

Southern Alberta Landscapes

MEETING THE CHALLENGES AHEAD ▶▶



STATE OF THE LANDSCAPE REPORT

Southern Alberta Landscapes

MEETING THE CHALLENGES AHEAD ▶▶

STATE OF THE LANDSCAPE REPORT

ISBN: 978-0-7785-6277-1 (Print version)
ISBN: 978-0-7785-6278-8 (Online version)
Website: www.gov.ab.ca/env/

Disclaimer: The contents of this document have been prepared with funds from Alberta Environment but do not necessarily reflect the Ministry's views or policies. Any mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Any comments, questions or suggestions on the content of this document may be directed to:

Regional Environmental Management
Alberta Environment
3rd Floor, Deerfoot Square
2938 - 11 Street N. E.
Calgary, Alberta T2E 7L7
Ph: (403) 297-7602
Fx: (403) 297-6069

Additional print copies of this document are available from:

Information Centre
Alberta Environment
Main Floor, Oxbridge Place
9820-106 Street
Edmonton, Alberta T5K 2J6
Ph: (780) 427-2700
Fx: (780) 422-4086
Outside of Edmonton dial 310-0000 for toll-free connection
Email: env.infocent@gov.ab.ca

Copyright in this publication, regardless of format, belongs to Her Majesty the Queen in right of the Province of Alberta. Reproduction of this publication, in whole or in part, regardless of purpose, requires the prior written permission of Alberta Environment.

© Her Majesty the Queen in right of the Province of Alberta, 2007.



ACKNOWLEDGEMENTS

Photo Credits:
Louella Cronkhite
Ian Dyson
Paul Harrington
Sarah Novak
Lana Robinson
Tim Schowalter
Design: Sarah Novak Design
Printing: Graphcom Printers Ltd.

►► List of Figures and Tables

LIST OF FIGURES

- Figure 1. The State of the Landscape Region (map)
- Figure 2. Simulated and Actual Landscape Composition Change:
- Figure 3. Major Footprints – Current
- Figure 4. State of the Landscape Report – Land Cover (map)
- Figure 5. State of the Landscape Report – Natural Subregions (map)
- Figure 6. State of the Landscape Report – River Basins (map)
- Figure 7. Groundwater Yield in Southern Alberta (map)
- Figure 8. Total Dissolved Solids in Southern Alberta Groundwater (map)
- Figure 9. Long Term Trend of Good Air Quality
- Figure 10. Average Annual Concentrations for Carbon Monoxide
- Figure 11. Average Annual Concentrations for Ozone
- Figure 12. Average Annual Concentrations for Sulphur Dioxide
- Figure 13. Average Annual Concentrations for Hydrogen Sulphide
- Figure 14. Alberta's Airshed Zones (map)
- Figure 15. Sites Designated Under Special Places Program (map)
- Figure 16. Response to Human Activity – Sprague's Pipit
- Figure 17. Response to Human Activity – American Robin
- Figure 18. Response to Human Activity – Loggerhead Shrike
- Figure 19. Response to Human Activity – Sharp-tailed Grouse
- Figure 20. Administrative Boundaries – SAL Region (map)
- Figure 21. Land Ownership in the SAL Region
- Figure 22. Land Ownership – SAL Region (map)
- Figure 23. Census Divisions in the SAL Region (map)
- Figure 24. Historic Urban/Rural Populations Trends
- Figure 25. Census Divisions in the SAL Region
- Figure 26. SAL Region – Location of Urban Centres (map)
- Figure 27. Footprint of Cities
- Figure 28. Total Number of Structures Per Township 1940-2002
- Figure 29. SAL – Transportation Access (map)
- Figure 30. SAL Crop Production Year 2000
- Figure 31. SAL Crop Types by Area Year 2000
- Figure 32. Major Crop Types – SAL
- Figure 33. Alberta's Irrigation Districts (map)
- Figure 34. Actual Volume of Water Diverted to Irrigation Districts
- Figure 35. Crop Types – Irrigated and Non-irrigated Areas
- Figure 36. Percentage of Crop Area Irrigated
- Figure 37. Trends in Livestock Production 1926-2001

- Figure 38. Improved vs Unimproved Pasture
- Figure 39. Number of Cattle per Hectare of Pasture
- Figure 40. Location of Confined Feeding Operations (map)
- Figure 41. Generalized Areas of Hydrocarbon Resources
- Figure 42. Stratigraphic Intervals Containing Coal Zones with CBM Potential
- Figure 43. Marketable Gas Production and Producing Gas Wells
- Figure 44. Distribution of Coal by Rank
- Figure 45. Location of Non-Energy Metallic Minerals
- Figure 46. Non-Energy Industrial Minerals
- Figure 47. Sand and Gravel Deposits
- Figure 48. Coal Bed Methane wells in the SAL area
- Figure 49. SAL Region - Oil and Gas Activity
- Figure 50. SAL Region – Mining
- Figure 51. Forested Land Jurisdictions in SAL Area
- Figure 52. SAL Region Parks and Protected Areas
- Figure 53. Parks and Protected Areas Campsites in the SAL Region
- Figure 54. SAL Region -Recreational Operations
- Figure 55. SAL Occupied Provincial Campsite Nights
- Figure 56. SAL Day Use Party Visits
- Figure 57. Campsite Ownership in SAL Region

