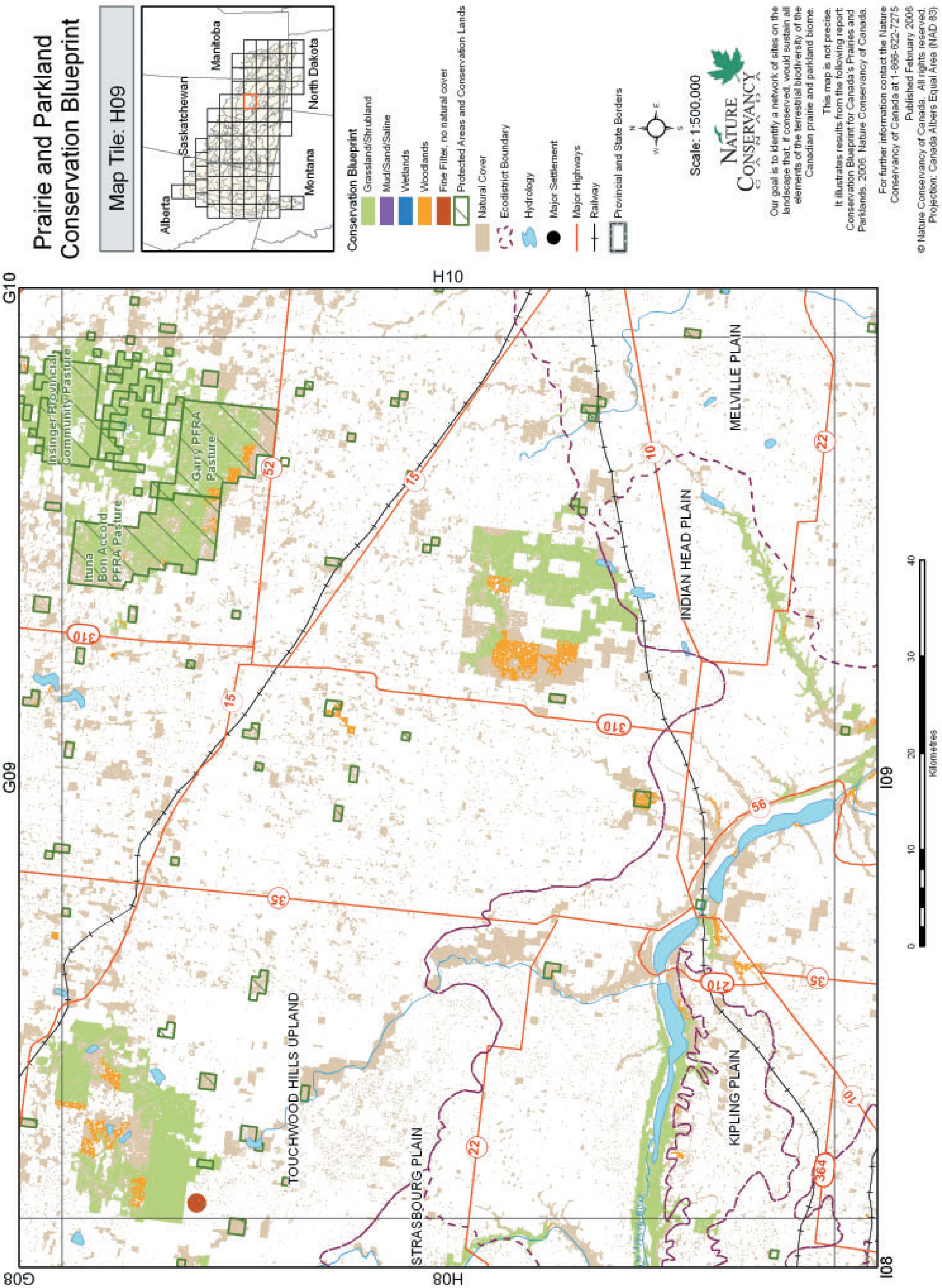
Prairie and Parkland Conservation Blueprint
Map Tile: H09
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
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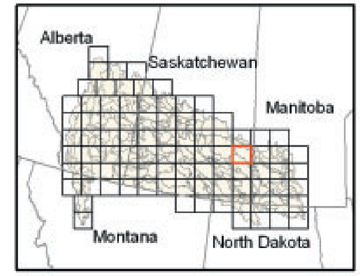
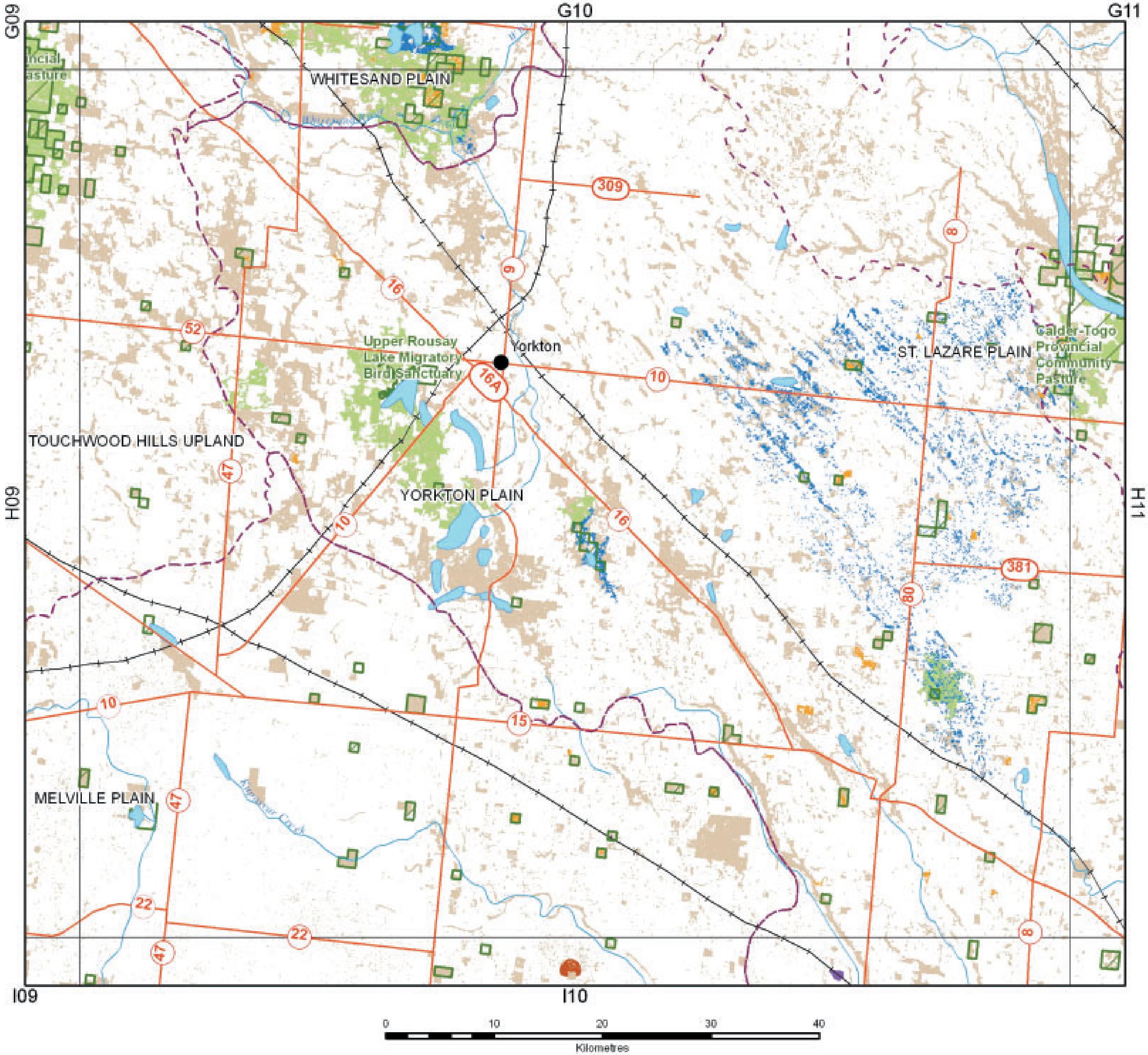
Projection: Canada Albers Equal Area (NAD 83)
G10
H10
G09
I09
G08
H08
I08
Insinger Provincial Community Pasture
Garry PFRA Pasture
Ituna Bon Accord PFRA Pasture
MELVILLE PLAIN
INDIAN HEAD PLAIN
TOUCHWOOD HILLS UPLAND
STRASBOURG PLAIN
KIPLING PLAIN
52
15
10
22
310
35
56
210
364
0
10
20
30
40
Kilometres

Prairie and Parkland Conservation Blueprint

Map Tile: H10





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

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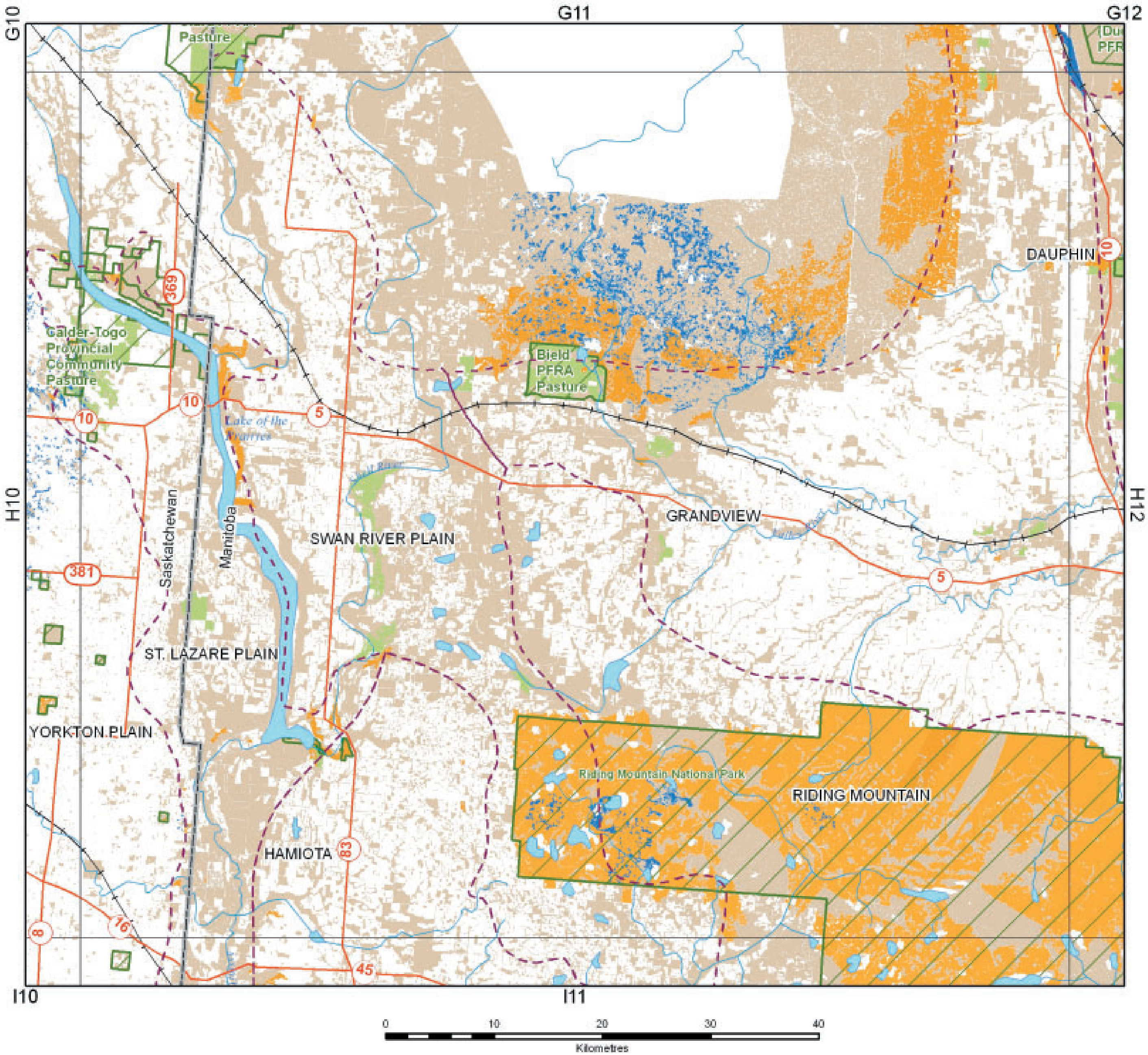
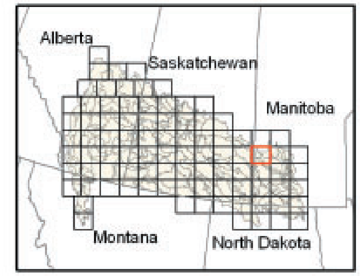


Prairie and Parkland Conservation Blueprint

Map Tile: H11



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N
W E
S

Scale: 1:500,000

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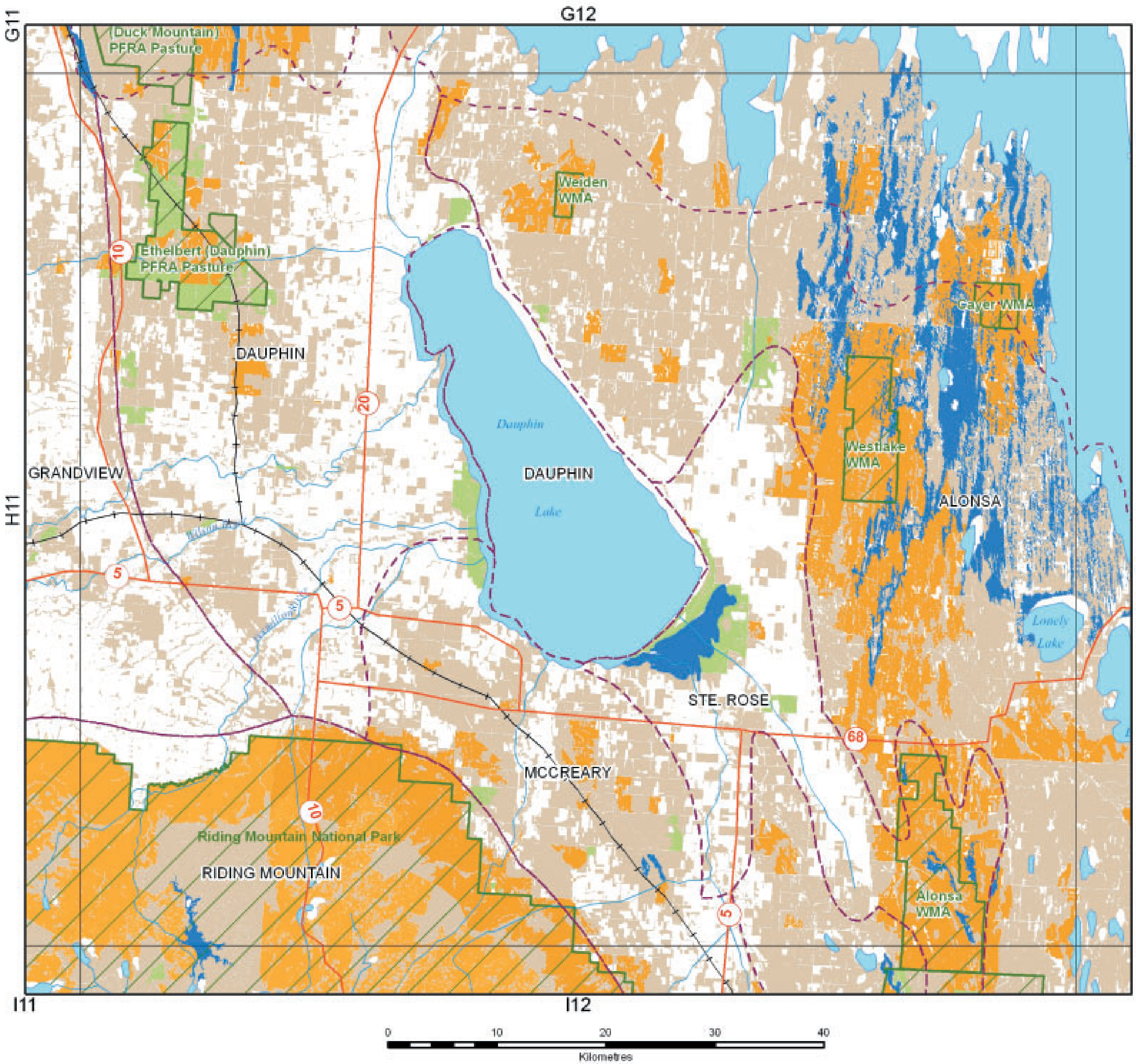
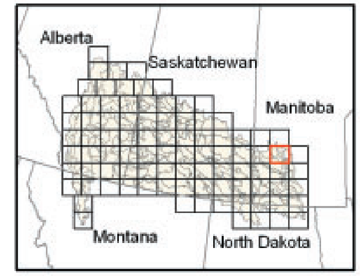
Prairie and Parkland Conservation Blueprint

Map Tile: H12





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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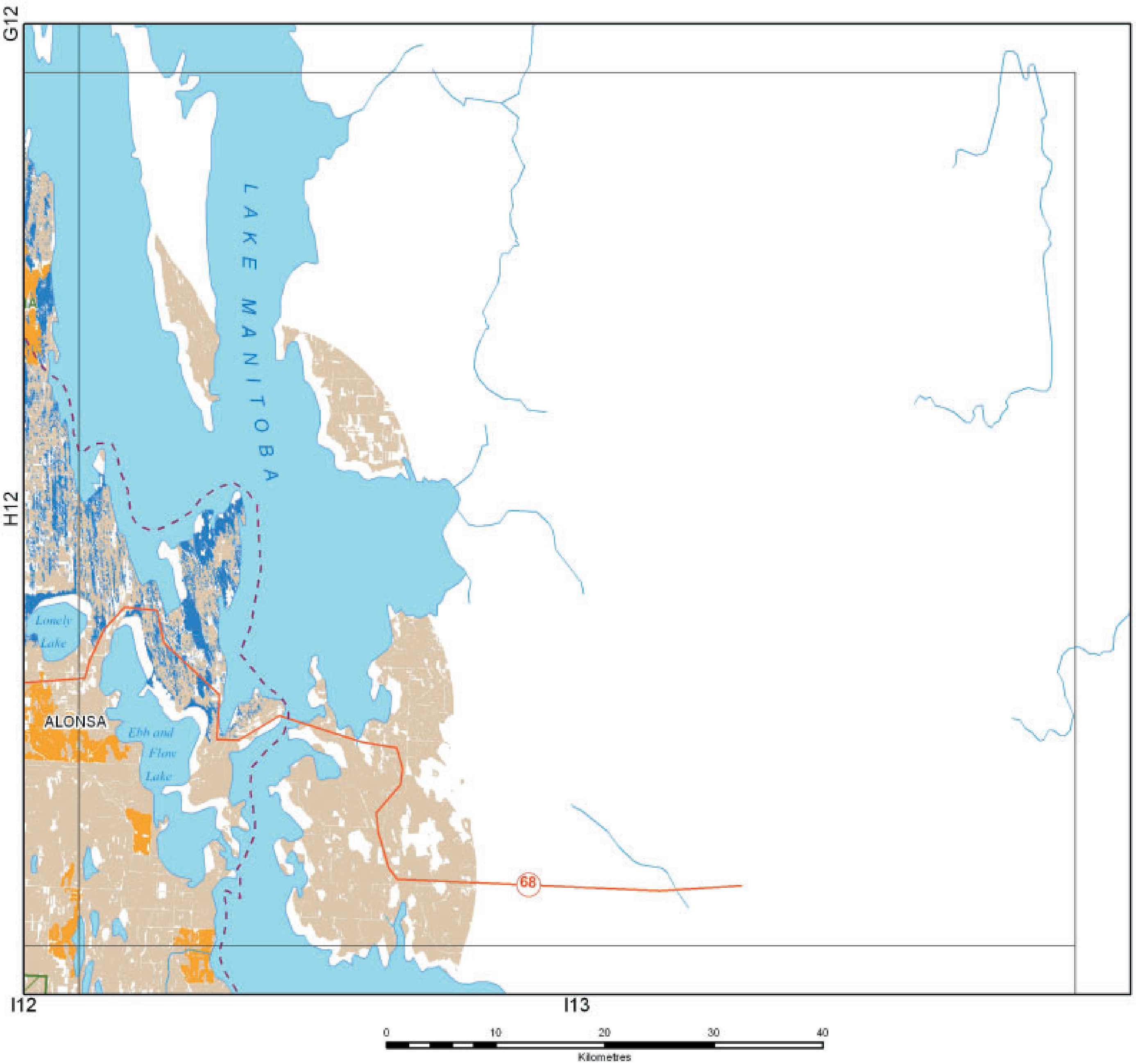
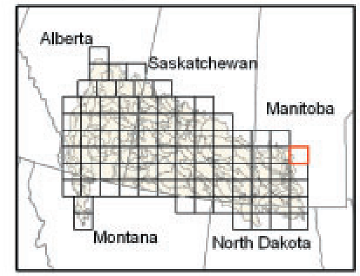


Prairie and Parkland Conservation Blueprint

Map Tile: H13



Scale: 1:500,000

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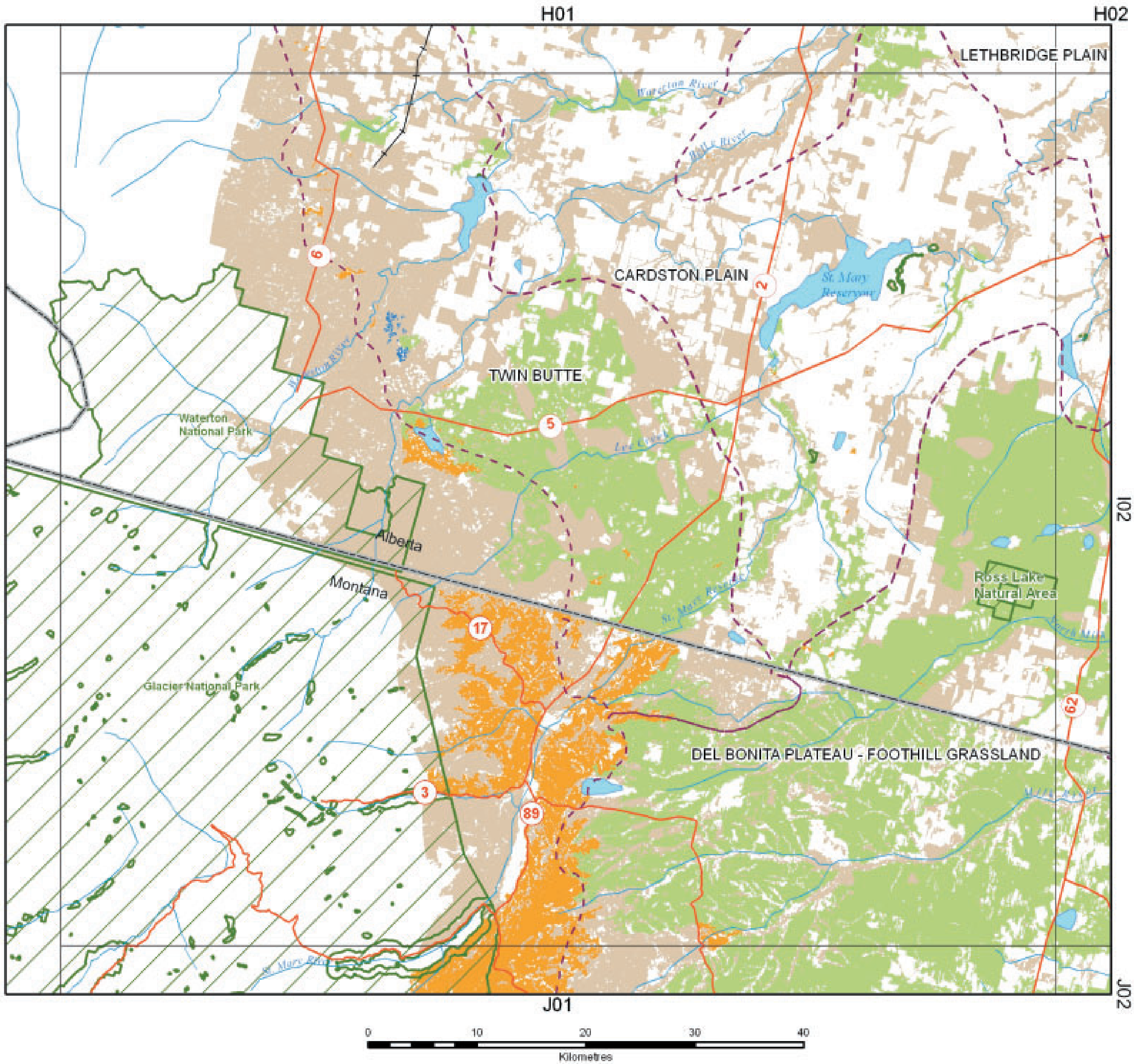
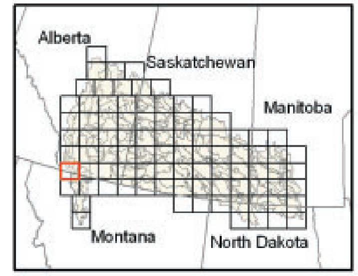