LIST OF TABLES

- Table 1. SSRB Water Allocations
- Table 2. Special Places Sites in SAL Area by Natural Region
- Table 3. SAL Region - Species at Risk
- Table 4. Invasive Plants (three most problematic species)
- Table 5. Native Reserves in the SAL Region
- Table 6. Census Divisions in the SAL Region
- Table 7. Population Density in SAL Region
- Table 8. Population Growth of Major Urban Centres
- Table 9. Land Use and Urban Development in the Four Cities
- Table 10. Alberta's Irrigation System

►► Table of Contents

Executive Summary: State of the Landscape	1 - 3
Introduction	4 - 5
Ecosystems and Natural Regions	6 - 13
Watersheds	14 - 24
Airsheds	25 - 27
Biodiversity and Species at Risk	28 - 41
Administrative Boundaries	42 - 46



Population and Settlement	47 - 52
Transportation	53 - 55
Agriculture and Irrigation	56 - 66
Energy and Mining	67 - 79
Forestry	80 - 81
Tourism, Parks and Recreation	82 - 87
Summary	88
Glossary	89 - 93

►► Executive Summary: State of the Landscape



Southern Alberta Landscapes: Meeting the Challenges Ahead (SAL) Report represents a “snap shot” of southern Alberta as it is today. The report looks at some of the historic trends that have resulted in the current landscape but is intended primarily as a tool that provides the contextual framework for discussion of current issues and future trends in the SAL region.

The SAL region includes all of the Alberta portion of the Grasslands Natural Region, the South Saskatchewan River Basin, and the Alberta portion of the Cypress Hills. Major urban areas include Red Deer, Airdrie, Calgary, Lethbridge, and Medicine Hat. In total, the SAL region includes about 17% of the total area of Alberta, or 112,500 km², with a population of about 1.5 million, or about half the population of the province.

Historic landscape change has been significant in southern Alberta, largely driven by agricultural expansion with the settlement of the province. Two-thirds of the region’s native grasslands have been converted to other land covers, from pre-settlement times to today, and 10% of the forested land cover has been transformed. Today, 48% of the SAL region is in native land cover and 52% is anthropogenic edge, including cities, roads, wellsites, cropland and rural residential development.

ECOSYSTEMS AND NATURAL REGIONS

The SAL region includes five of the six natural regions represented in Alberta, and 12 of the 20 sub-regions. The largest natural region is the Grassland, with Parkland, Foothills, Rocky Mountain and Boreal Forest constituting the rest of the landscape.



WATERSHEDS

There are two major river basins in the SAL region - the South Saskatchewan and the Milk. In the extreme northeast corner, a portion of the Battle, a sub-basin of the North Saskatchewan River Basin, loops into the region. The South Saskatchewan River Basin, which includes the Bow, Oldman and Red Deer Rivers and their tributaries, drains 120,000 km² of the province. The Alberta portion of the Milk River Basin, in the far south, is 6,500 km².

WILDLIFE AND SPECIES AT RISK

There is a wide diversity of plants and animals in the region. More than 75% of Alberta’s species at risk are in the southeast region of the province. Wildlife-human conflicts are increasing with population growth and land fragmentation.

SETTLEMENT

The SAL region includes 19 counties, nine municipal districts, three Special Areas, three improvement districts, and six First Nation Reserves. There are 12 census divisions.

Most of the urban population lives in the region’s five cities: Calgary, Red Deer, Airdrie, Lethbridge, and Medicine Hat. Calgary, with a population of 1,021,060, is the fourth largest city in Canada, with average annual increases from 1997 to 2001 of approximately 17,000 persons a year. Significant new growth (country residential) is taking place to the west of the Calgary, on the Eastern Slopes of the Rocky Mountains.

►► Executive Summary: State of the Landscape

TRANSPORTATION

The SAL region currently has more than 13,140 kilometres of major roads and about 109,600 kilometres of minor roads and trails. There are about 4,380 kilometres of railway track. Roads and rail lines are not evenly distributed in Alberta, being concentrated more in the southern half of the province.

The majority of roadways are in the form of smaller local or municipal roads that provide basic land access and link together to form a network serving the local population.