Prairie and Parkland Conservation Blueprint

Map Tile: I01



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

NATURE CONSERVANCY CANADA

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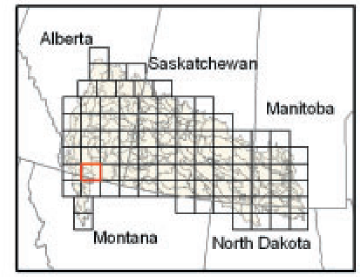
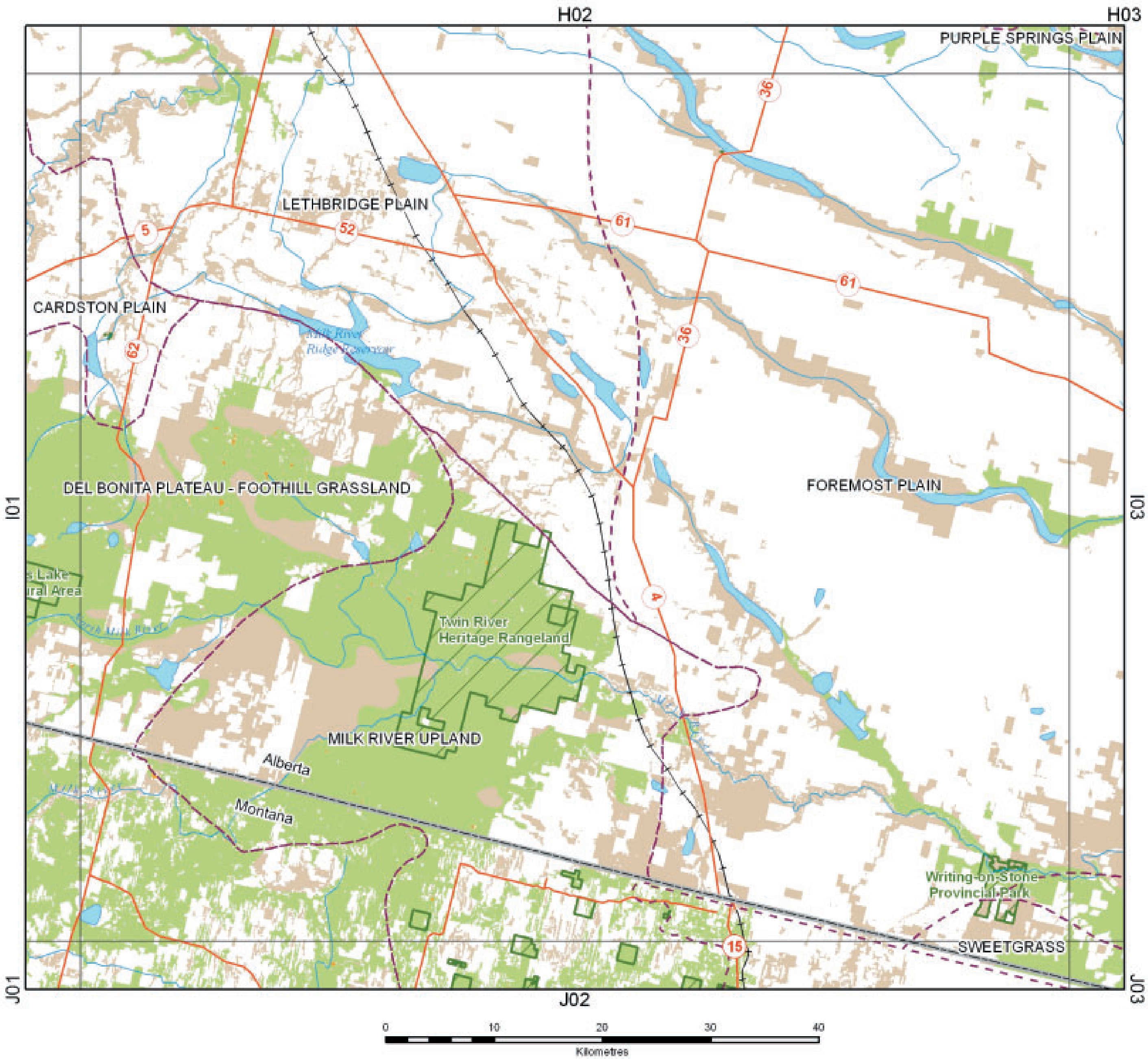
Published February 2006

Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: I02





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

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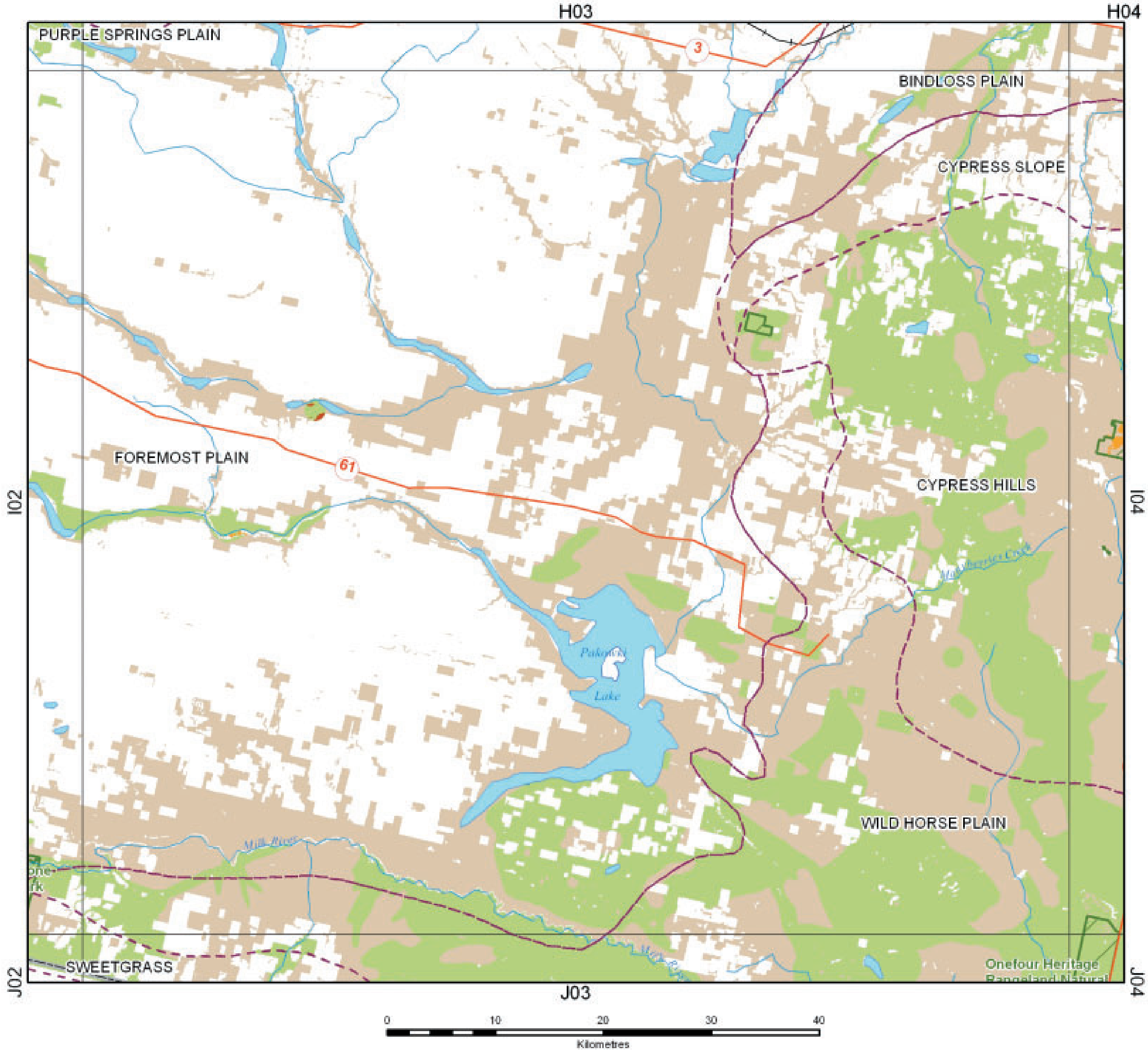
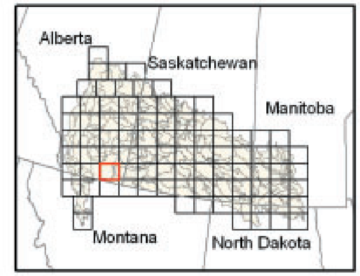


Prairie and Parkland Conservation Blueprint

Map Tile: I03



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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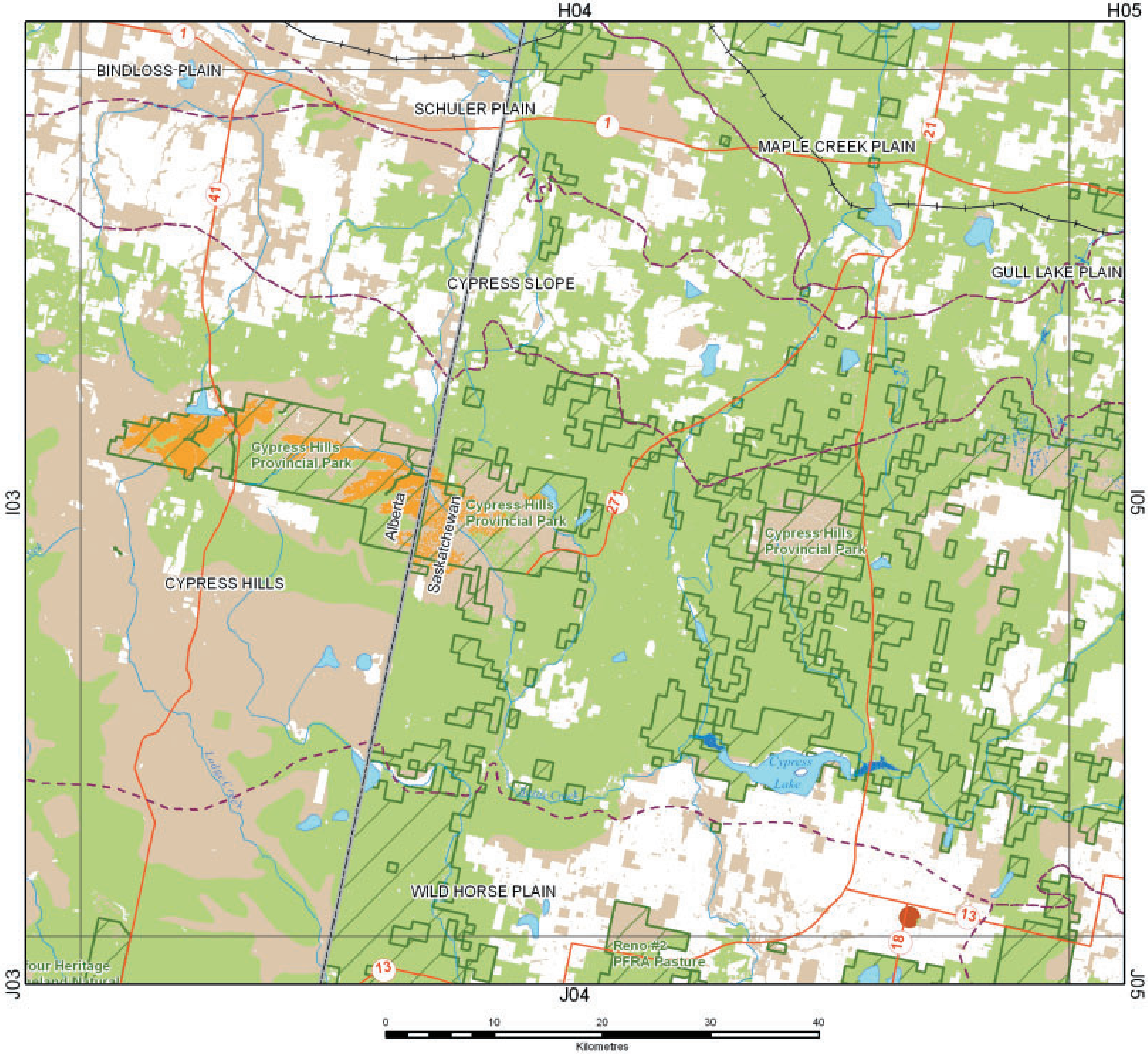
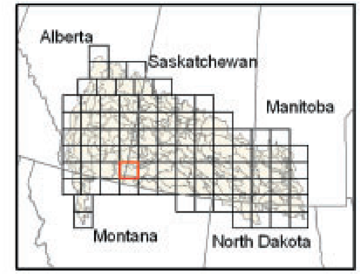
Prairie and Parkland Conservation Blueprint

Map Tile: I04





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

Nature Conservancy Canada

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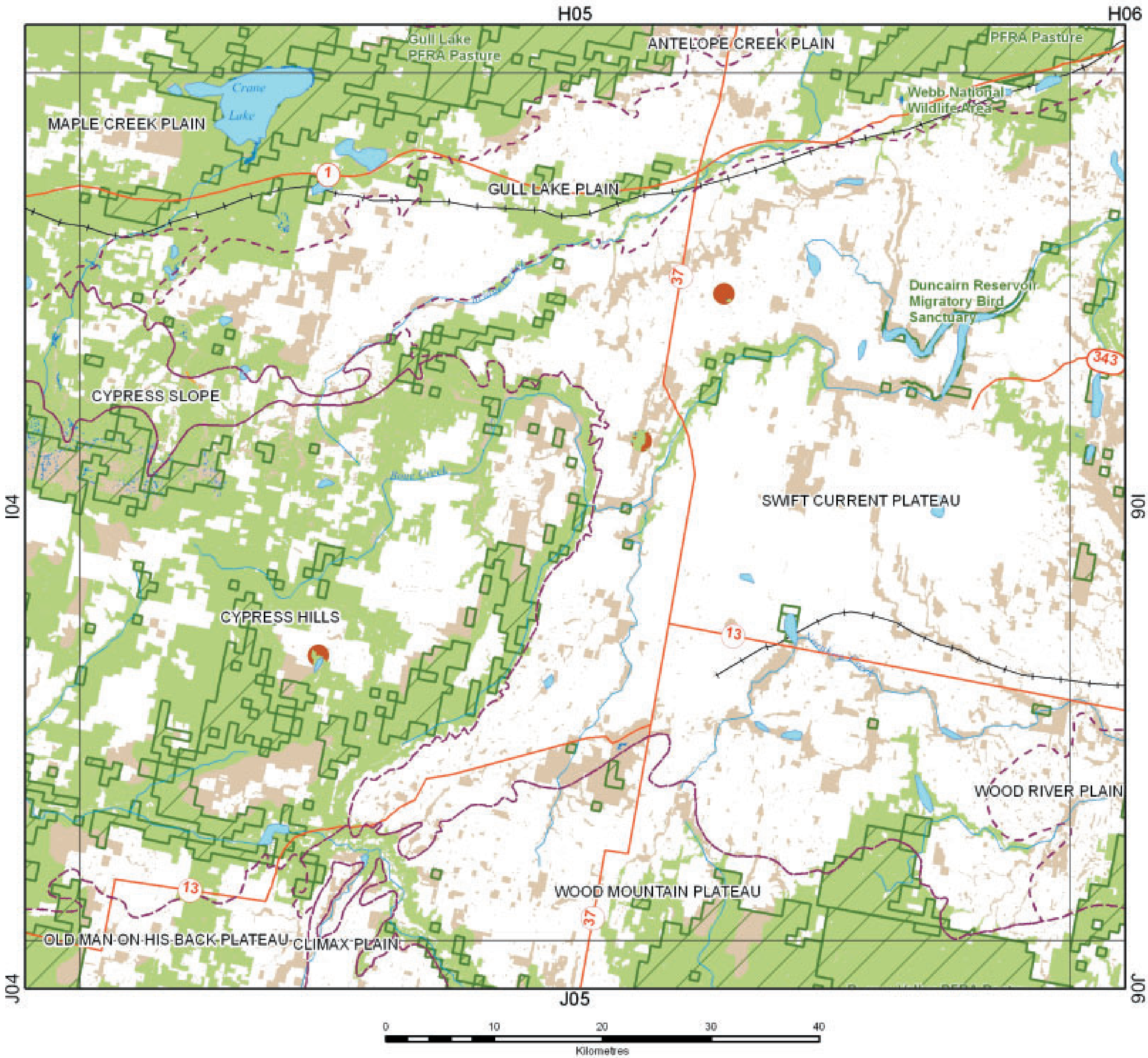
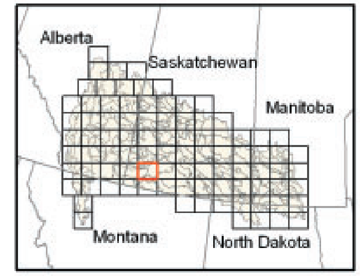


Prairie and Parkland Conservation Blueprint

Map Tile: I05



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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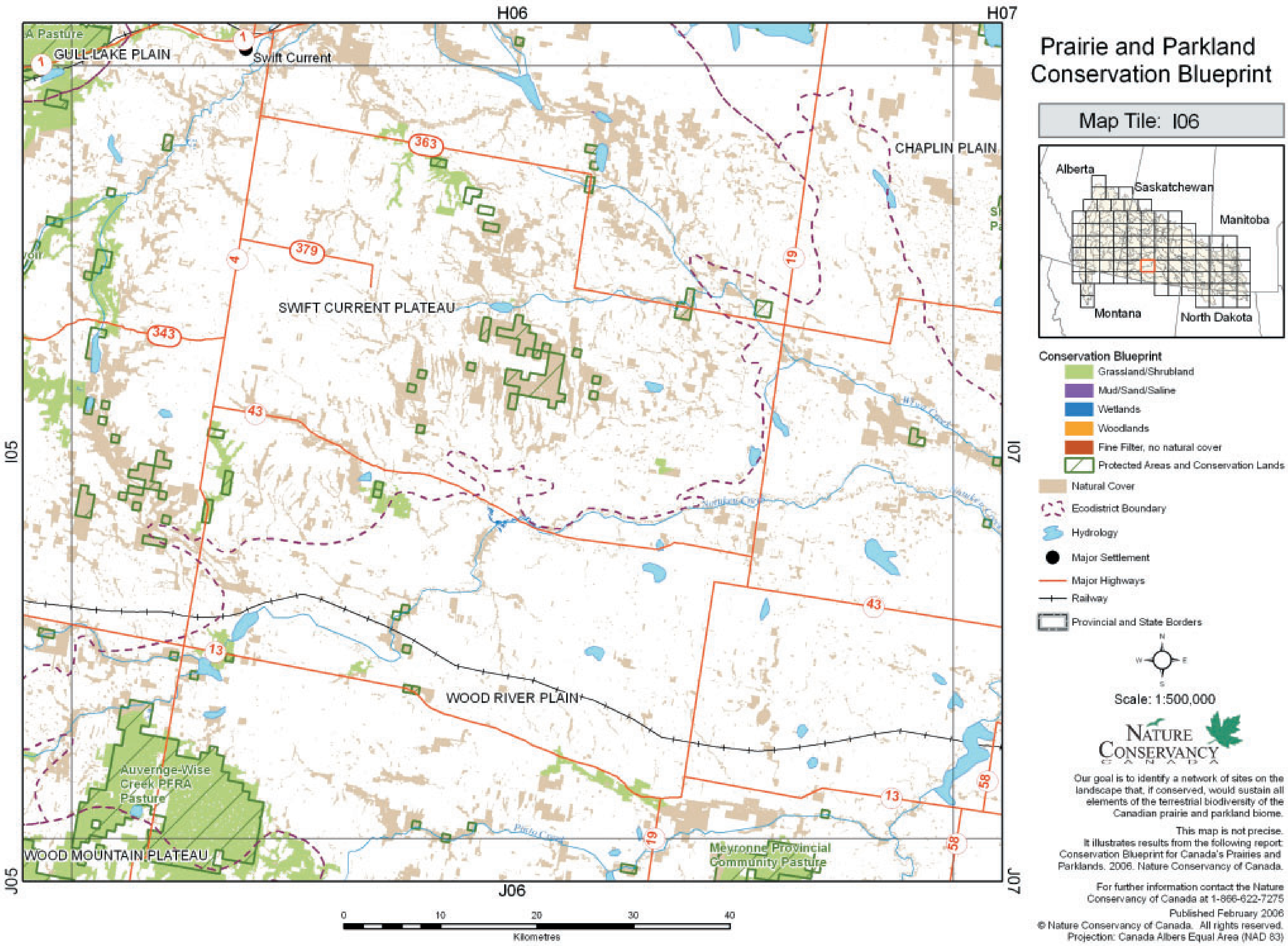
Prairie and Parkland
Conservation Blueprint
Map Tile: I06
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
Nature Conservancy Canada
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Published February 2006
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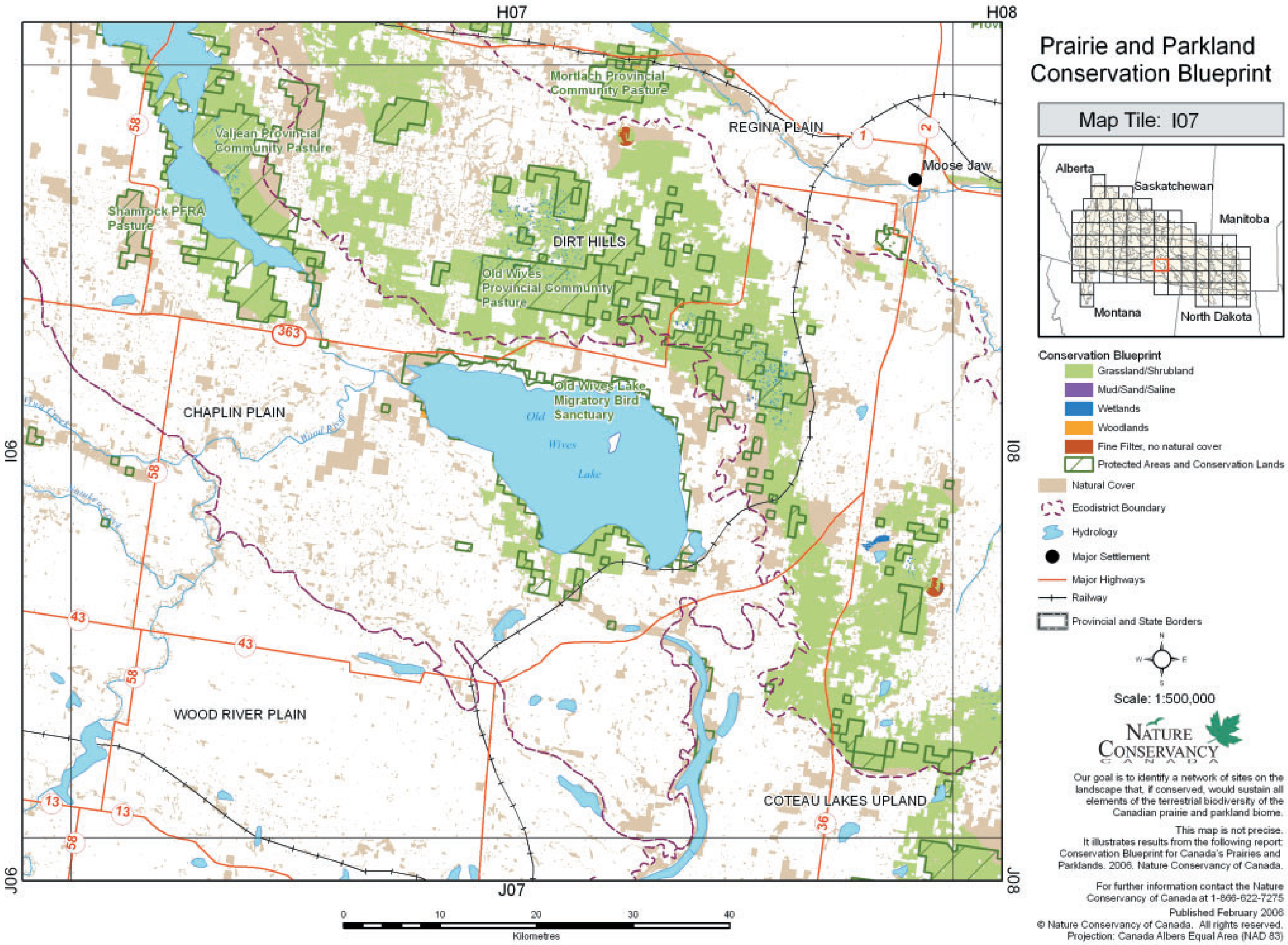
Projection: Canada Albers Equal Area (NAD 83)
H06
H07
I05
I07
J05
J06
J07
GULL LAKE PLAIN
Swift Current
CHAPLIN PLAIN
SWIFT CURRENT PLATEAU
WOOD RIVER PLAIN
WOOD MOUNTAIN PLATEAU
Auvergne-Wise Creek PFRA Pasture
Meyronne Provincial Community Pasture
1
4
13
19
43
58
343
363
379
0
10
20
30
40
Kilometres


Prairie and Parkland Conservation Blueprint
Map Tile: I07
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
Nature Conservancy Canada
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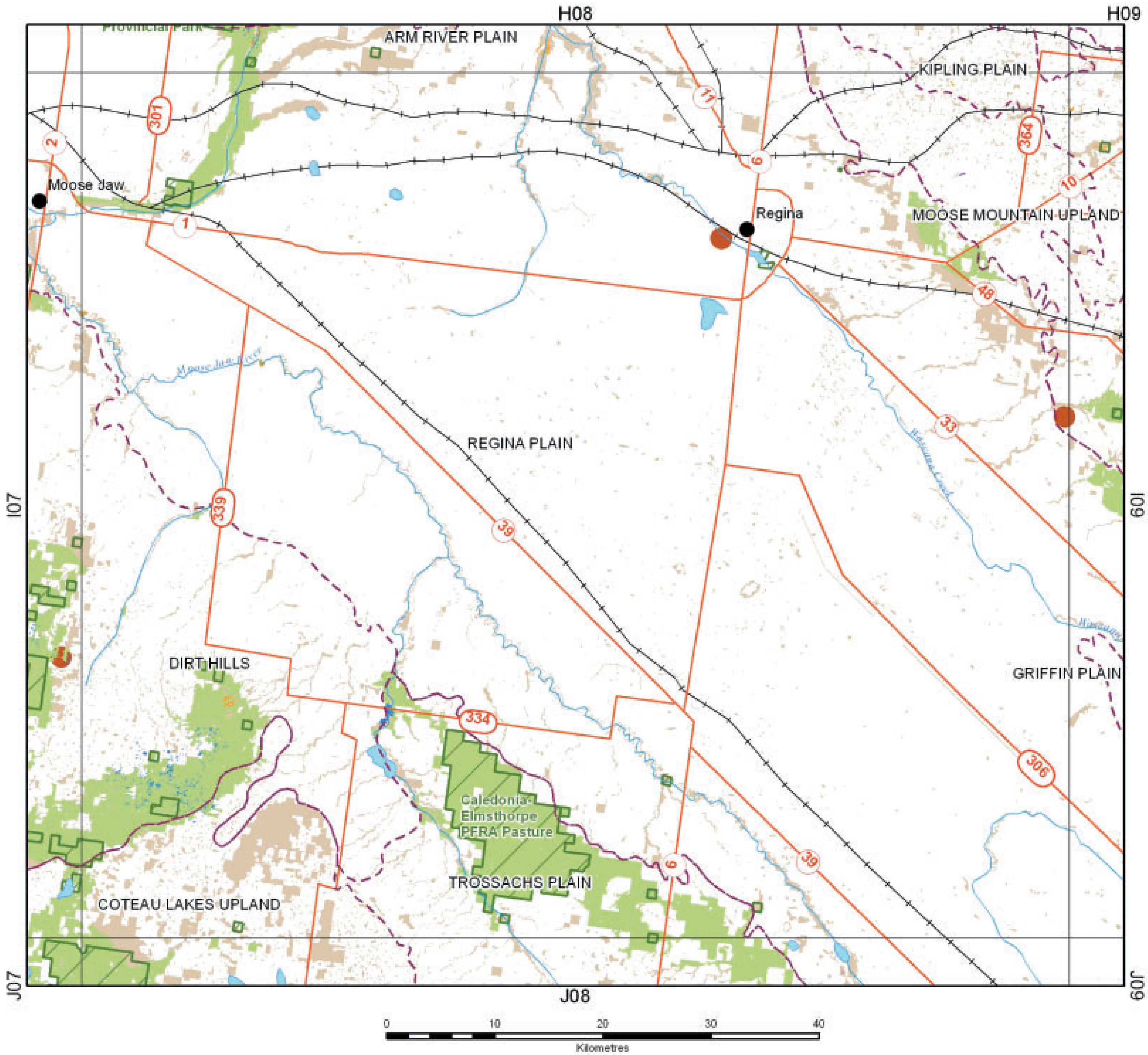
Projection: Canada Albers Equal Area (NAD 83)
H07
H08
I06
I08
J06
J07
J08
Mortlach Provincial Community Pasture
REGINA PLAIN
Moose Jaw
Valjean Provincial Community Pasture
Shamrock PFRA Pasture
DIRT HILLS
Old Wives Provincial Community Pasture
Old Wives Lake Migratory Bird Sanctuary
Old Wives Lake
CHAPLIN PLAIN
WOOD RIVER PLAIN
COTEAU LAKES UPLAND
1
2
13
36
43
58
363
0
10
20
30
40
Kilometres

Prairie and Parkland Conservation Blueprint

Map Tile: I08

Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders



Scale: 1:500,000

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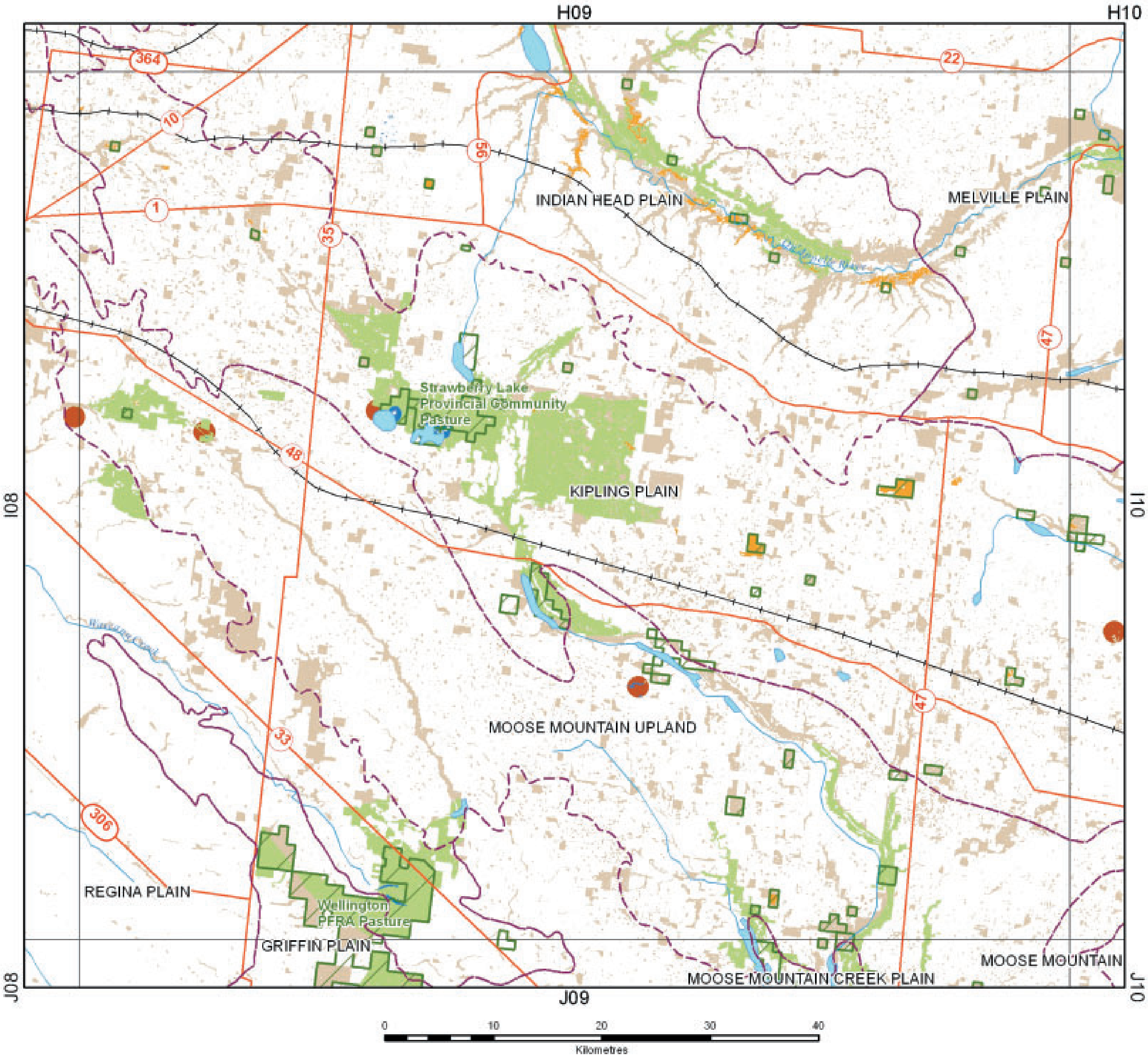
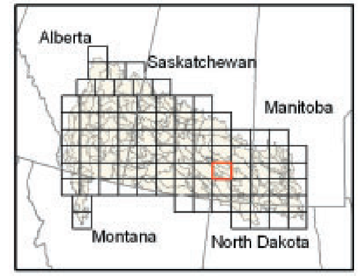


Prairie and Parkland Conservation Blueprint

Map Tile: I09



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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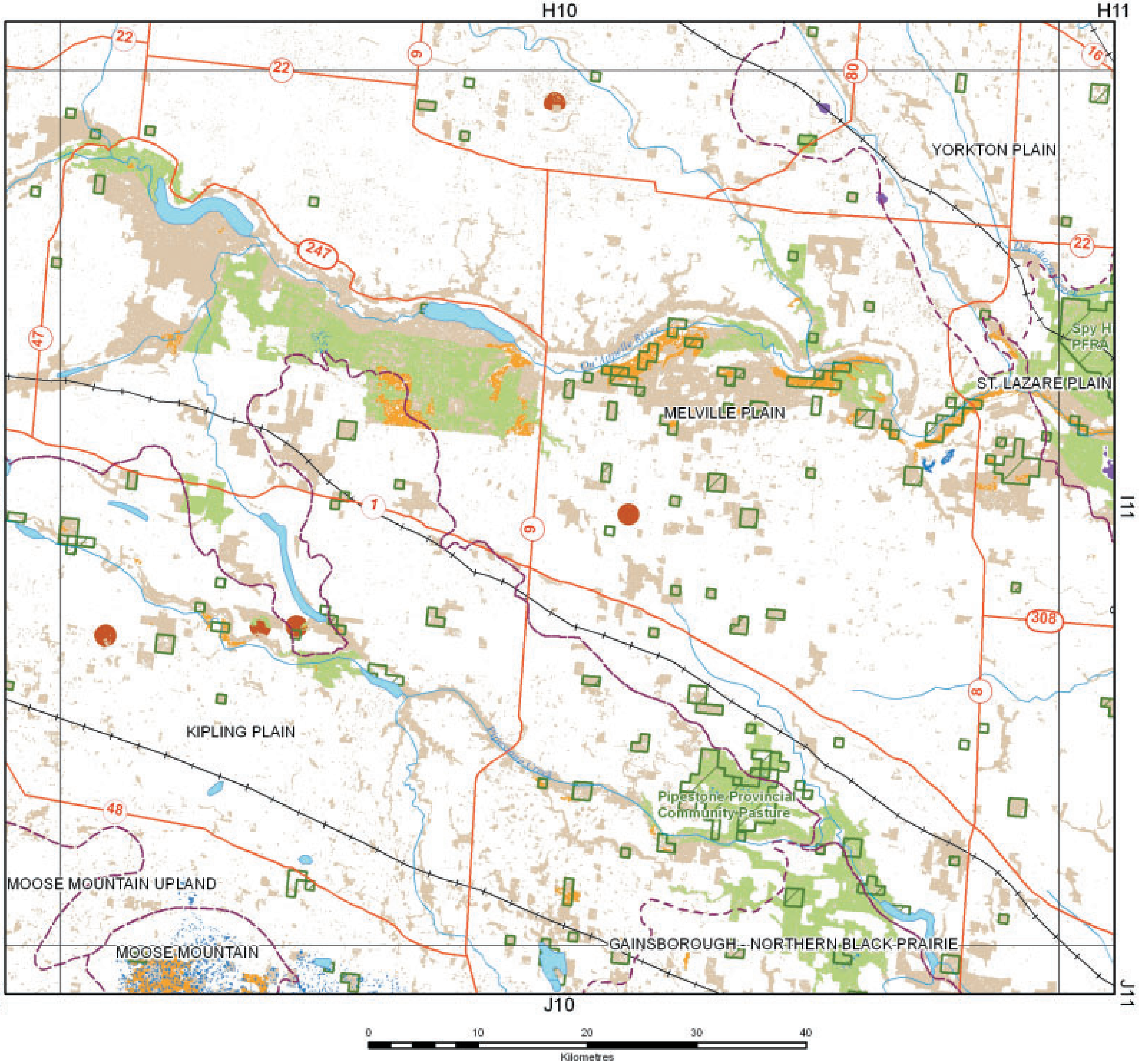

Prairie and Parkland Conservation Blueprint

Map Tile: I10

Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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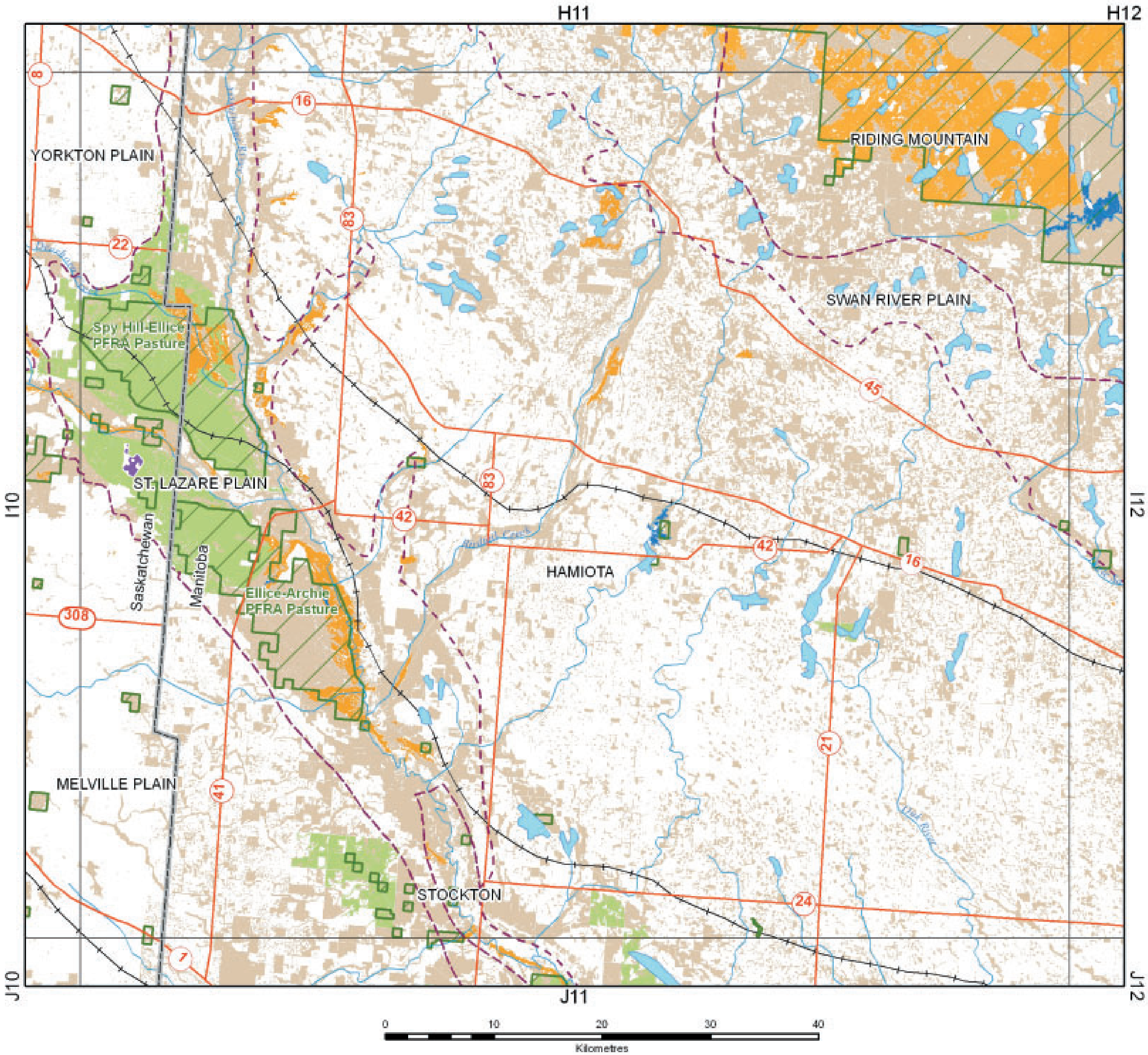
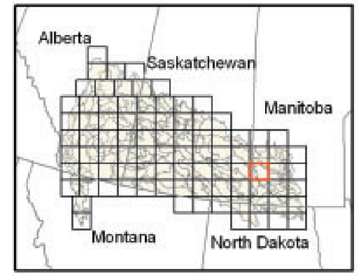


Prairie and Parkland Conservation Blueprint

Map Tile: I11



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
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- Railway
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Scale: 1:500,000

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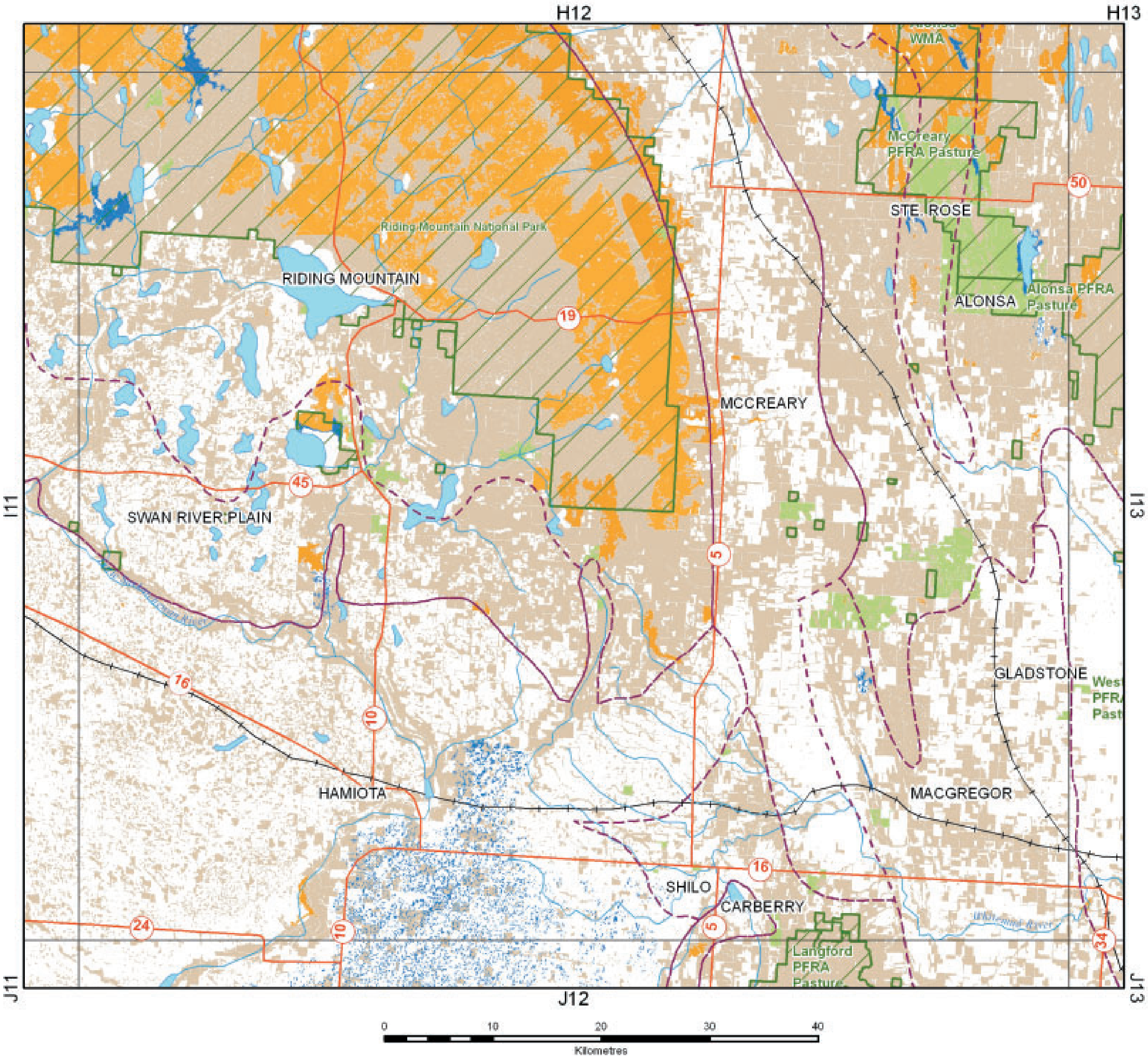
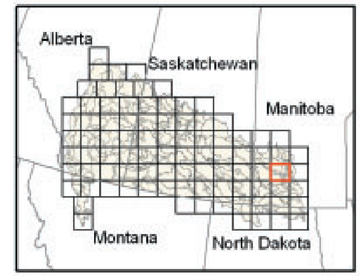