AGRICULTURE AND IRRIGATION

In 2001, the Agricultural Profile of the SAL region included:

- Approximately 25,000 farms,
- 60,000 km² of cropland, and
- 6,000 km² of irrigated land.

Irrigation greatly increases yields compared to those expected without the benefit of reliable moisture. Irrigation also enables the growing of crops that could not survive on the amount of precipitation available on dryland farms in Alberta.

Major crop types in the SAL region include:

- Cereal crops such as spring- and fall-seeded wheat, malt and feed barley, oats, rye, durum, and triticale;
- Oilseed crops (primarily canola and flax);
- Specialty crops, including field peas, mustard, lentils, dry beans, faba beans, safflowers, sunflowers, canaryseed, herbs and spices, sugar beets, potatoes, corn, and other vegetables grown for commercial production; and
- Forage crops, including alfalfa, brome grass, timothy, wheatgrass, clover, and wild ryes.

The main livestock types are cattle (beef and dairy), hogs, poultry (eggs and meat), sheep (wool and meat), and horses. Currently, there are approximately:

- 4.5 million head of cattle in the region, which represents approximately 68% of the cattle in the province;
- 5.5 million chickens; and
- 1.5 million swine.



Southern Alberta is home to more than 130 agri-food processing companies. While establishments in the food processing industry are diverse, the meat-packing and processing sector accounts for about 50% of Alberta's food processing sales. Other large sectors include dairy, feed, cereal, grain and flour, sugar, canola processing, and frozen fruits and vegetables, particularly potatoes.

ENERGY, MINING AND INDUSTRY

Energy activity in the SAL region includes 51,000 producing oil and gas wells, 184 sweet gas plants, 124 sour gas plants, 116,860 km of pipelines, one active coal mine, and one coal-fired power plant. There is also one gas-fired electrical generation utility and 10 gas fired non-utilities.

There are significant coal deposits at the Sheerness mine near Hanna. Coal production in 2003 was 3.8 million tons, slightly more than 10% of total coal production in Alberta.

►► Executive Summary: State of the Landscape

As of February 2007, wind farms in southern Alberta had a wind generation capacity of 384 megawatts (MW) (provincial electricity generating capacity is 11,500 MW). There are currently 21 wind projects. As well, there are 18 hydro-electric projects.

Twelve major facilities produce a variety of petrochemical and chemical products, including ammonia, methanol, ethylene glycol, alpha olefins, nitrogen/oxygen, and ammonium nitrate.

A variety of non-energy resource-based industries exist in the region, including a cement plant, lime plants, a brick plant, an ammolite factory, a gypsum, zeolite and barite facility, and an ethane processing plant.

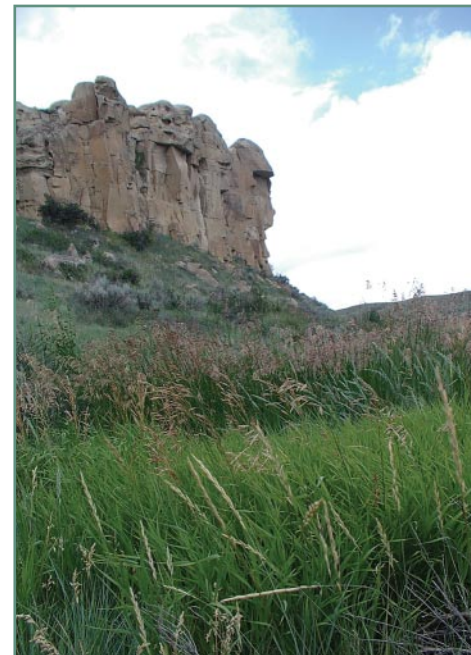
FORESTRY

A relatively small proportion (18,000 km² - 16%) of the SAL region is forested. Currently, 48% of the total forested land base is actively managed for timber production. The remainder is in parks, Prime Protection Zone 1, or is withdrawn from the active land base because of proximity to water bodies, steep slopes or other hazards.

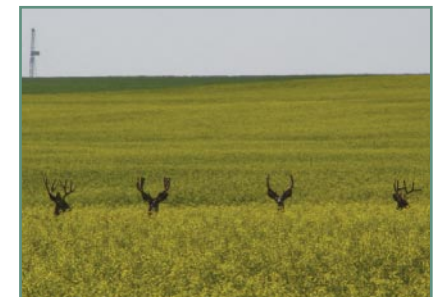
There are two Forest Management Agreements within the SAL project boundary, as well as two Community Timber Programs and four Coniferous Timber Quotas.

TOURISM AND RECREATION

Parks and protected areas account for 8,100 km² or 7.2% of the land base of the SAL area, compared with 12.4% for Alberta as a whole. There are 12 major ski areas, covering approximately 4,012 hectares, 91 golf courses, with a combined area of approximately 4,400 hectares, and 182 campgrounds, covering an area of 4,830 hectares.