Prairie and Parkland Conservation Blueprint

Map Tile: I12



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N W E S

Scale: 1:500,000

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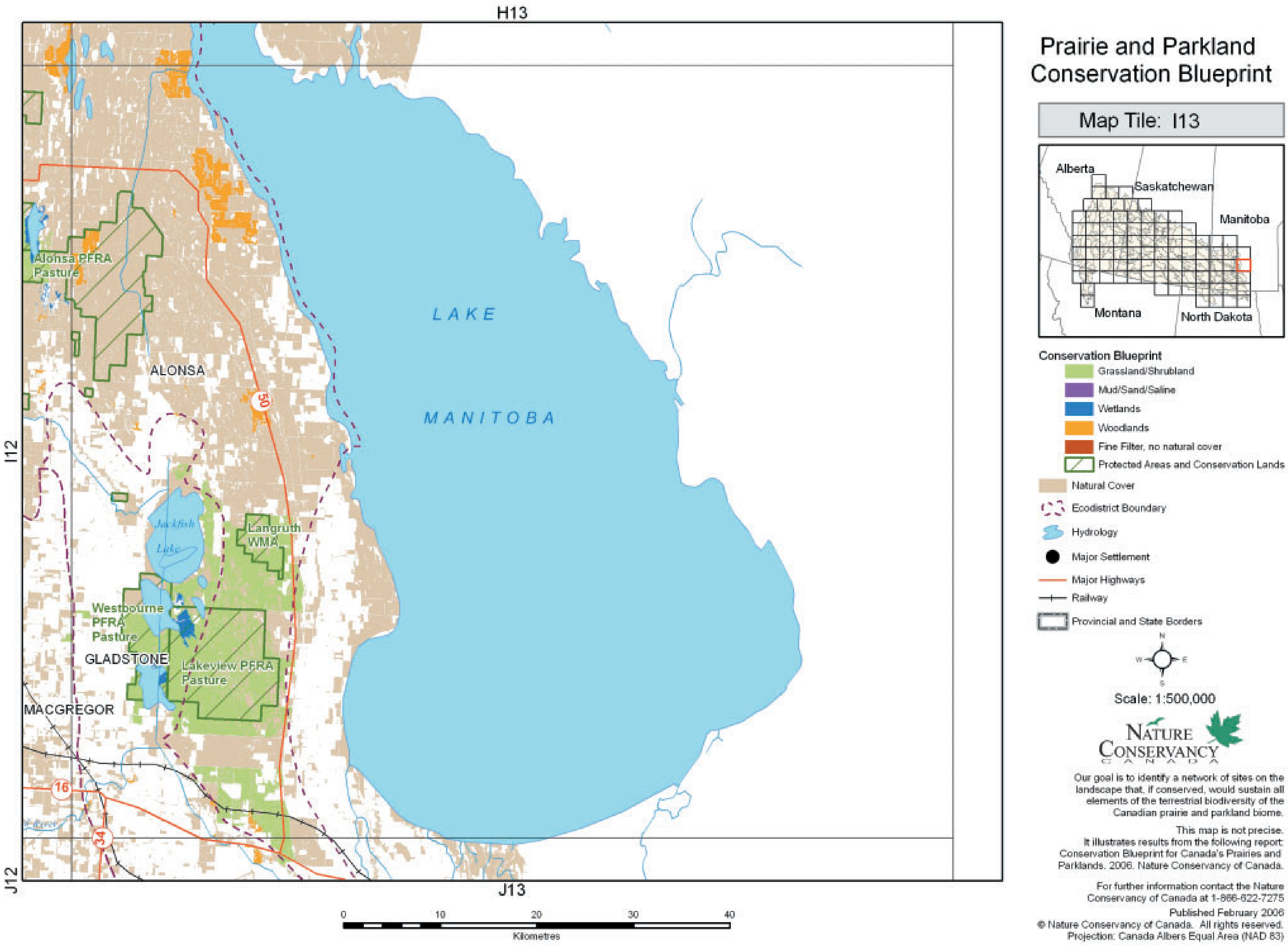

H13
J13
I12
J12
LAKE
MANITOBA
Alonsa PFRA Pasture
ALONSA
Jackfish Lake
Langruth WMA
Westbourne PFRA Pasture
GLADSTONE
Lakeview PFRA Pasture
MACGREGOR
50
16
34
0
10
20
30
40
Kilometres
Prairie and Parkland Conservation Blueprint
Map Tile: I13
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
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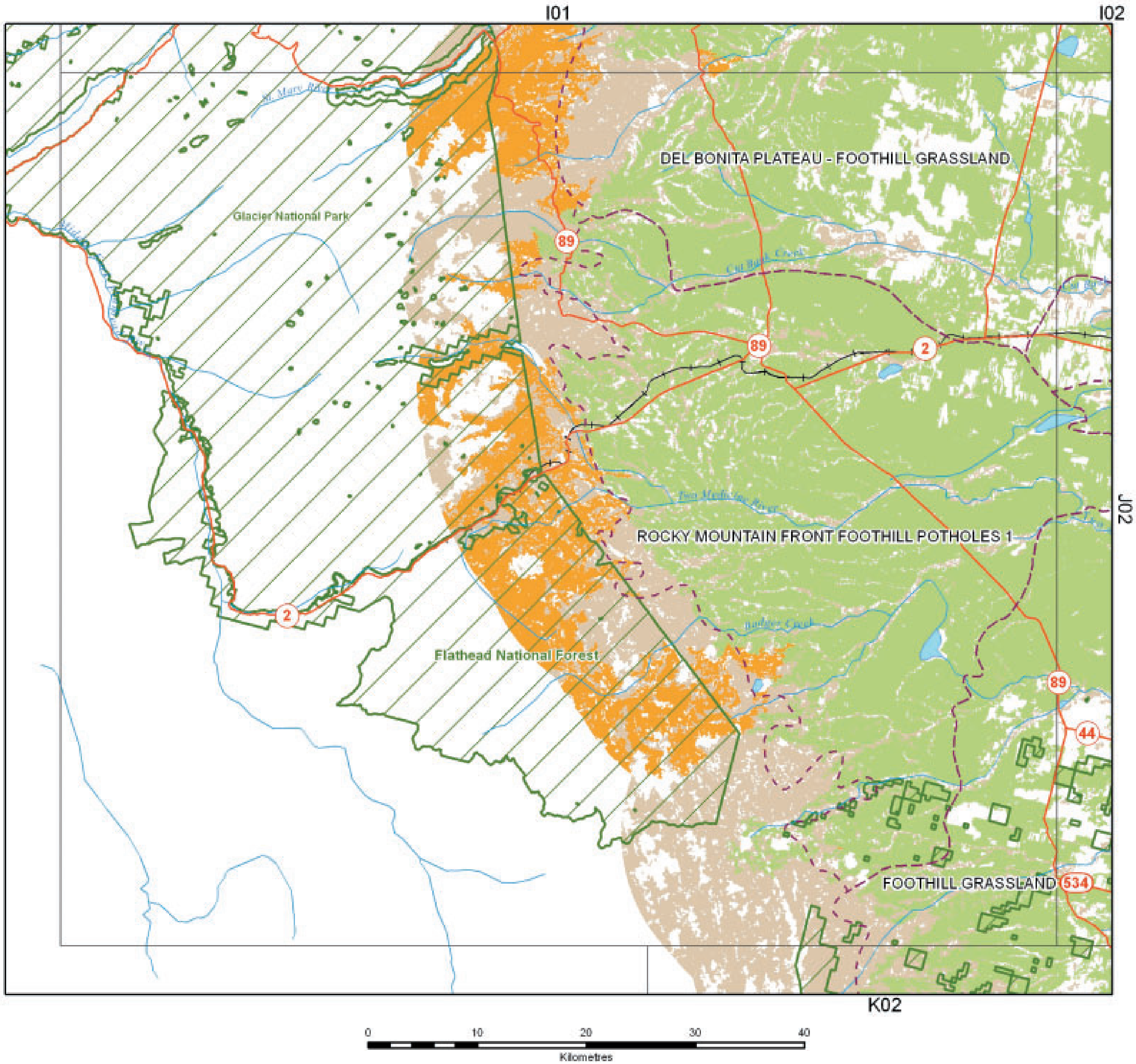
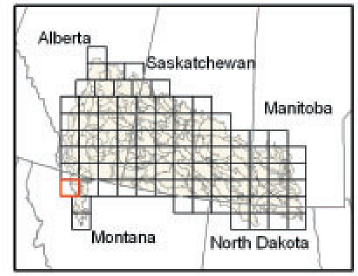
Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: J01





Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

Natural Cover

Ecodistrict Boundary

Hydrology

Major Settlement

Major Highways

Railway

Provincial and State Borders

Scale: 1:500,000

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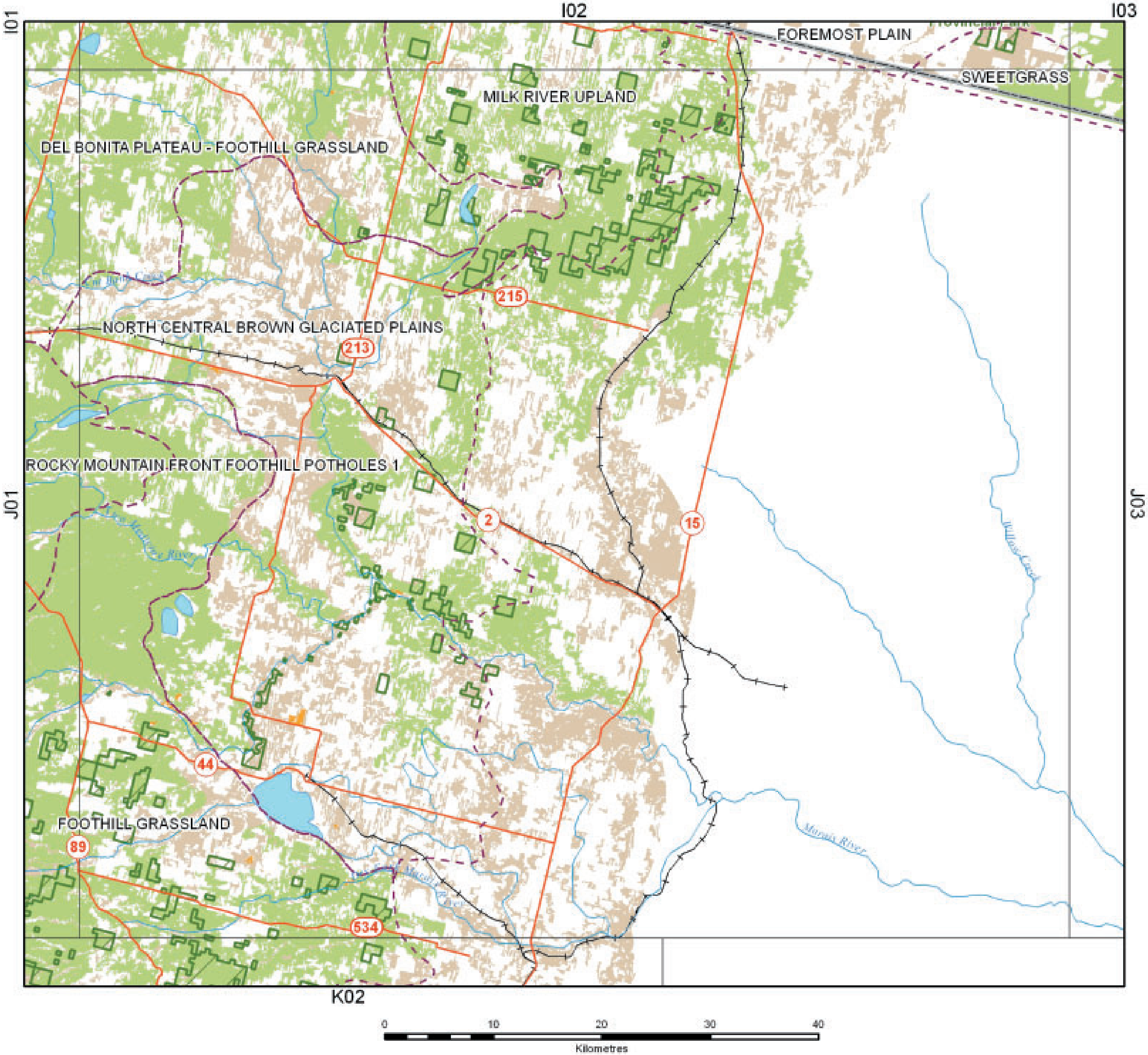
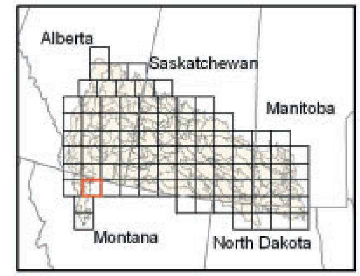


Prairie and Parkland Conservation Blueprint

Map Tile: J02



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
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- Hydrology
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- Major Highways
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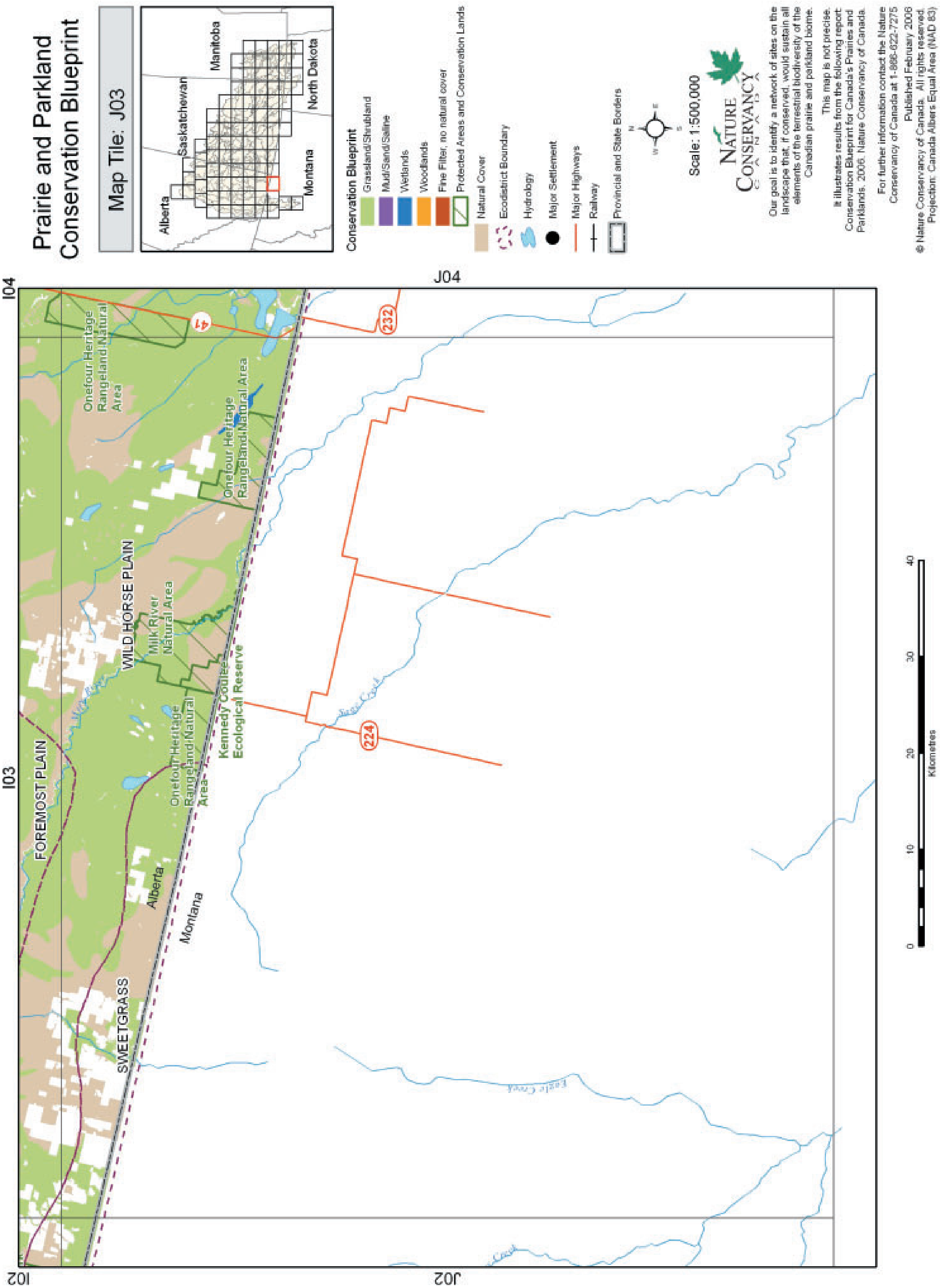
Prairie and Parkland Conservation Blueprint
Map Tile: J03
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
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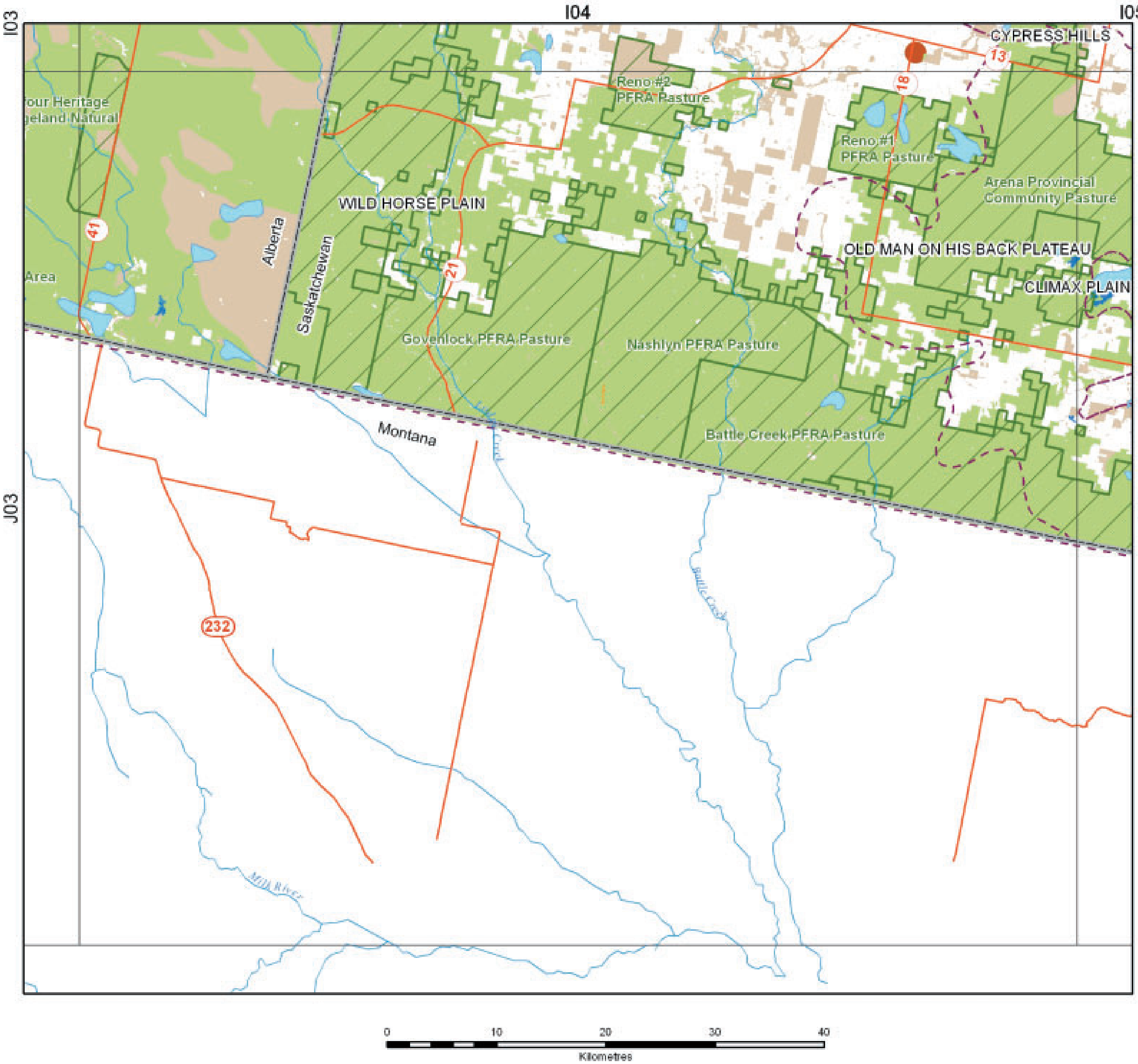
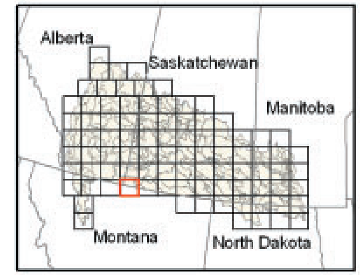
Projection: Canada Albers Equal Area (NAD 83)
I04
I03
I02
J04
J02
FOREMOST PLAIN
WILD HORSE PLAIN
SWEETGRASS
Onefour Heritage Rangeland Natural Area
Milk River Natural Area
Kennedy Coulee Ecological Reserve
Alberta
Montana
41
232
224
0
10
20
30
40
Kilometres



Prairie and Parkland Conservation Blueprint

Map Tile: J04



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N W E S

Scale: 1:500,000

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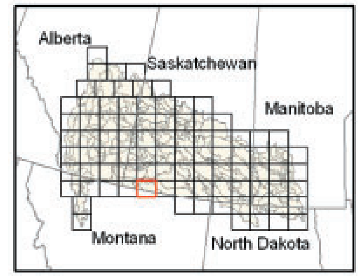
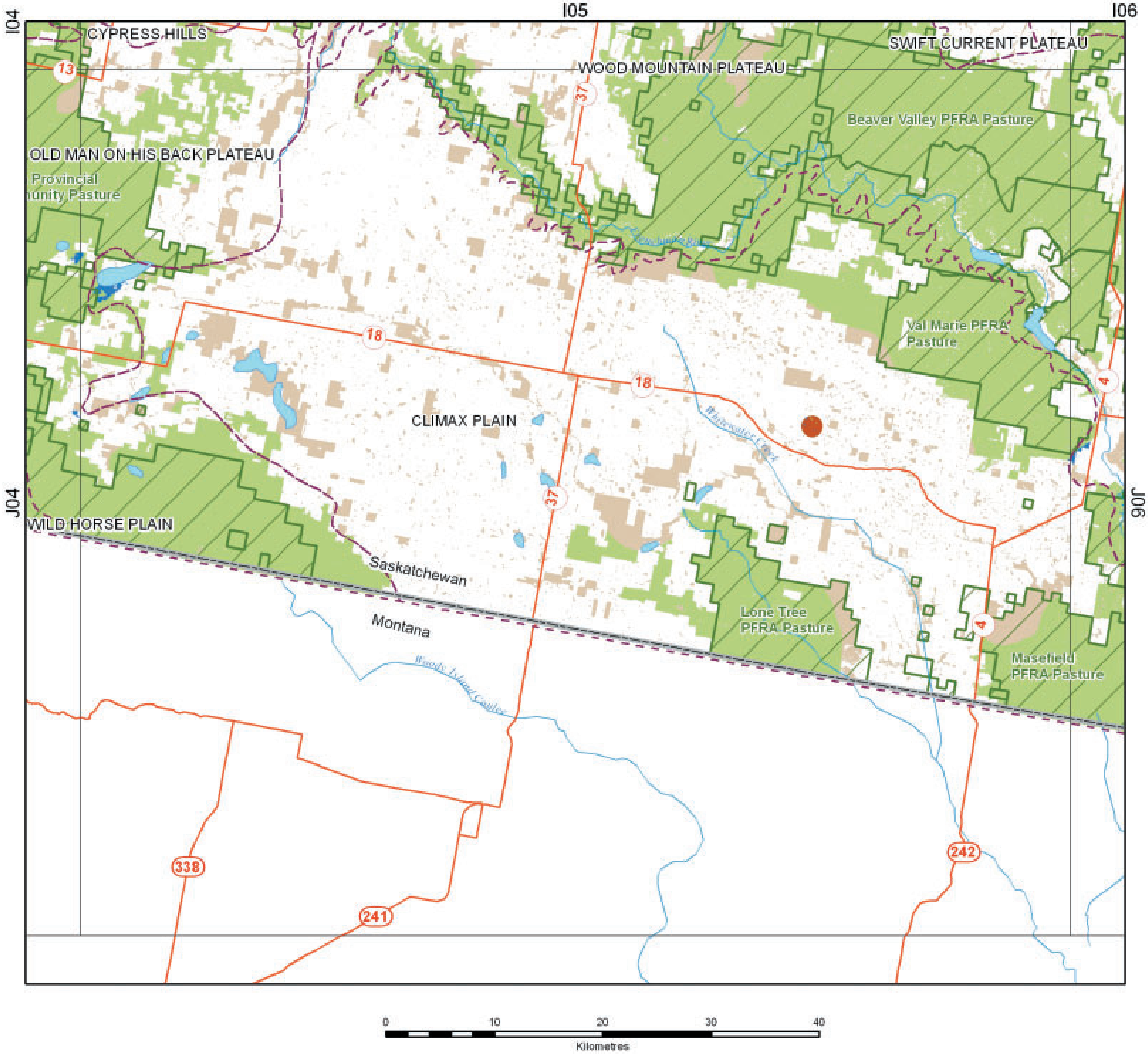
Prairie and Parkland Conservation Blueprint

Map Tile: J05





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
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- Provincial and State Borders