Parks and protected areas account for 8,100 km² or 7.2% of the land base of the SAL area, compared with 12.4% for Alberta as a whole.



►► Introduction

STATE OF THE LANDSCAPE

The Province of Alberta is richly endowed with natural resources that have sustained and benefited its citizens economically and environmentally. Recognizing the increasing demand for those resources due to population and lifestyle pressures, the Alberta Government has stated its commitment to the wise management of Alberta's natural resources and environment. The Commitment to Sustainable Resource and Environmental Management was signed for the benefit of all Alberta's present and future generations in March 1999.

Southern Alberta Landscapes: Meeting the Challenges Ahead (SAL) was launched in 2002 as a cross-Ministry, inter-governmental, strategic planning initiative to examine sustainable development issues in southern Alberta. The focus is on understanding the complexity of the landscape, and the effects of human activities on environmental quality. The project is looking at the cumulative effects of changes in land use, resource demands, population increases and climate change over the next 50 years, or two generations, and how those changes affect the sustainability of the environment.

To achieve the goal of a continuing high quality of life in a sustainable environment, SAL is looking at social, economic and environmental data for southern Alberta. The data will assist those working on SAL to:

- Take stock of the current state of the region's resources,
- Assess the consequences of potential changes over the next two generations,
- Identify issues that need to be addressed to ensure a sustainable future, and
- Address the question of how we can meet our social and economic needs while ensuring environmental quality.

SAL is an opportunity to develop a strategic vision of the future of southern Alberta that provides for all the benefits society wants, while ensuring a sustainable environment.



THE SAL REGION

The SAL study area includes all of the Grasslands Natural Region, the South Saskatchewan River Basin, and the Alberta portion of the Cypress Hills. Major urban areas located in the region include Red Deer, Airdrie, Calgary, Lethbridge, and Medicine Hat. In total, the SAL region includes about 17% of the total area of Alberta, or 112,514 km² (based on the Natural Resources Canada 2001 figure for the total area of Alberta of 661,848 km²), and a population of about 1.5 million, or about half the provincial population of 3,413,500 (as of Oct. 1, 2006, Census Canada).

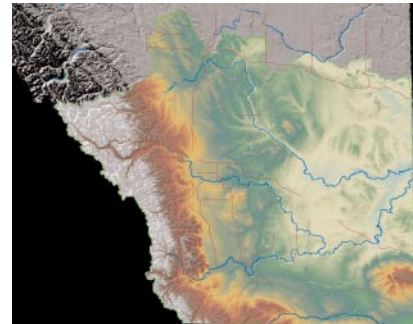


Figure 1. The SAL Region

PURPOSE OF THE REPORT

The State of the Landscape Report represents a “snap shot” of the region as it is in 2006. The report looks at some of the historic trends that have result-

►► Introduction

ed in the current landscape and, where relevant, raises some of the issues of concern about the landscape. It is intended as a tool that provides the contextual framework for discussion of current issues and future trends in the SAL region. Generally, discussion of those trends will appear in other SAL documents and reference to these discussions in this report will be made only when they are relevant to describing the current landscape.

WHAT'S IN THIS REPORT?

Historic landscape change has been significant and permanent in the SAL region, driven largely by the settlement of the province, agricultural expansion and other human activities. Two-thirds of the region's native grasslands have been lost from pre-settlement times to today, while 10% of the forested land cover is gone. As of 2006, about 48% of the SAL region is in native land cover and 52% is in anthropogenic footprint (48% in croplands and 4% in settlements, roads and other human developments). In addition to the direct influence and effects of human activities, changes in the environment have been caused by edge effects, the alterations to temperature, light intensity, plant and animal migration patterns, and other aspects of the ecosystem caused by the juxtaposition of anthropogenic areas and natural areas. Most of the anthropogenic edge discussed in this State of the Landscape report has occurred since settlement by non-Native people on the Prairies.

Other than croplands, the anthropogenic footprint is comprised primarily of towns & cities (40%), followed by roads (30%). Wellsites occupy 17% of the developed SAL region, followed by rural residential developments (7%). Cereal crops and tame grasses dominate the agricultural land cover and a significant proportion of crops are irrigated. Thus, most of the SAL area has been affected in one way or another by human activities.

This report discusses both the remaining natural landscape and the anthropogenic landscape. Though the population density of the SAL region is relatively low – approximately 13 people per km², with most of those people concentrated in the five urban centres – the human effects on the landscape are evident everywhere, through forest practices, tourism, agriculture, the energy industry, and so on. It is these impacts on the landscape that speak to the need for a sustainable development strategy for the SAL region.



►► Ecosystems and Natural Regions

The SAL region is currently about equally divided between natural landscapes and cropland, with an additional 4% in other anthropogenic footprint. The region’s land cover is predominantly grassland and cropland, with smaller areas of forest, riparian areas, wetlands, and built-up areas.

Figure 2 illustrates how the SAL region has been transformed from the original landscape, dominated by grassland, to a landscape now dominated by cropland. Figure 3, the “Major Footprints” graph, shows the developed parts of the SAL region, including major roads, minor roads and trails, rural residential settlements, towns and cities, recreation facilities, confined feeding operations, wellsites, and pipelines.

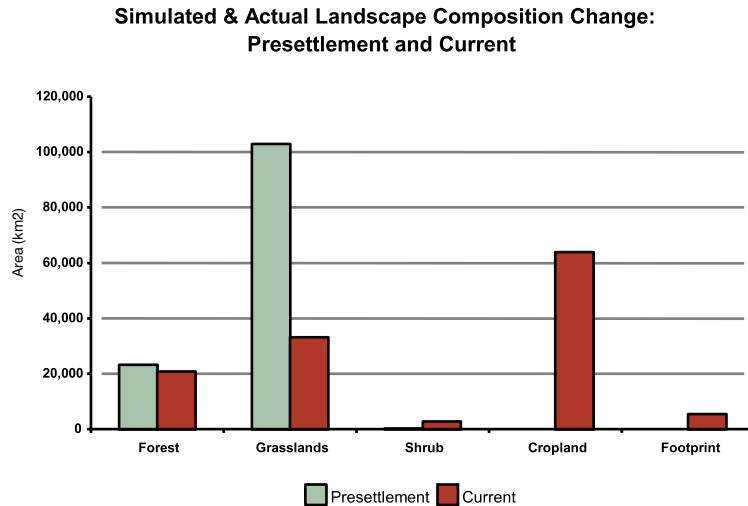


Figure 2. Simulated and Actual Landscape Composition Change

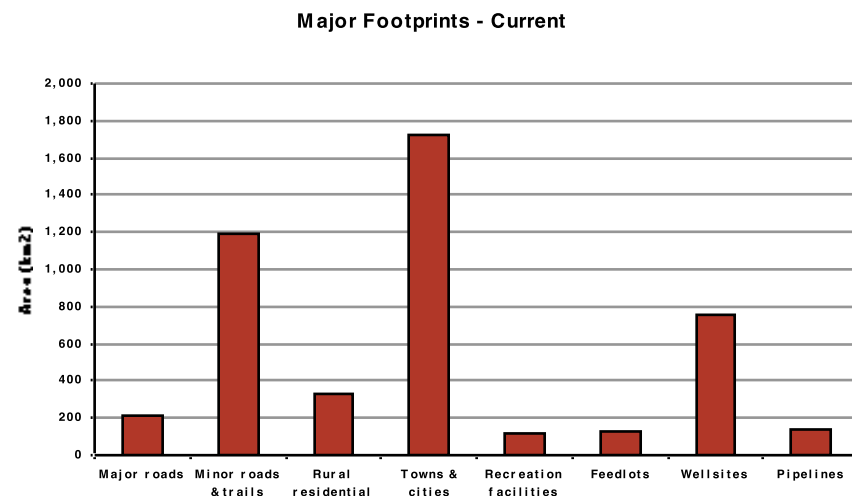


Figure 3. Major Footprints - Current



GRASSLAND NATURAL REGION

The Grassland Natural Region, which extends west to the Foothills and north to the Parkland of central Alberta, covers 14.5% (96,221 km²) of the province, almost all of which is in the SAL area. This region is a flat-to-gently rolling plain, with a few major hill systems. Badlands have developed where river valleys and their associated coulees and ravines are carved deeply into bedrock, especially along the Red Deer, Oldman-South Saskatchewan and Milk Rivers.

Grasslands are dominated by grasses, which include rough fescue, bluebunch fescue, Parry oat grass (rare), and bearded wheat grass (common). Extensive narrow-leaf cottonwood forests, found nowhere else in Canada, occur along the Oldman, Belly, Waterton and St. Mary Rivers. Upland wildlife is most diverse on the broad plateaus of the Cypress Hills and the Milk River Ridge.

There are four Grassland Subregions within the SAL region: Mixedgrass, Northern Fescue, Foothills and Parkland. Each is distinguished by differences in climate, soils, and vegetation, as described below.