Scale: 1:500,000

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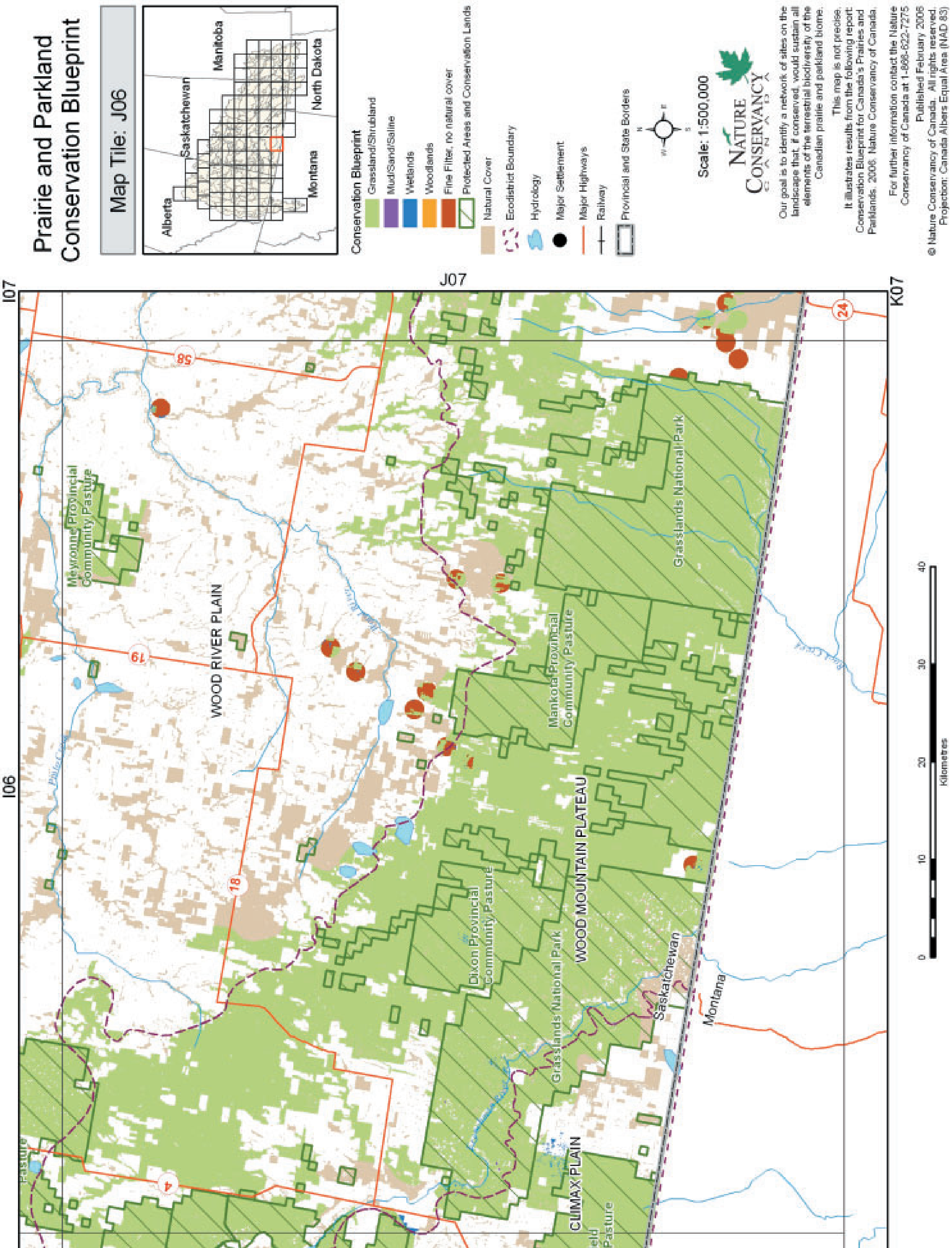
Prairie and Parkland Conservation Blueprint
Map Tile: J06
Alberta
Saskatchewan
Manitoba
North Dakota
Montana
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
Nature Conservancy Canada
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Published February 2006
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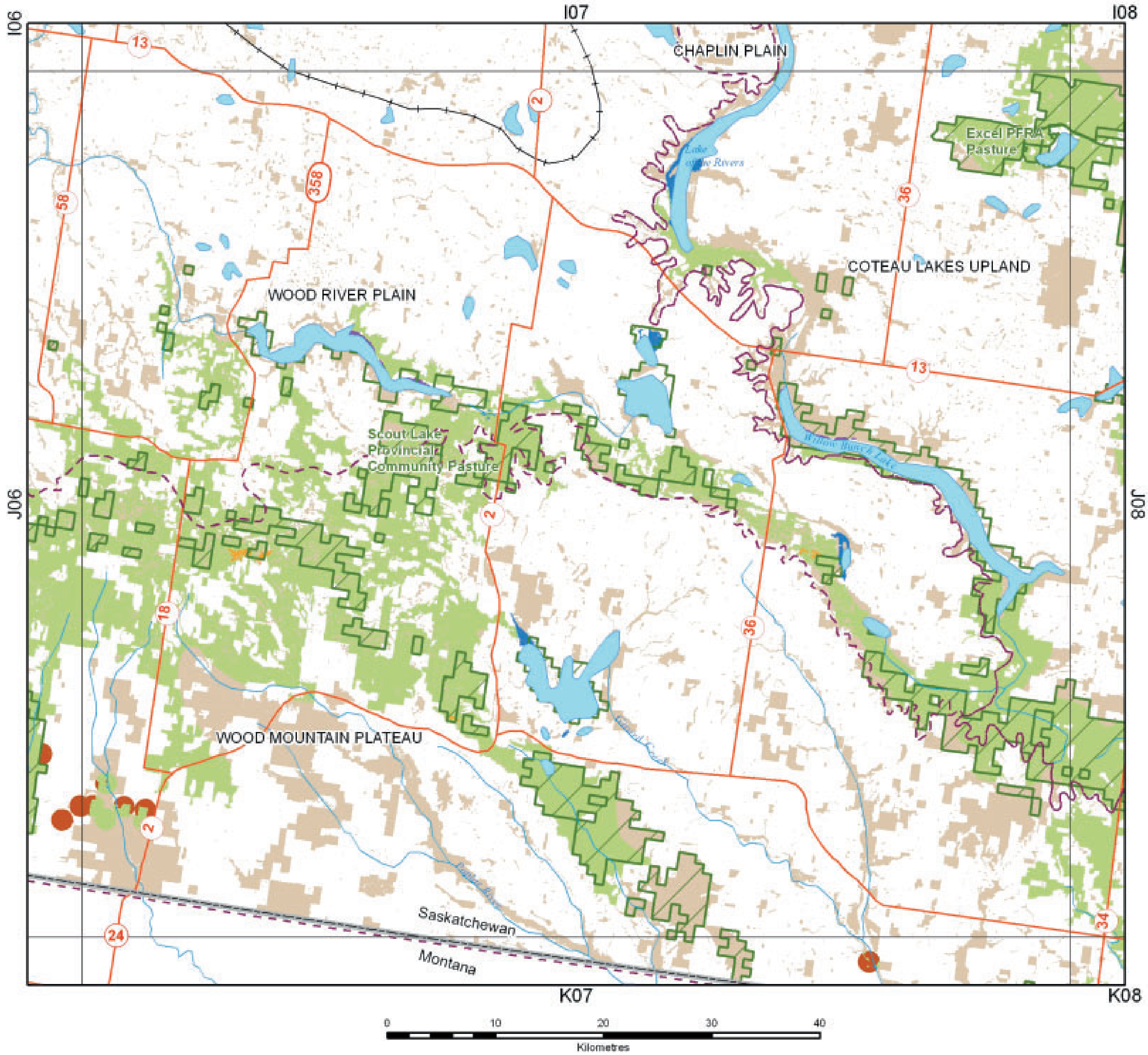
Projection: Canada Albers Equal Area (NAD 83)
I05
I06
I07
J05
J07
K07
WOOD RIVER PLAIN
WOOD MOUNTAIN PLATEAU
CLIMAX PLAIN
Meyronne Provincial Community Pasture
Mankota Provincial Community Pasture
Dixon Provincial Community Pasture
Grasslands National Park
Masefield PFRA Pasture
Saskatchewan
Montana
58
19
18
4
24
0
10
20
30
40
Kilometres

Prairie and Parkland Conservation Blueprint

Map Tile: J07



Alberta
Saskatchewan
Manitoba
Montana
North Dakota

Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

NATURE CONSERVANCY CANADA

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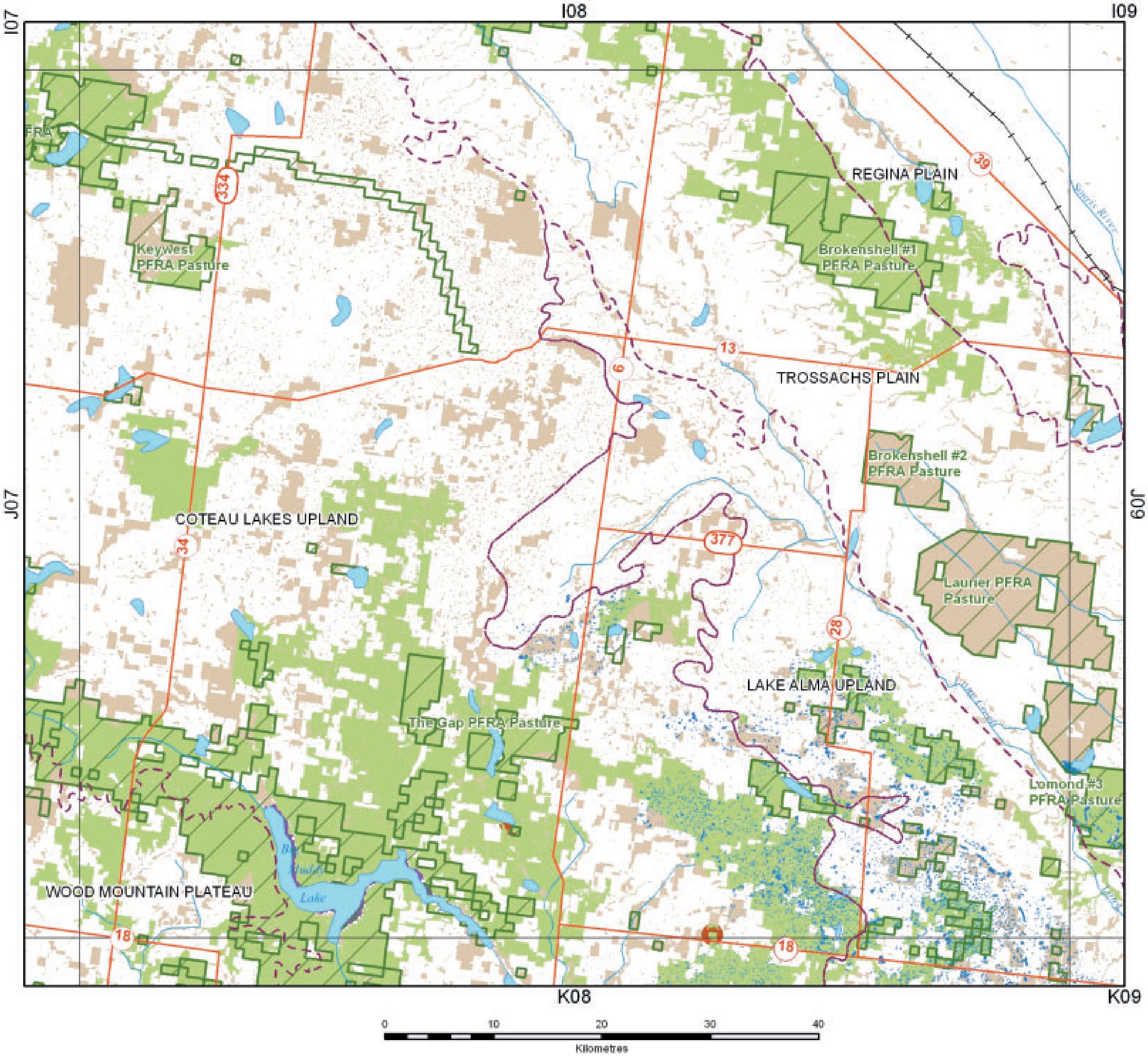
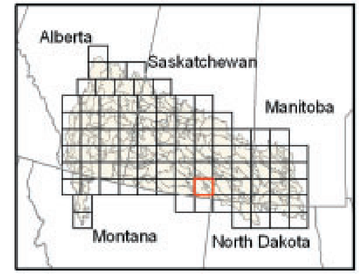


Prairie and Parkland Conservation Blueprint

Map Tile: J08



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N
W E
S

Scale: 1:500,000

NATURE CONSERVANCY
C A N A D A

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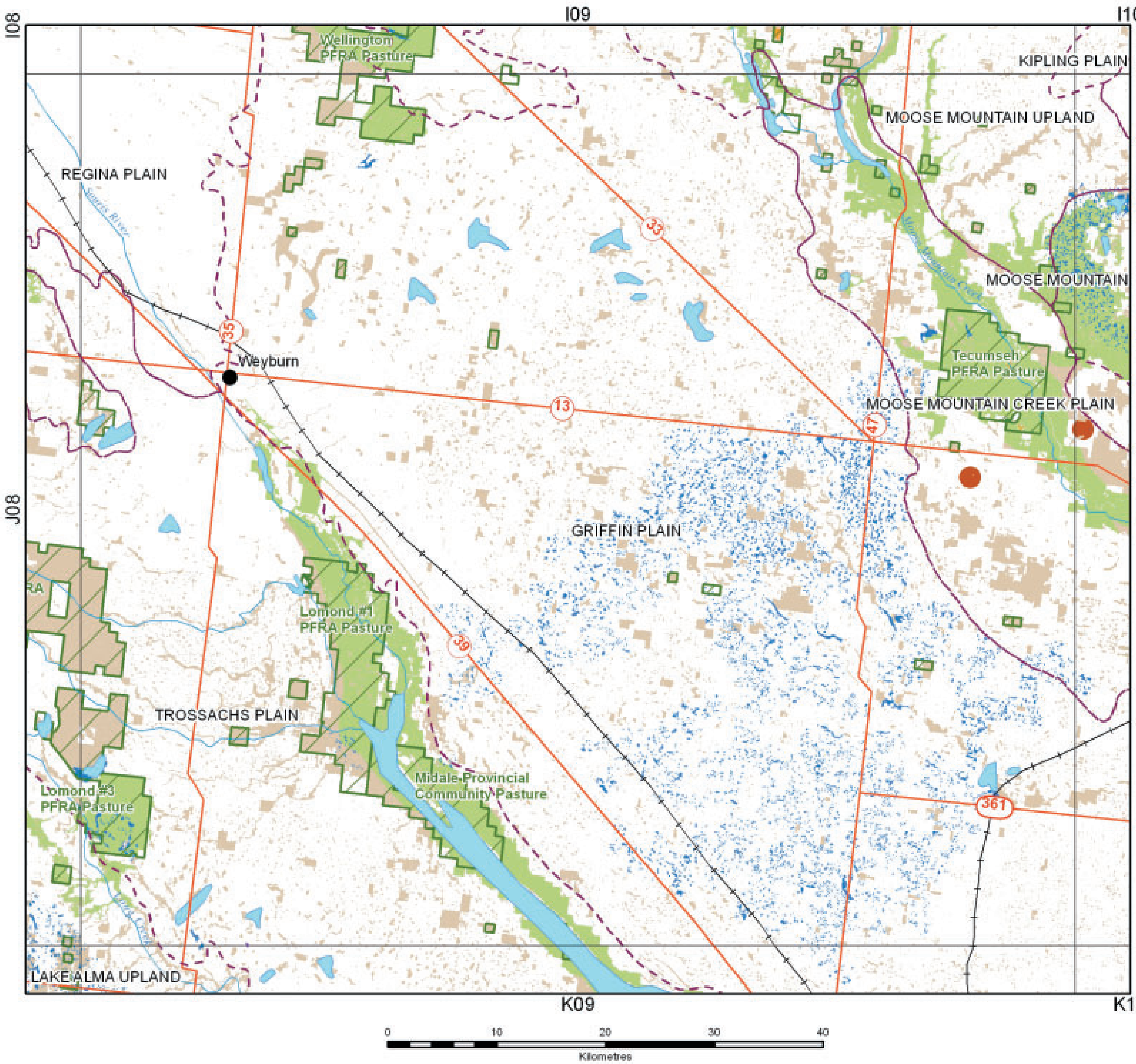

Prairie and Parkland Conservation Blueprint

Map Tile: J09

Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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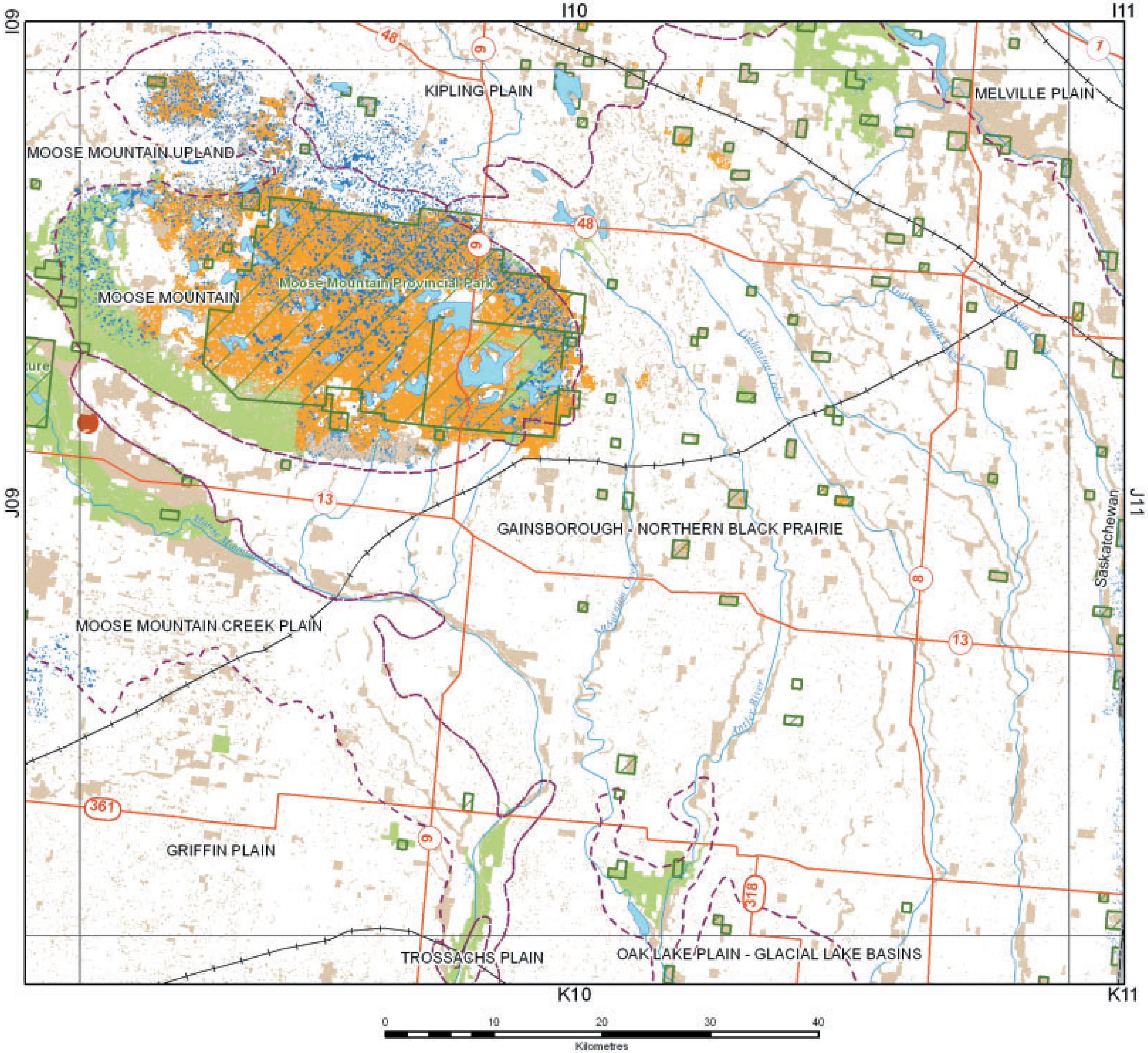

Prairie and Parkland Conservation Blueprint

Map Tile: J10

Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

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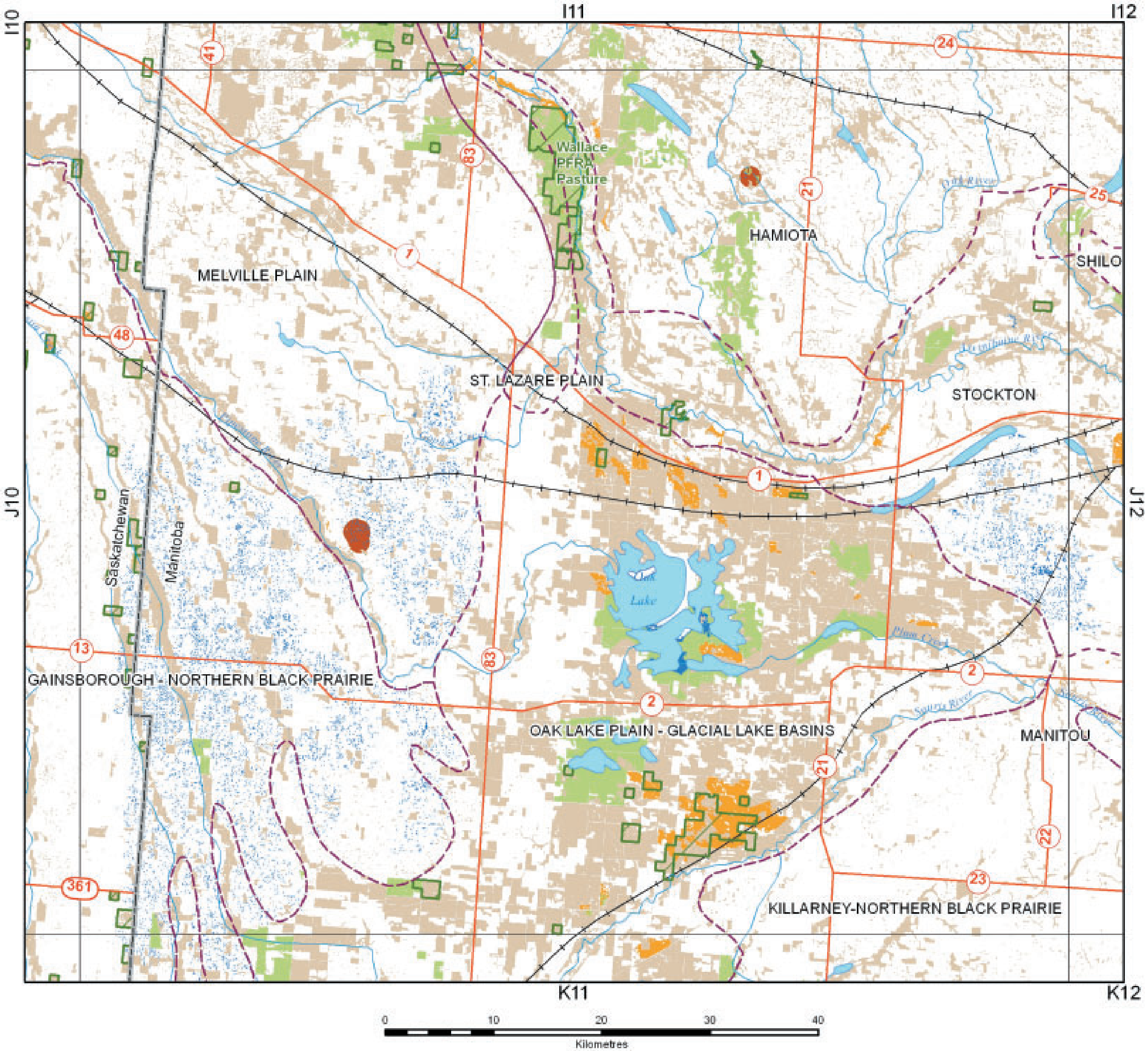
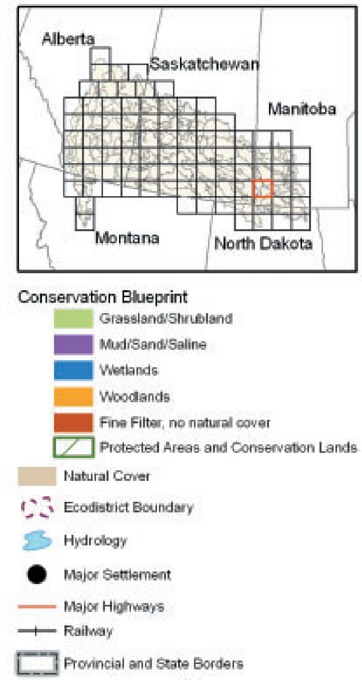
Projection: Canada Albers Equal Area (NAD 83)

Prairie and Parkland Conservation Blueprint

Map Tile: J11





Scale: 1:500,000

NATURE CONSERVANCY CANADA

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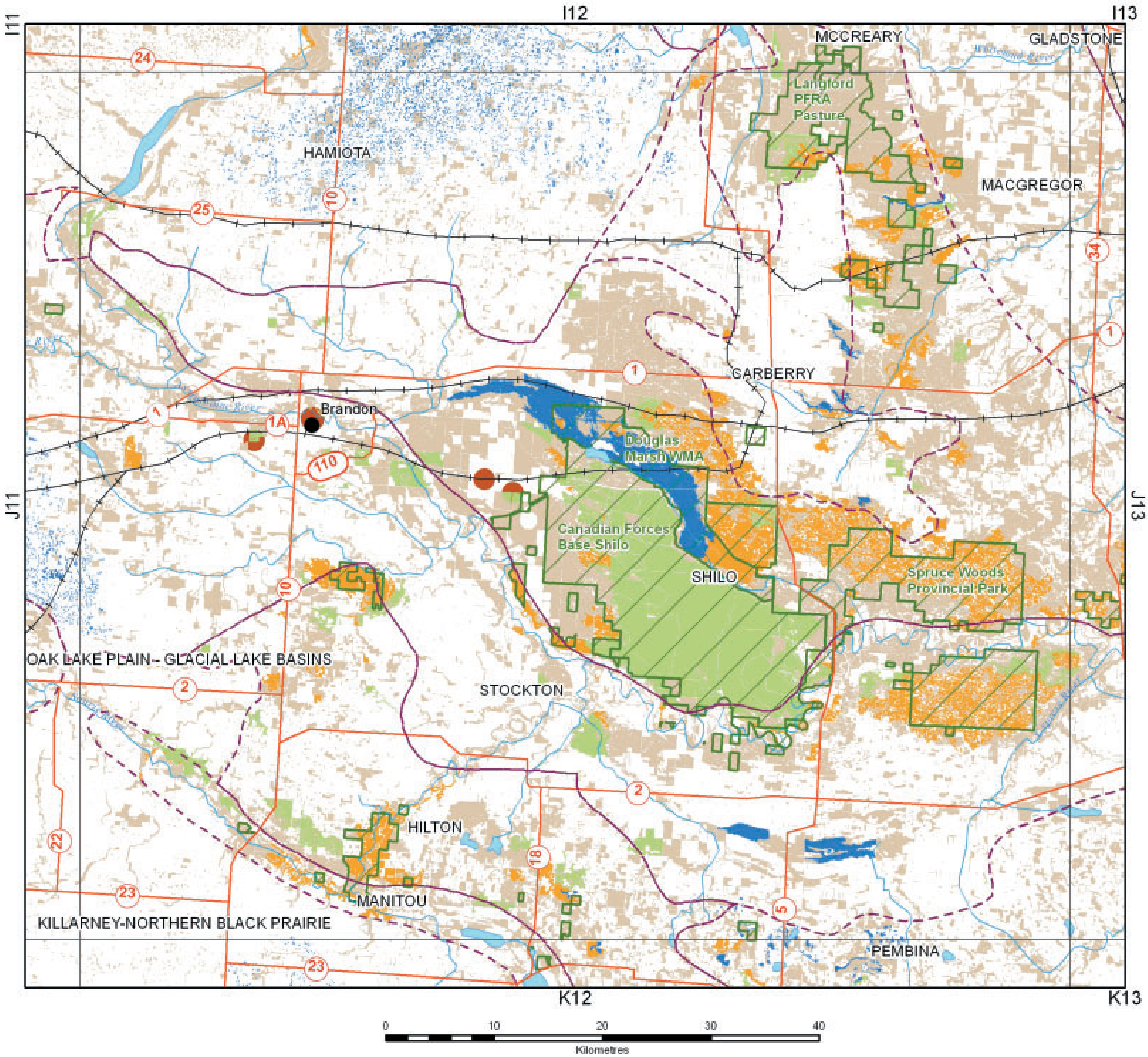
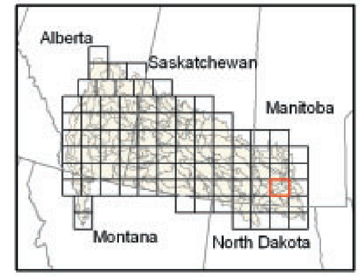


Prairie and Parkland Conservation Blueprint

Map Tile: J12



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

N E S W

Scale: 1:500,000

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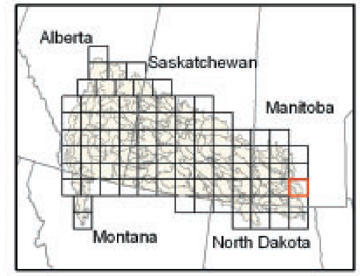
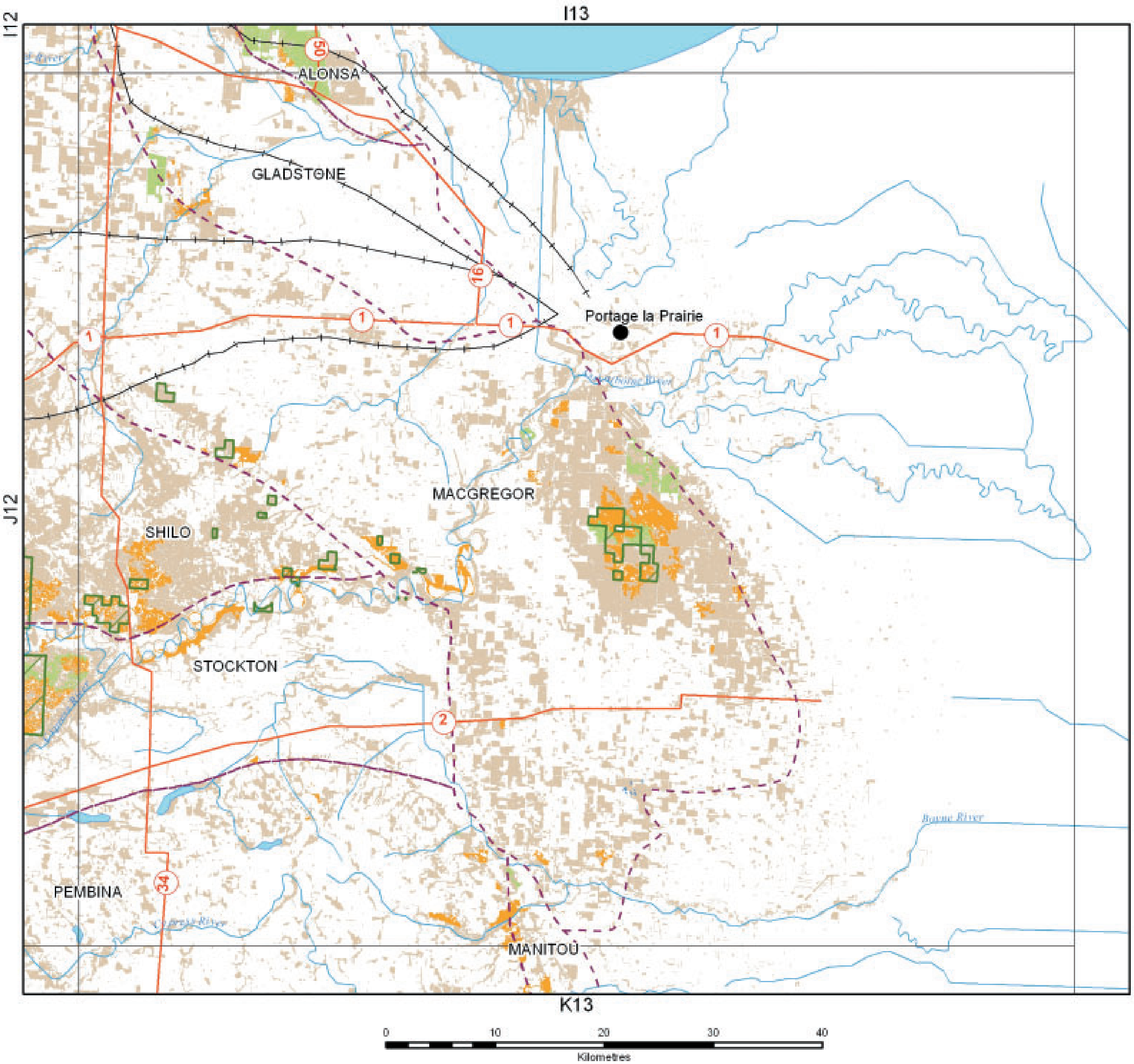
Prairie and Parkland Conservation Blueprint

Map Tile: J13





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
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- Railway
- Provincial and State Borders

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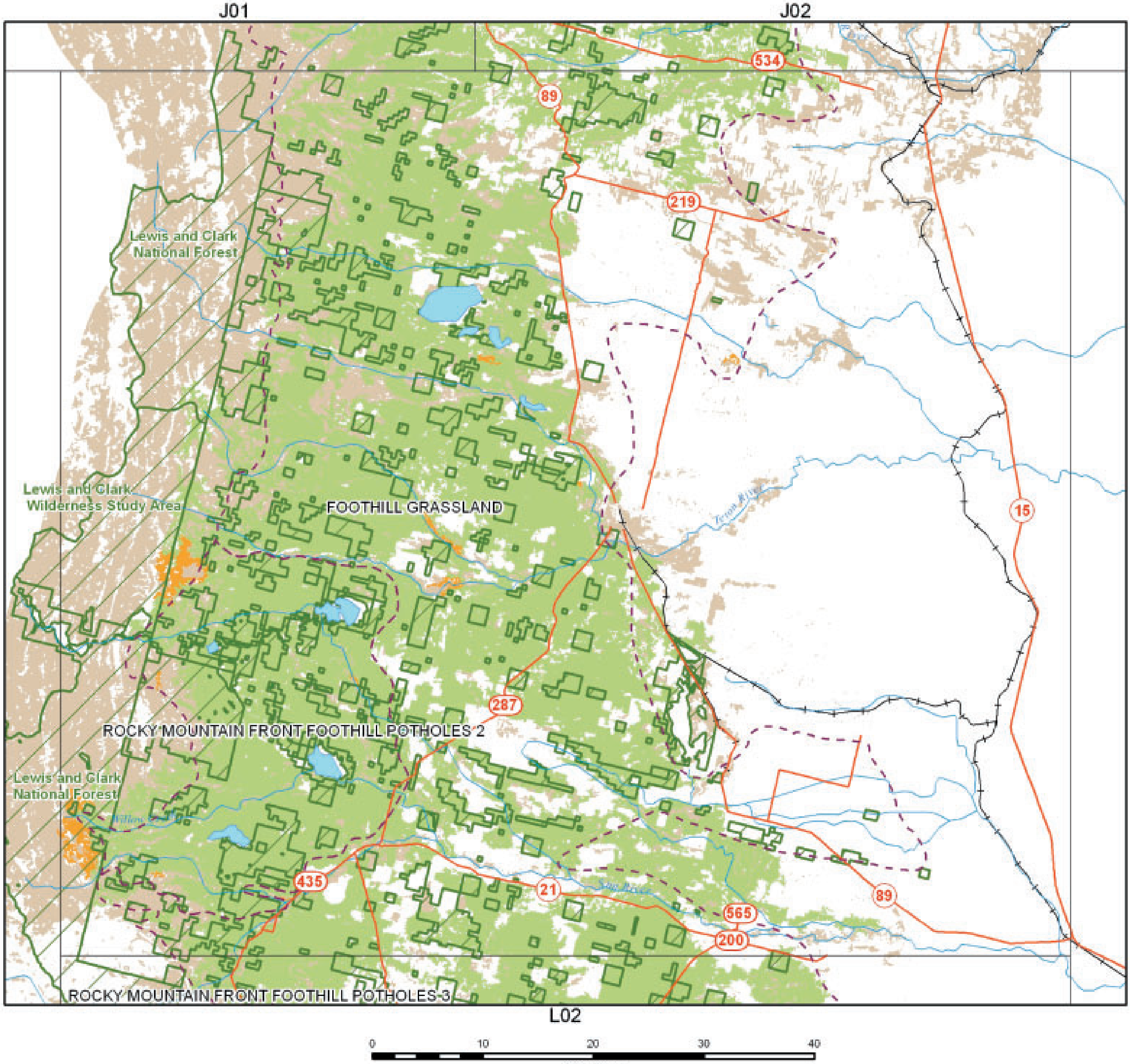
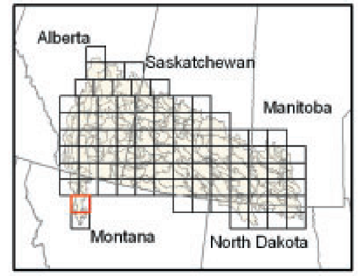


Prairie and Parkland Conservation Blueprint

Map Tile: K02



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
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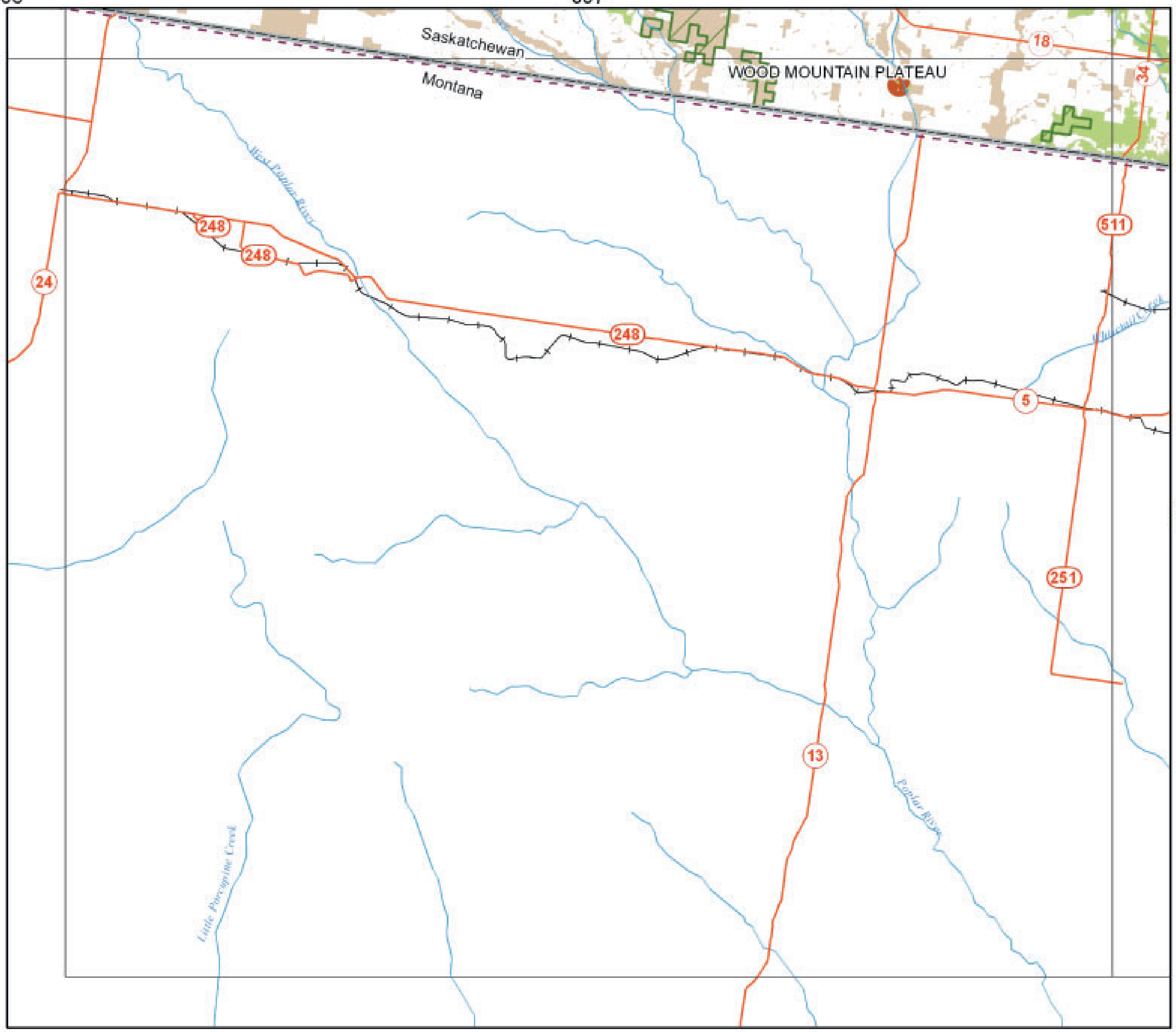
Projection: Canada Albers Equal Area (NAD 83)

J06 J07

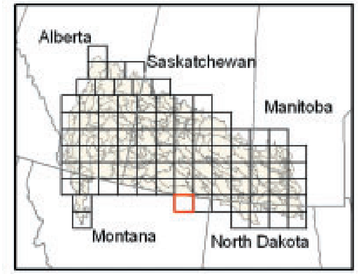


K08

0 10 20 30 40
Kilometres

Prairie and Parkland Conservation Blueprint

Map Tile: K07



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
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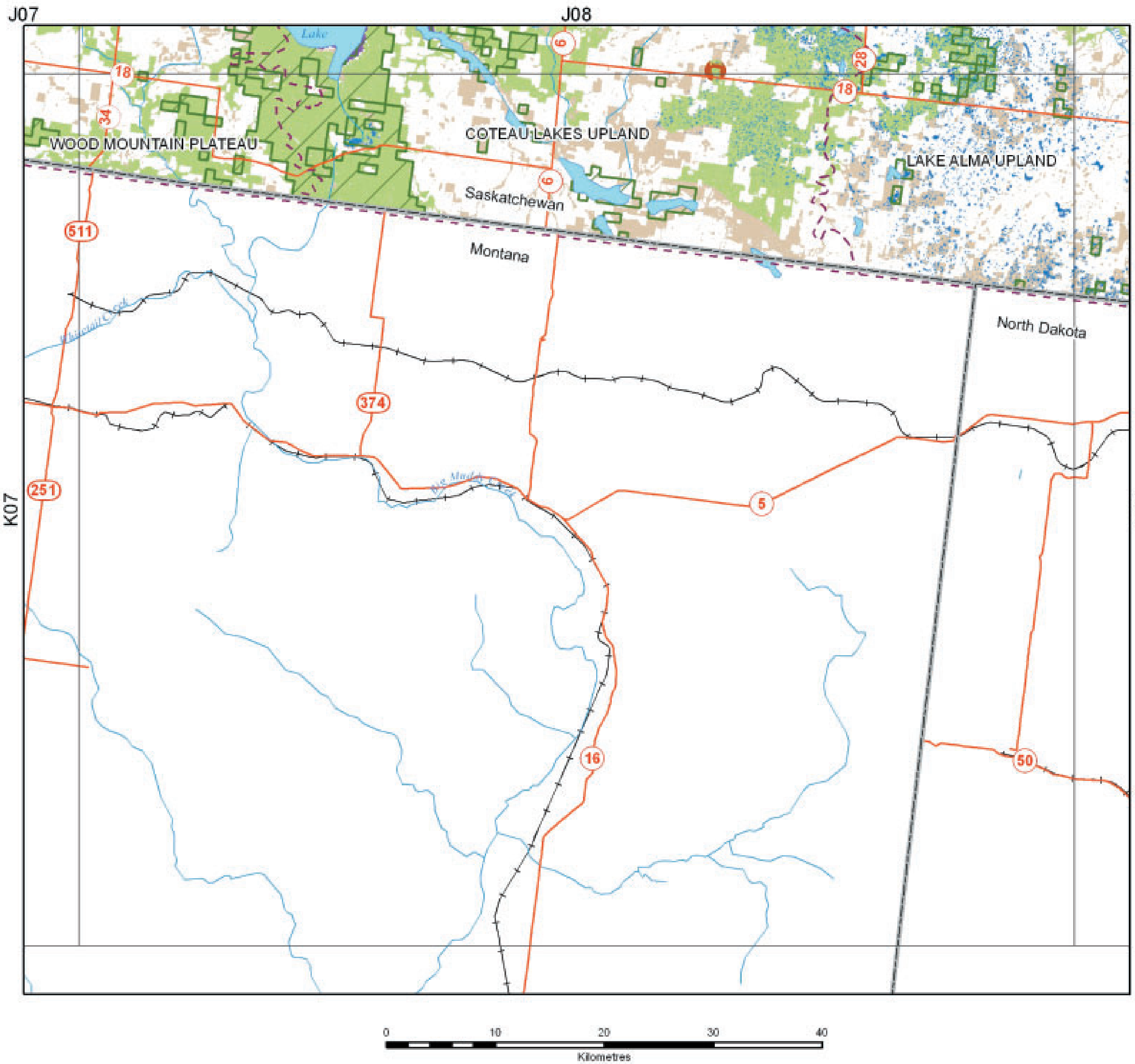
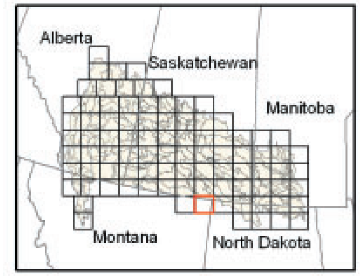
Map Tile: K08





Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

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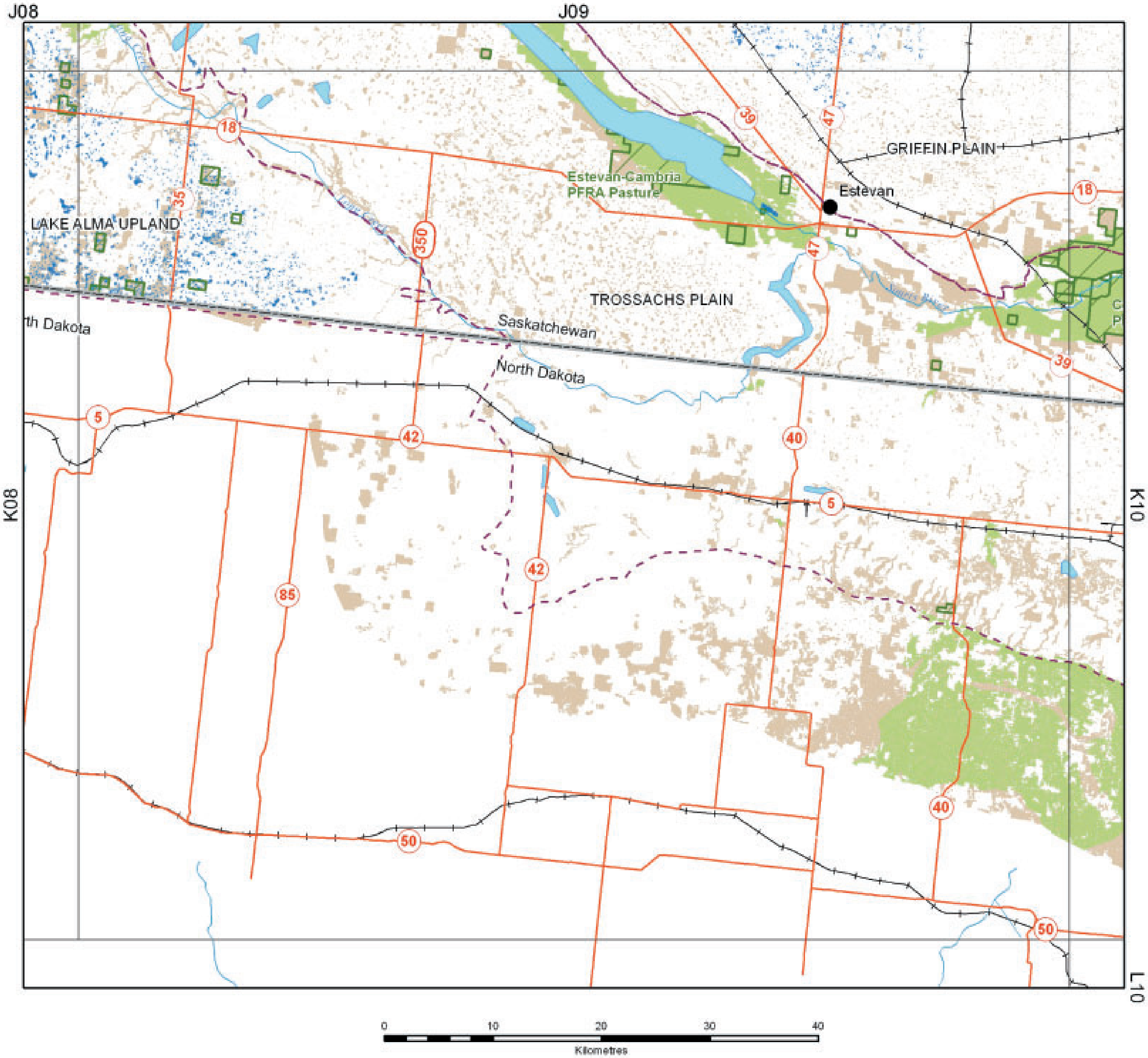
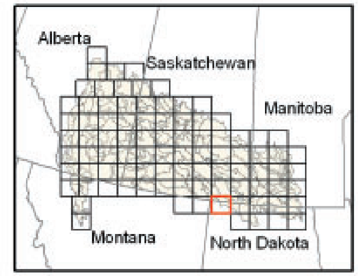