►► Ecosystems and Natural Regions

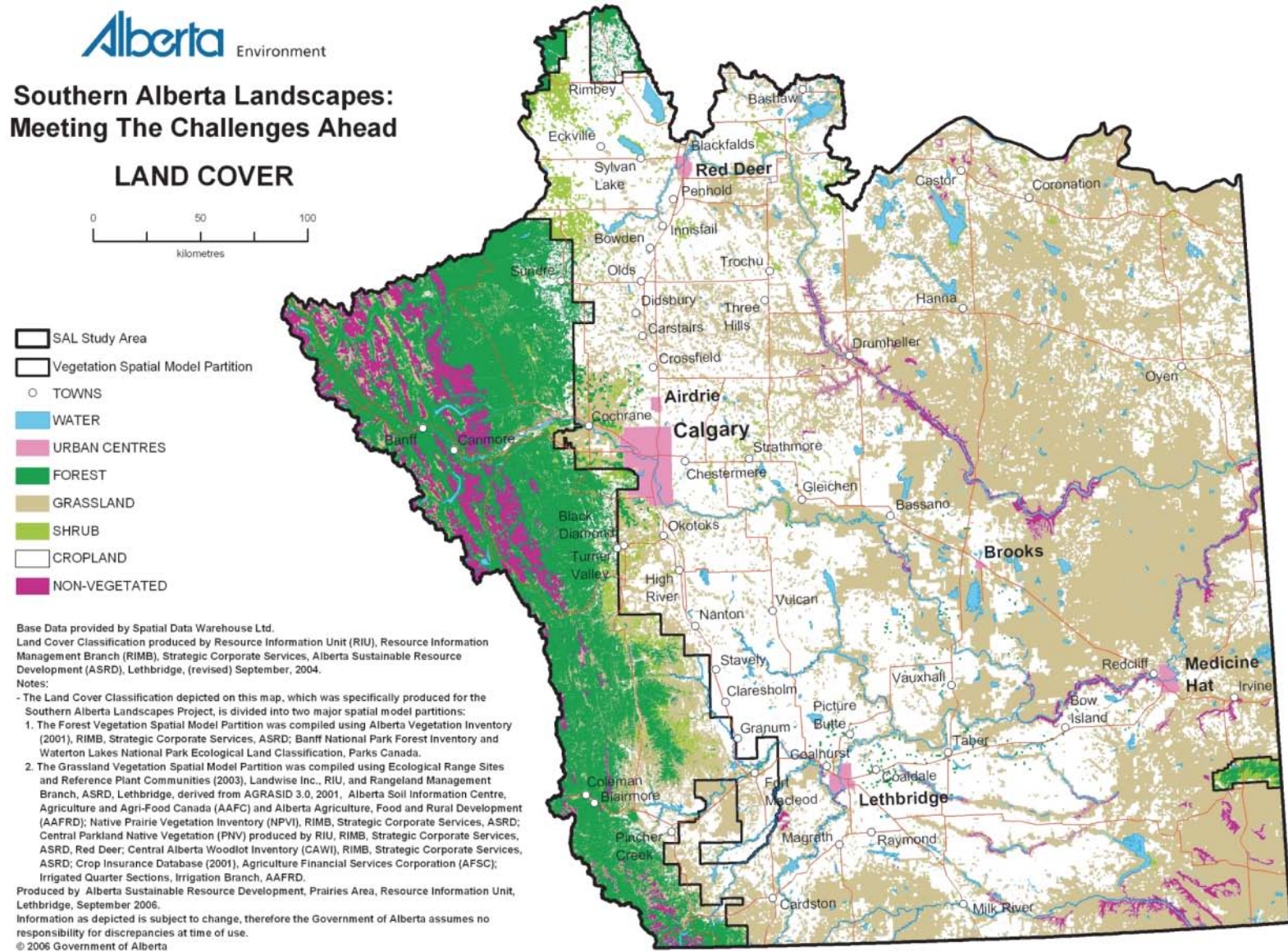


Figure 4. Land Cover in the SAL Region

►► Ecosystems and Natural Regions

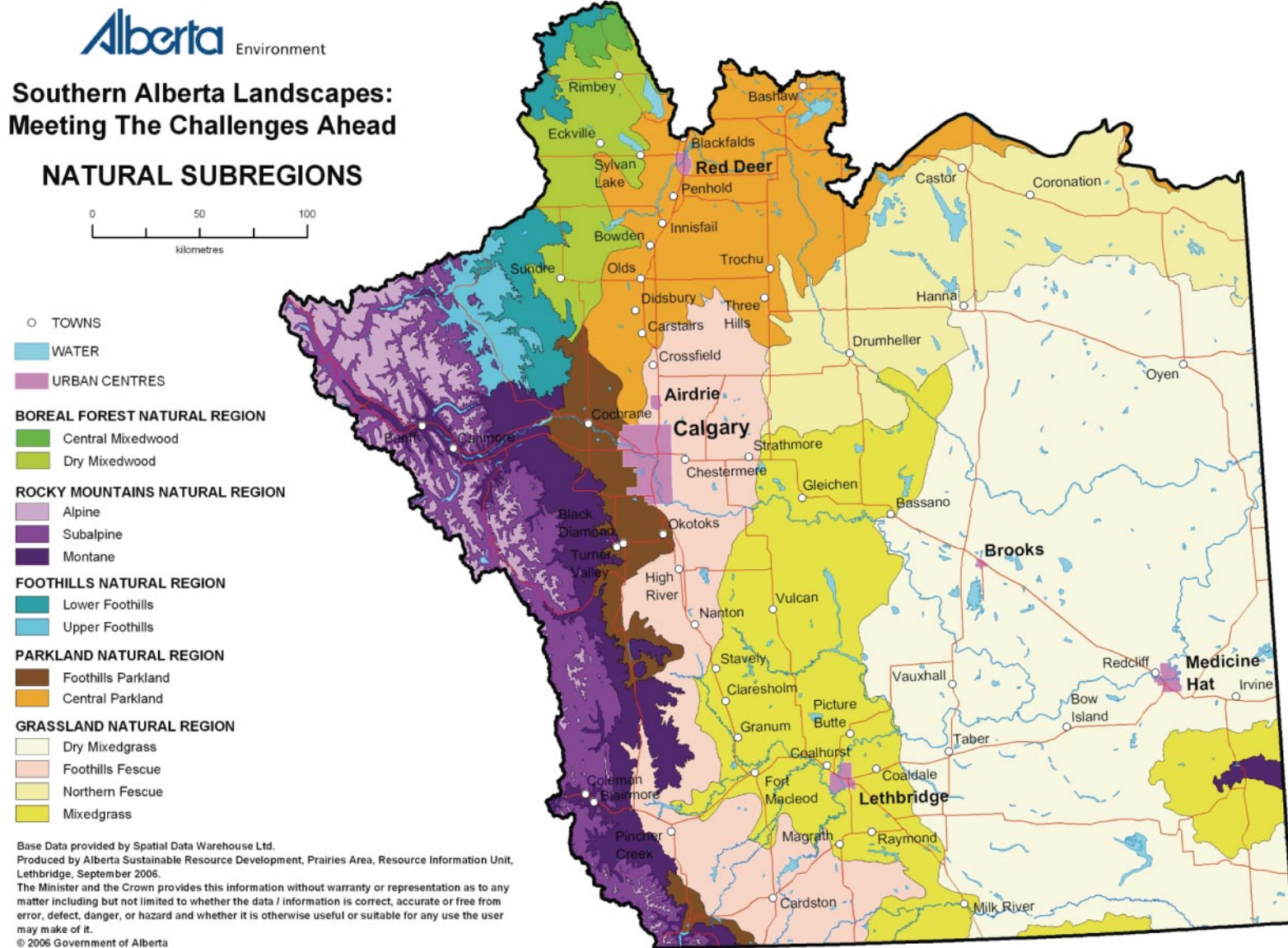


Figure 5. Natural Subregions of the SAL Area

►► Ecosystems and Natural Regions

A natural region (or ecoregion) is defined as a group of landscapes that contain similar landforms, hydrology, geology, soils, climate, plants and wildlife.¹ Each natural region is divided into subregions, defined as an area of land within a natural region that contains similar landscape patterns. In Alberta, there are six natural regions, with 20 subregions. The SAL area includes five of the six natural regions and 12 subregions. The largest natural region is the Grassland Natural Region (see Figure 4).

DRY MIXEDGRASS SUBREGION

The Dry Mixedgrass Subregion is the largest Grassland Subregion, covering approximately 48,000 km² or about 49% of the total area of the Grasslands Natural Region. The Dry Mixedgrass Subregion is generally of low relief. Elevations range from 600 metres near Empress to slightly more than 1300 metres on the lower slopes of the Cypress Hills, Sweetgrass Hills and Milk River Ridge. This subregion is the warmest and driest in Alberta.

The name “mixedgrass” comes from the predominance of both short grasses, such as blue grama, and mid-height grasses, such as spear grass, western wheat grass and June grass.

Most of this ecoregion has been altered by agricultural development. Currently, the area is mainly used for cattle production on native pasture and for crop production on irrigated land.²

Of the four grassland subregions, the Dry Mixedgrass Subregion contains the highest diversity of animal species. Many species, especially those of the sand dune areas and the extreme southeast part of Alberta, occur nowhere else in the province. Characteristic species of heavily grazed uplands include horned lark, McCown’s longspur, chestnut-collared longspur, and Richardson’s ground squirrel. Species found in lightly grazed areas include Baird’s sparrow, Sprague’s pipit, sharp-tailed grouse, and upland sandpiper. Sage grouse, lark bunting, Brewer’s sparrow, and pronghorn prefer the sagebrush communities.