Prairie and Parkland Conservation Blueprint

Map Tile: K09



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders

Scale: 1:500,000

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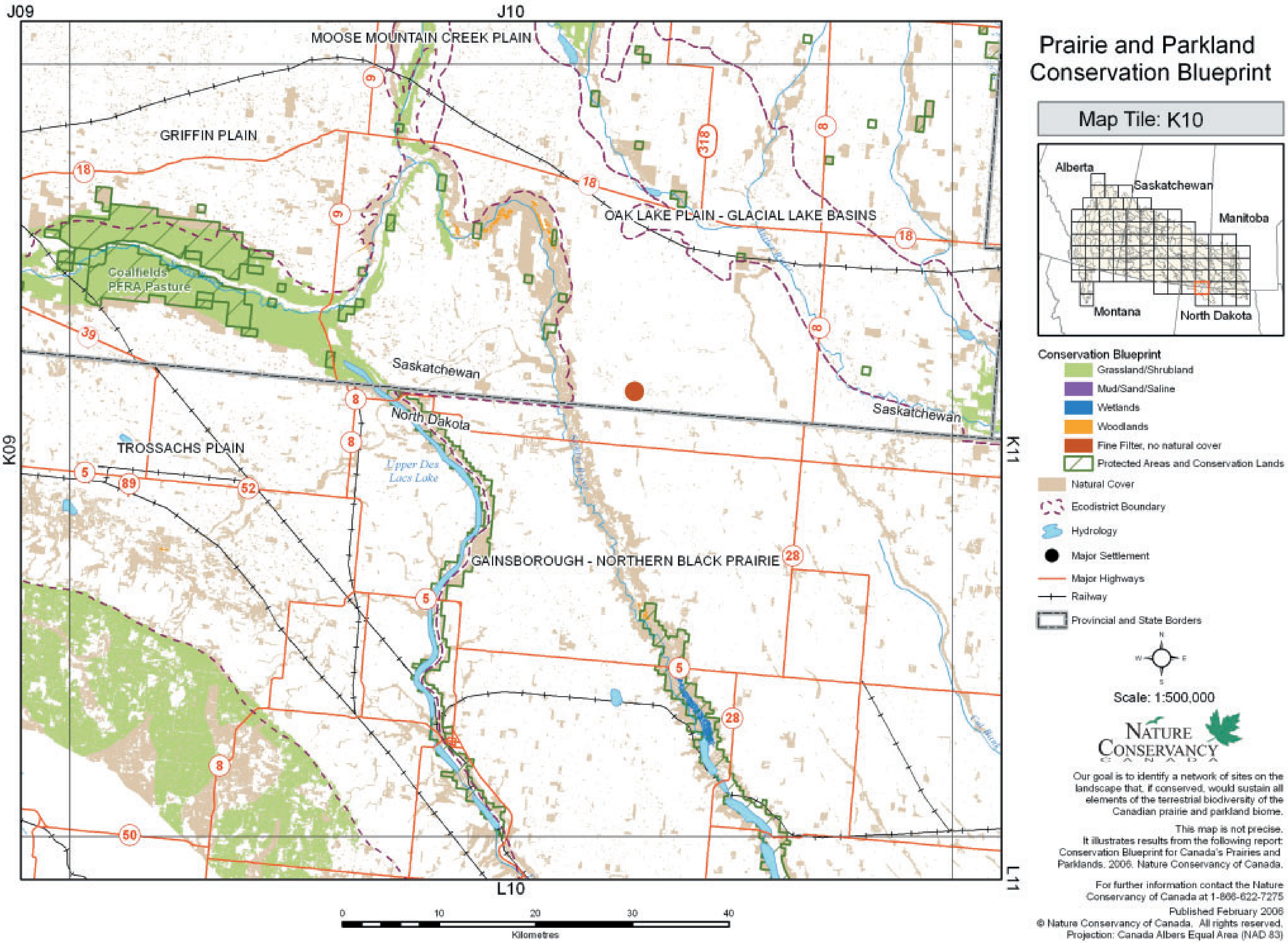
Prairie and Parkland Conservation Blueprint
Map Tile: K10
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
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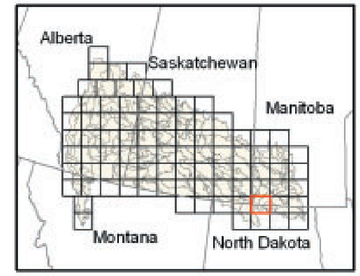
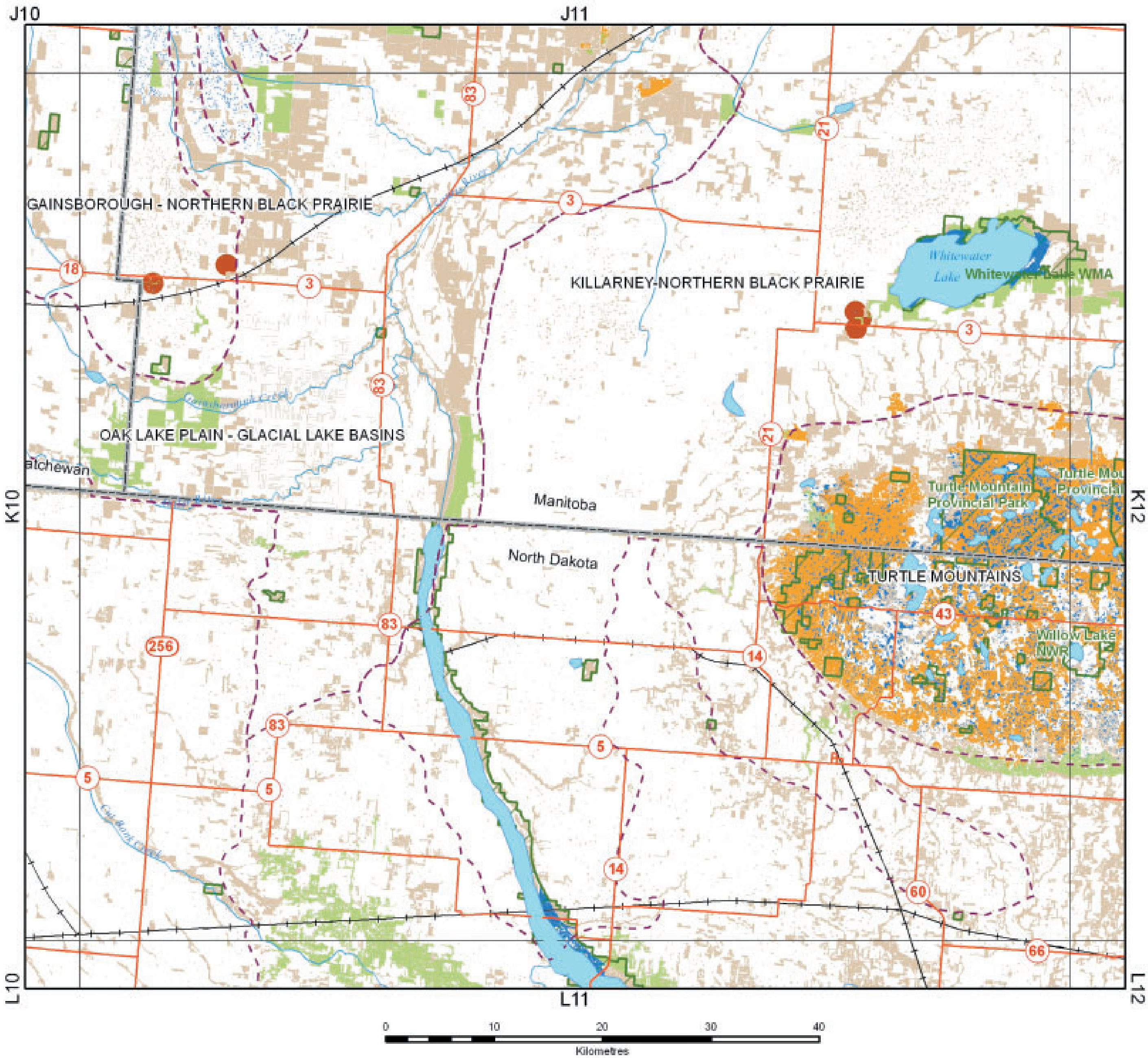
Projection: Canada Albers Equal Area (NAD 83)
J09
J10
K09
K11
L10
L11
MOOSE MOUNTAIN CREEK PLAIN
GRIFFIN PLAIN
OAK LAKE PLAIN - GLACIAL LAKE BASINS
Coalfields PFRA Pasture
Saskatchewan
North Dakota
TROSSACHS PLAIN
Upper Des Lacs Lake
GAINSBOROUGH - NORTHERN BLACK PRAIRIE
18
9
39
8
5
89
52
28
50
318
0
10
20
30
40
Kilometres

Prairie and Parkland Conservation Blueprint

Map Tile: K11





Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

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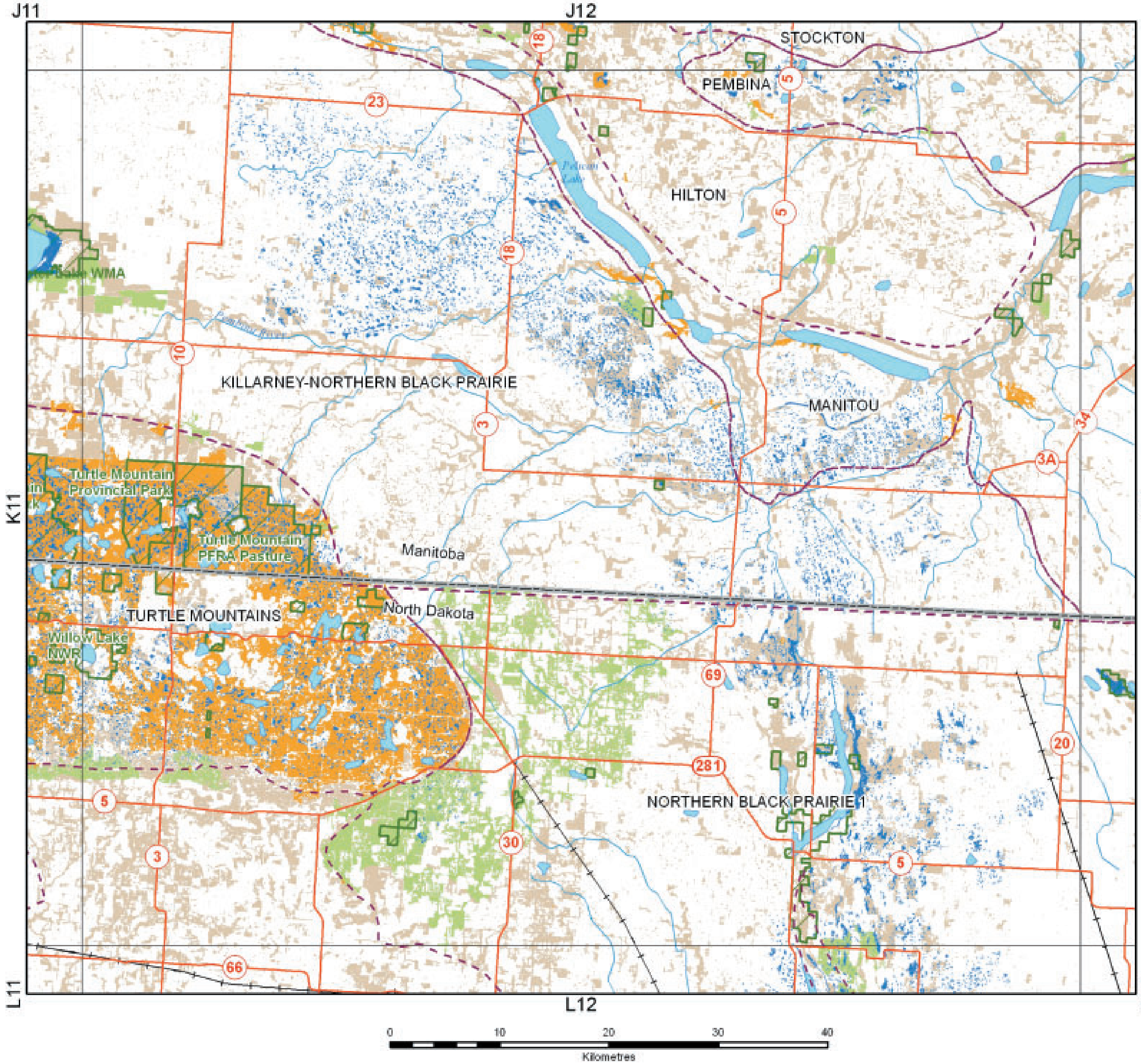
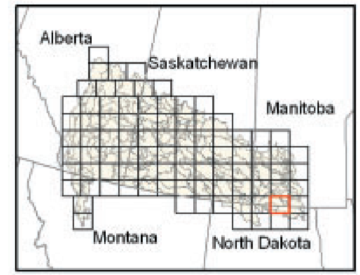


Prairie and Parkland Conservation Blueprint

Map Tile: K12



Conservation Blueprint

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- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
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- Provincial and State Borders

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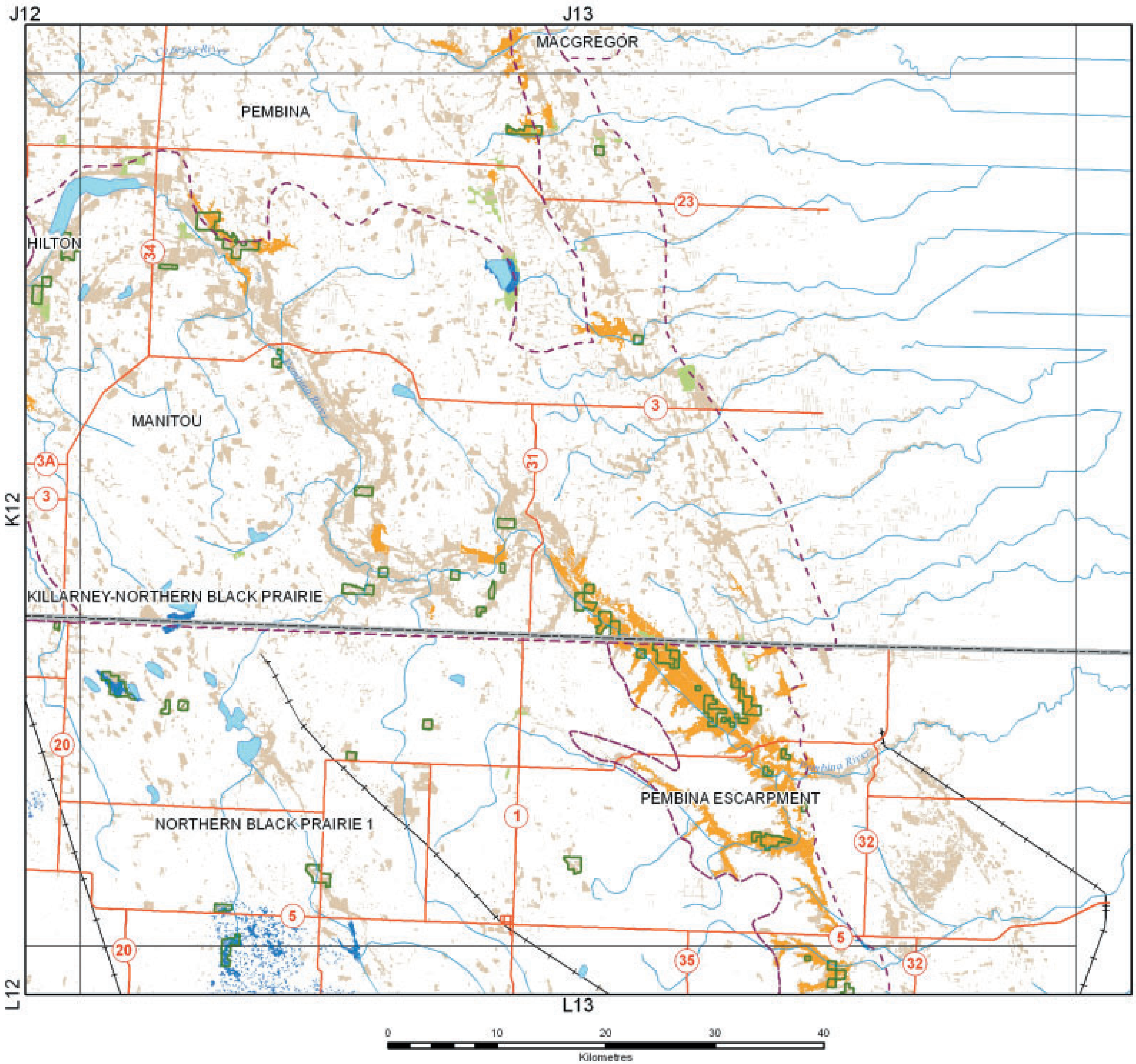
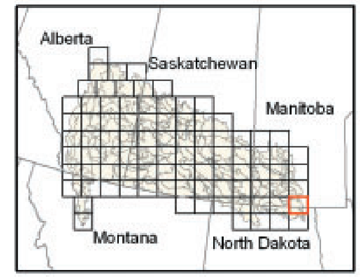


Prairie and Parkland Conservation Blueprint

Map Tile: K13



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
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- Major Settlement
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- Railway
- Provincial and State Borders

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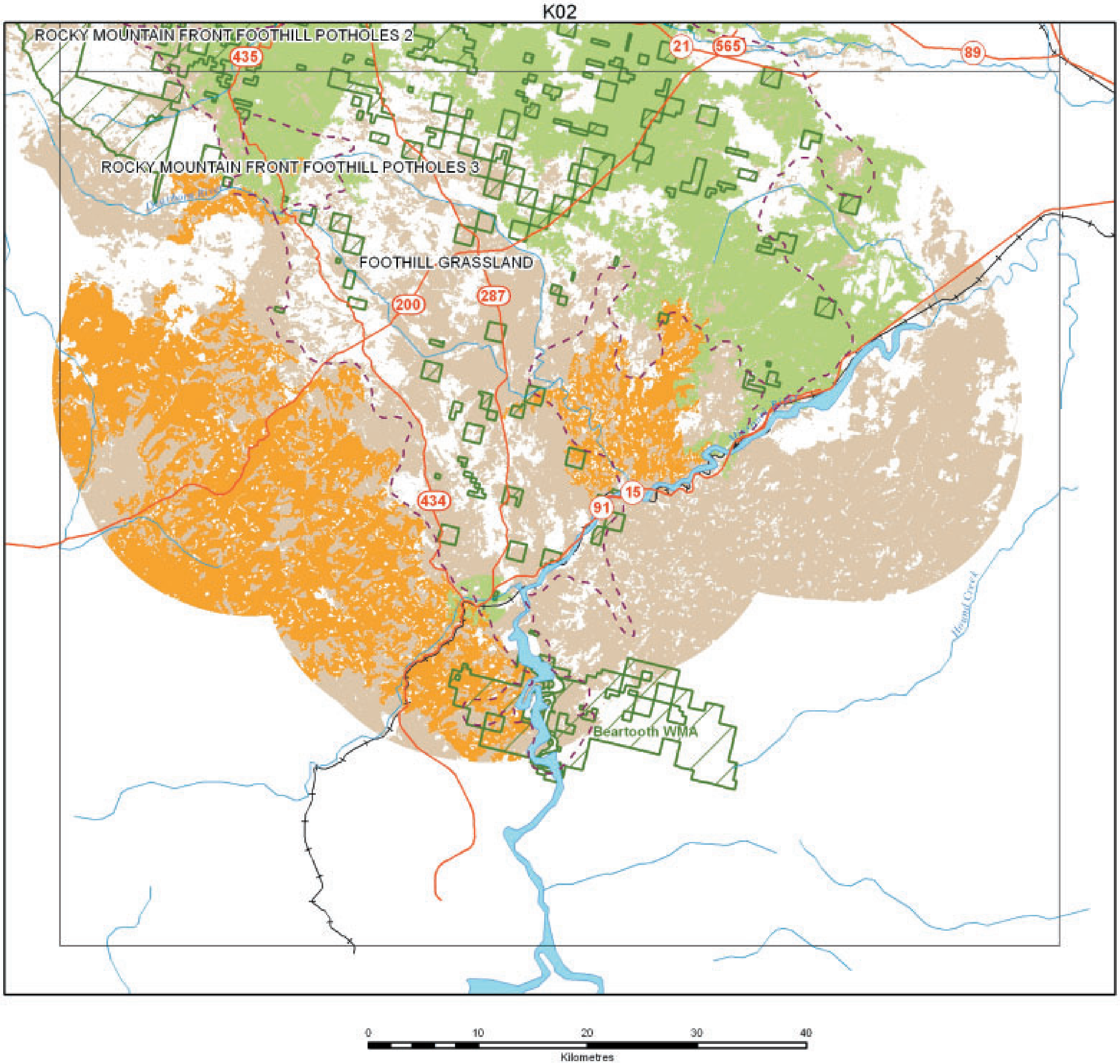
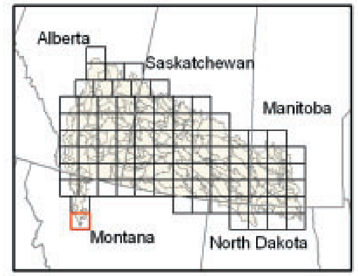


Prairie and Parkland Conservation Blueprint

Map Tile: L02



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
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- Railway
- Provincial and State Borders

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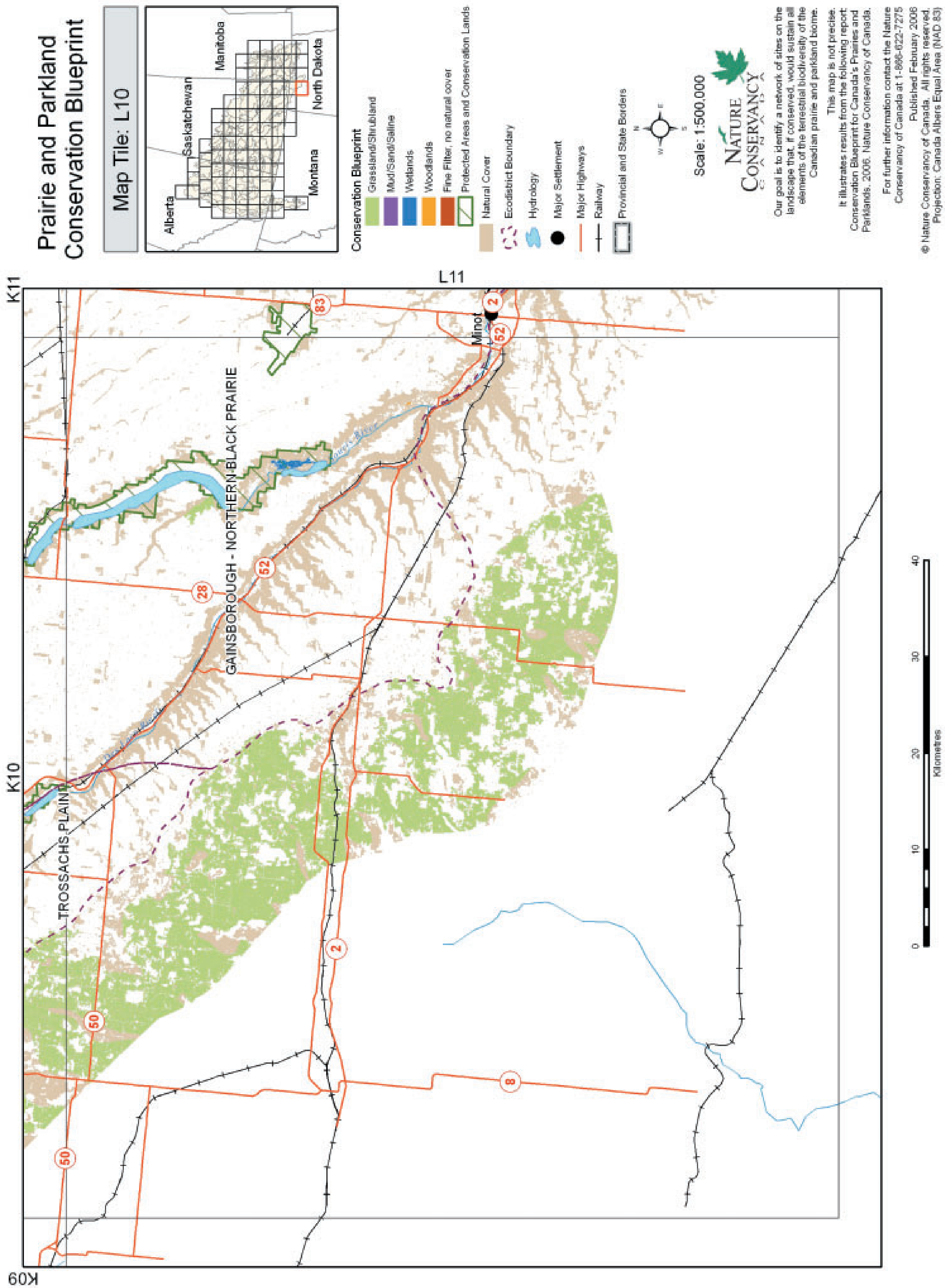
Prairie and Parkland Conservation Blueprint
Map Tile: L10
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
Wetlands
Woodlands
Fine Filter, no natural cover
Protected Areas and Conservation Lands
Natural Cover
Ecodistrict Boundary
Hydrology
Major Settlement
Major Highways
Railway
Provincial and State Borders
Scale: 1:500,000
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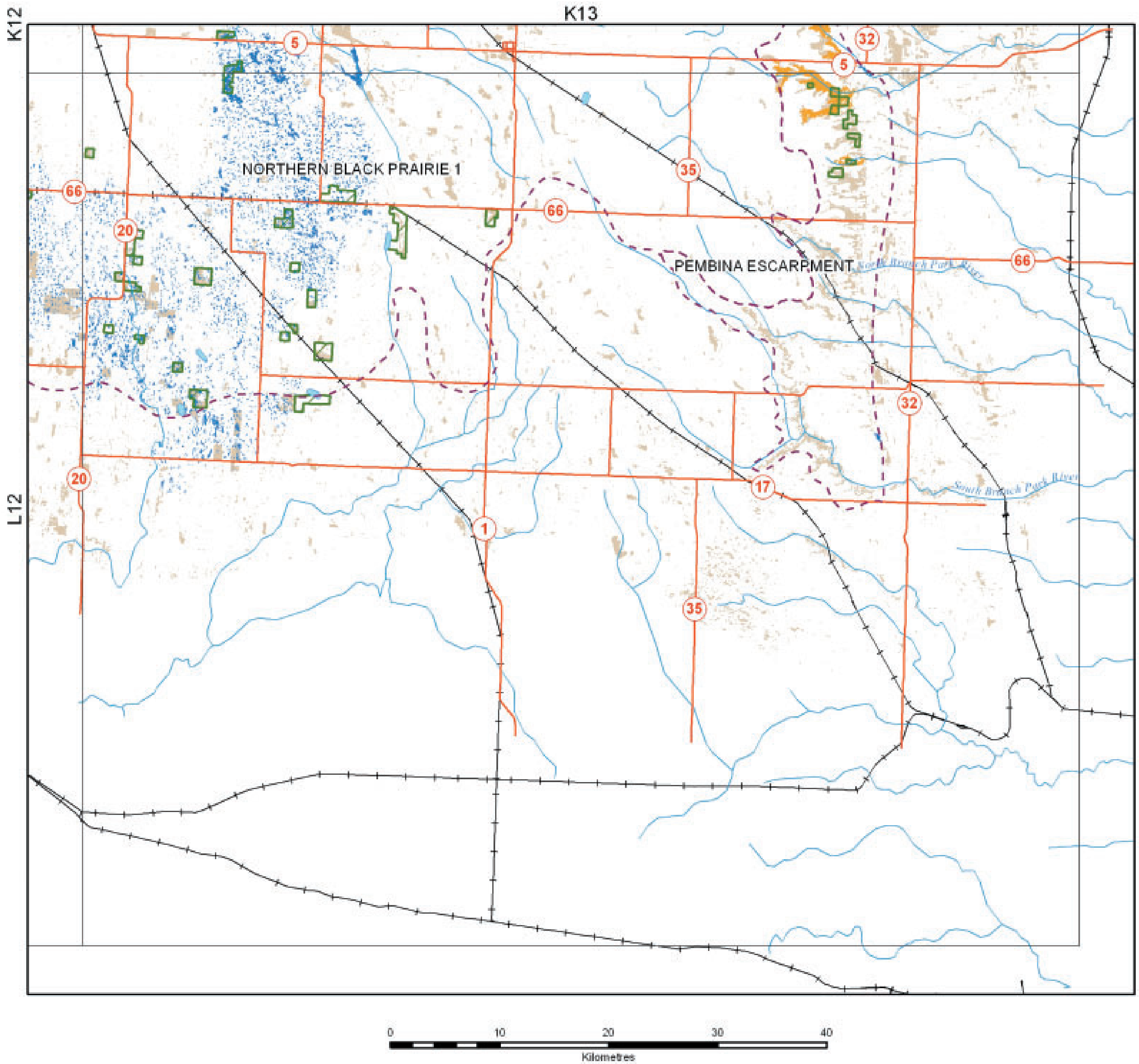
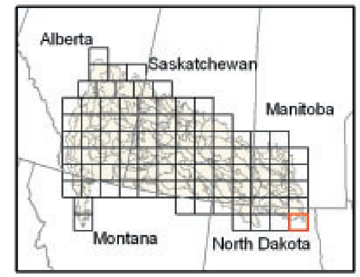
Projection: Canada Albers Equal Area (NAD 83)
K11
L11
K10
K09
Minot
GAINSBOROUGH - NORTHERN BLACK PRAIRIE
TROSSACHS PLAIN
83
2
52
28
50
8
0
10
20
30
40
Kilometres



Prairie and Parkland Conservation Blueprint

Map Tile: L13



Conservation Blueprint
- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands

- Natural Cover
- Ecodistrict Boundary
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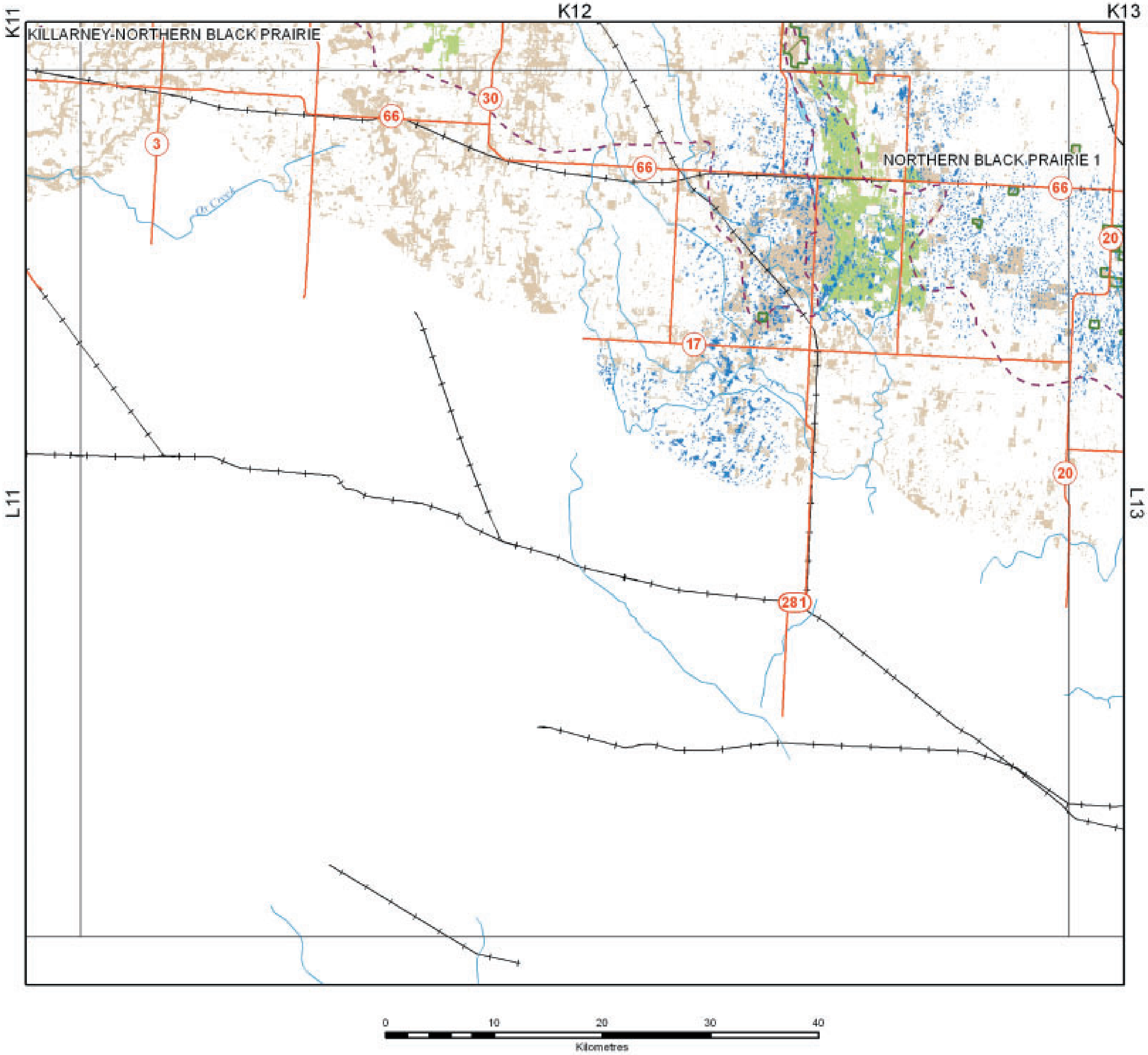
For further information contact the Nature Conservancy of Canada at 1-866-622-7275

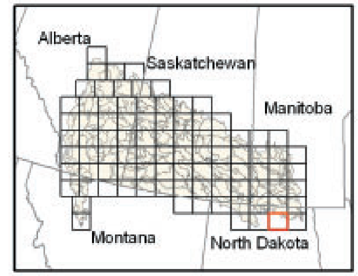
Published February 2006

Projection: Canada Albers Equal Area (NAD 83)



Prairie and Parkland Conservation Blueprint

Map Tile: L12



Conservation Blueprint

- Grassland/Shrubland
- Mud/Sand/Saline
- Wetlands
- Woodlands
- Fine Filter, no natural cover
- Protected Areas and Conservation Lands
- Natural Cover
- Ecodistrict Boundary
- Hydrology
- Major Settlement
- Major Highways
- Railway
- Provincial and State Borders

Scale: 1:500,000

Nature Conservancy Canada

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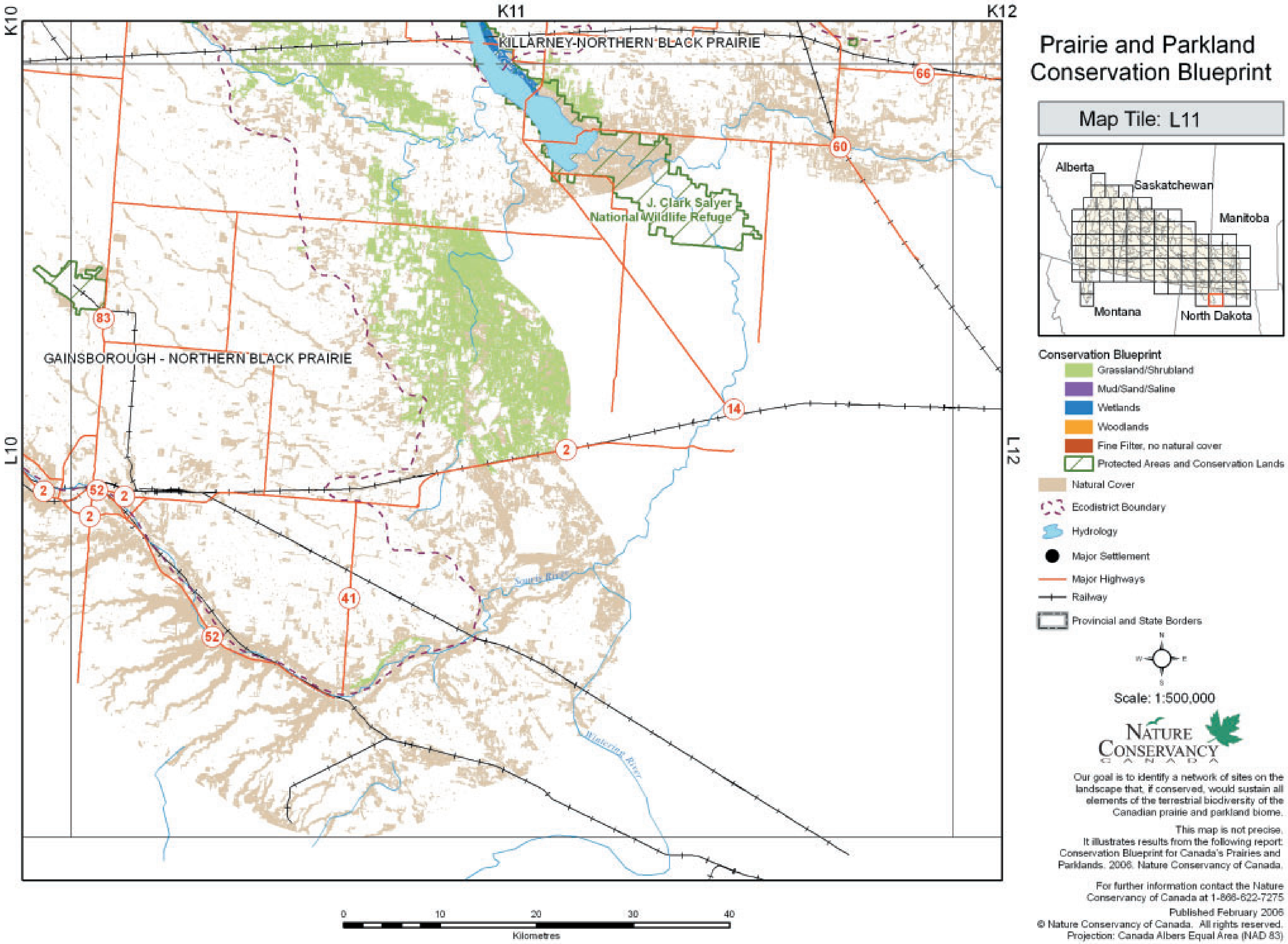
K10
K11
K12
L10
L12
KILLARNEY-NORTHERN BLACK PRAIRIE
GAINSBOROUGH - NORTHERN BLACK PRAIRIE
J. Clark Salyer
National Wildlife Refuge
Souris River
Wintering River
66
60
83
14
2
52
41
0
10
20
30
40
Kilometres
Prairie and Parkland
Conservation Blueprint
Map Tile: L11
Alberta
Saskatchewan
Manitoba
Montana
North Dakota
Conservation Blueprint
Grassland/Shrubland
Mud/Sand/Saline
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Appendix E
Ecodistrict Summary Tables

The CD in the back pocket includes the report and an Appendix E that includes Summary Tables for each ecodistrict in the study area. Refer to Figure 10 for locations, and Appendix C for a cross-walk list of ecodistrict names and numbers.

Sample Ecodistrict Summary Table: Pembina Escarpment Ecodistrict (ND2), Aspen Parkland Ecoregion

Ecological System	Number of Patches	Total area in ecodistrict (ha)	Total area in ecodistrict (%)	Natural cover in ecodistrict (%)	Total area in PA (ha)	% of ecological system in PA	Total area in CL (ha)	% of ecological system in CL	Total area in blueprint (ha)	% of ecological system in blueprint
GRASSLANDS										
Grasslands / Shrublands, Bedrock	3	65.3	0.09%	0.36%					56.1	85.81%
Grasslands / Shrublands, Moraine Plain	3	31.1	0.04%	0.17%					16.9	54.49%
Grasslands / Shrublands, Valley Complex	4	142.1	0.20%	0.78%					0.7	0.51%
WOODLANDS										
Deciduous woodlands, Bedrock	2	4.8	0.01%	0.03%					4.8	100.00%
Deciduous woodlands, Eolian Plain	1	2.0	0.00%	0.01%					2.0	100.00%
Deciduous woodlands, Glaciofluvial Deposits	89	805.2	1.15%	4.44%					248.0	30.79%
Deciduous woodlands, Glaciolacustrine (Coarse Deposits)	15	65.0	0.09%	0.36%			0.2	0.28%	49.4	76.04%
Deciduous woodlands, Glaciolacustrine (Fine Deposits)	18	144.3	0.21%	0.80%			4.9	3.37%	53.4	36.99%
Deciduous woodlands, Moraine Hummocky	56	424.9	0.61%	2.34%			7.2	1.69%	83.1	19.55%
Deciduous woodlands, Moraine Plain	203	7,547.0	10.81%	41.63%			868.0	11.50%	5,387.0	71.38%
Deciduous woodlands, Moraine Ridged	35	3,746.7	5.36%	20.67%			711.1	18.98%	3,553.3	94.84%
Deciduous woodlands, Moraine Undulating	158	1,594.8	2.28%	8.80%			5.9	0.37%	308.5	19.35%
Deciduous woodlands, Sand Hills	102	2,256.7	3.23%	12.45%			197.7	8.76%	1,225.0	54.28%
Deciduous woodlands, Valley Complex	119	946.8	1.36%	5.22%			33.9	3.58%	168.6	17.80%
WETLANDS										
Wetlands	227	351.8	0.50%	1.94%			7.7	2.20%	55.8	15.86%
Sum	**1,035**	**18,128.3**								

Protected areas (PA) include **federally protected areas** (national parks, national wildlife areas, migratory bird sanctuaries) and **provincially protected areas** (provincial parks and conservation reserves).
Conservation lands (CL) are designated lands that are conserved from land conversion, such as community pastures and Department of National Defence lands (see report).

Explanation of columns, above

Number of Patches: Number of patches of the ecological system in the ecodistrict.

Total area in ecodistrict: Total area (ha) of the ecological system in the ecodistrict.

Total area in ecodistrict (%): Percent of the total area of the ecodistrict that is covered by this ecological system type (helps to identify dominant and minor ecological system types).

Natural cover in ecodistrict (%): Percent of the total area of natural cover that is represented by this ecological system type (also helps to identify dominant and minor types).

Total area in PA: Total area (ha) of the ecological system that is in a protected area in the ecodistrict.

% of ecological system in PA: Percent of the total area of the ecological system that is represented in protected areas.

Total area in CL: Total area (ha) of the ecological system that is in conservation land in the ecodistrict.

% of ecological system in CL: Percent of the total area of the ecological system that is represented in conservation lands.

Total area in blueprint: Total area (ha) of the ecological system that is in the conservation blueprint.

% of ecological system in blueprint: Percent of the total area of the ecological system that is represented in the conservation blueprint.

About the DVD-ROM

The DVD-ROM included with this report contains the full report, A Conservation Blueprint for Canada's Prairies and Parklands, and related maps, tabular and spatial data sets. The Blueprint can be explored using the Interactive Tile Maps contained on this DVD-ROM, or by directly viewing the data using either ESRI's free, downloadable ArcReader tool, or any GIS software compatible with ESRI's shapefile format.

This product requires at the minimum a computer with a DVD-ROM drive and a web browser installed. Viewing the documents requires Adobe Acrobat Reader, and viewing the data directly requires at minimum ESRI ArcReader. Links to download these software are found in the DVD-ROM.

Starting the DVD-ROM

Insert the DVD-ROM, into your computer's drive. On most computers, the DVD-ROM will automatically start, opening a web browser window and presenting you with the user interface.

If the DVD-ROM does not automatically, the user interface can be manually started by locating the DVD-ROM in a file browser window (Windows Explorer) and opening the folder **nav**, and double-clicking on the file **index.htm**.

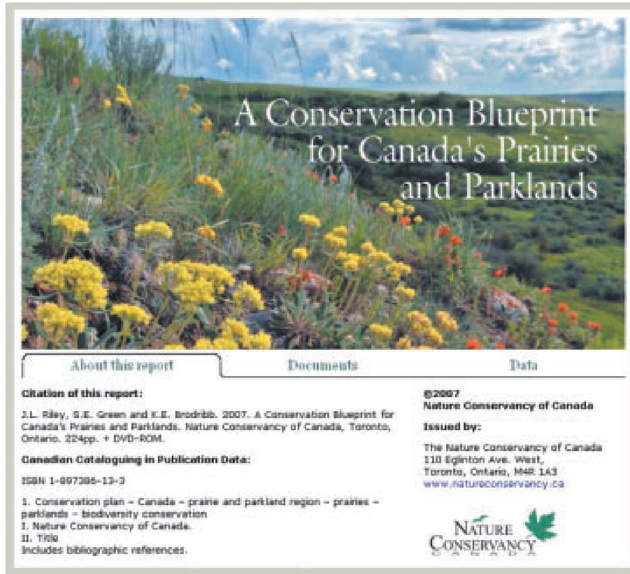
The DVD-ROM User Interface

The DVD-ROM user interface has been designed as a series of web pages, viewable on any recent web browser. The interface contains three main pages.

The **About this Document** page contains citation, publication and contact information.

The **Documents** page contains links to all of the reports contained on the DVD-ROM, and a link to the folder of individual tile maps. These links should all open their respective documents in a new window. There is also a link to download the Adobe Acrobat Reader installer.

The **Data** page contains links to the Interactive Tile Maps, the ArcReader 9.1 project file, the ArcMap 9.1 project file, and folders containing the actual data. There is also a link to download the ArcReader installer.



Interactive Tile Maps

The Interactive Tile Maps are accessible from the **Data** page in the DVD-ROM user interface. These allow for exploration of the Conservation Blueprint results in an easy, intuitive manner, without the need for additional software.

The Index Map will be loaded initially, and clicking on any grid square on the map will take the user to the specified tile.

The Interactive Tile Maps allow the user to navigate between individual tiles by clicking in the border of any tile map (on the number of the adjacent tile, *e.g.* **D03**) to move to the next tile map. The user can also return to the main Index Map via the link at the bottom of each page, or by clicking on the small Index Map in each tile.

A link at the bottom right of each tile map page will open a new window containing a high resolution version of the tile, suitable for printing.

Updates

All updates, addenda and errata can be found on the Nature Conservancy of Canada's Conservation Resources website **(http://science. natureconservancy.ca)** by searching the Online Resources for "Prairies and Parklands", or by entering the following link directly: **(http://science.natureconservancy.ca/resources /resources.php?Key=Prairies+and+Parklands.**