Sandy areas support some rare species, including Ord’s kangaroo rat and the western hognose snake. Riparian shrublands and forests support a diverse

animal community, including brown thrasher, grey catbird, yellow-breasted chat, mourning dove, northern flicker, house wren, northern oriole, deer mouse, Nuttall’s cottontail, and white-tailed deer.

Rock outcrops and badlands provide nesting habitat for golden eagle, rock wren, ferruginous hawk, prairie falcon, and mountain bluebird.

Wetlands are home to many bird species, as well as to the boreal chorus frog, northern leopard frog, plains spadefoot toad, and garter snake.

MIXEDGRASS SUBREGION

The Mixedgrass Subregion covers approximately 19,000 km², or about 19% of the total area of the Grasslands Natural Region. The Mixedgrass Subregion typically includes gently undulating to rolling morainal and glacial lake deposits, with minor areas of steeper terrain along the lower and middle slopes of the Milk River Ridge and the Sweetgrass and Cypress Hills.

The area is currently used for irrigation and dryland farming of small grains. There is some livestock grazing, where irrigation water is not available or where the topography limits crop production.

The fauna of the Foothills Fescue Subregion is not as extensive as in the other subregions of the Grassland Natural Region.

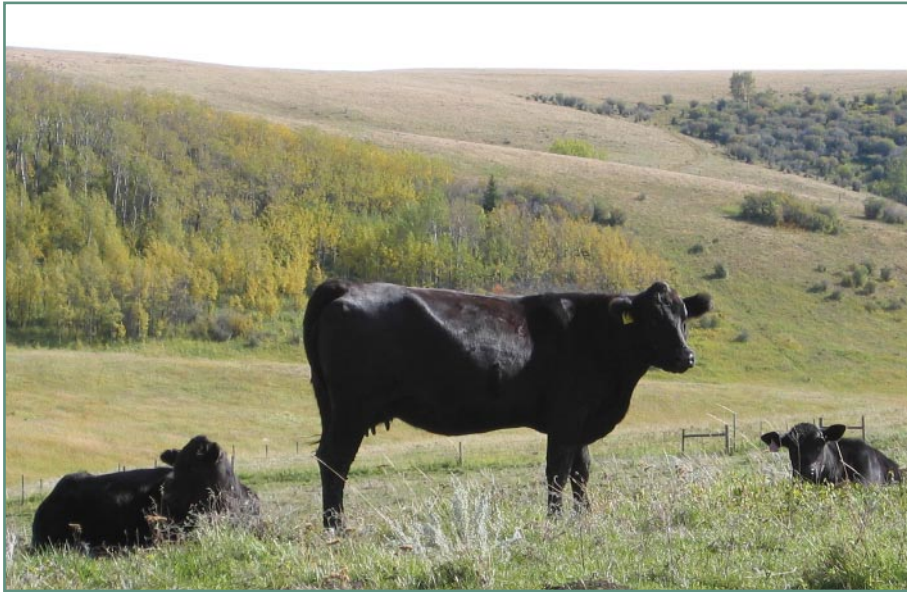


¹ The Alberta Natural Heritage Information Centre (ACD) provides the natural region mapping for Alberta.

² Source: The Ecoregions Map of Alberta, W.L. Strong and K.R. Leggatt, Agriculture Canada, 1981.

►► Ecosystems and Natural Regions

Native grasslands in the Mixedgrass Subregion are dominated by needle grasses and wheat grasses, with many of the same forbs and dwarf shrubs that occur in the grasslands of the Dry Mixedgrass Subregion. Here, in the Mixedgrass Subregion, tall shrub and tree growth is also restricted mainly to moist draws and river valleys. Wildlife species of the Mixedgrass Subregion are similar to those discussed for the Dry Mixedgrass Subregion.



NORTHERN FESCUE SUBREGION

The Northern Fescue Subregion covers approximately 16,000 km², or about 16% of the total area of the Grasslands Natural Region. The Northern Fescue Subregion is characterized by gently rolling moraine and hummocky moraine. Sand plains, dune fields and glacial lake deposits also occur.

The grasslands are dominated by rough fescue. June grass, western porcupine grass, slender wheatgrass and Hooker's oat grass are also important. Common forbs include prairie crocus, prairie sagewort, mouse-ear chickweed, wild blue flax, and three-flowered avens. Wildlife species of the Northern Fescue Subregion are similar to those found in the Dry Mixedgrass and Mixedgrass Subregions.

FOOTHILLS FESCUE SUBREGION

The Foothills Fescue Subregion is the smallest subregion, covering approximately 15,000 km² or about 15% of the total area of the Grasslands Natural Region. The Foothills Fescue Subregion is located along the flanks of the Rocky Mountain foothills, including the Porcupine Hills, and in the Sweetgrass Hills and parts of the Cypress Hills plateau. Elevations are much higher than in the other two grassland subregions, ranging up to 1400 metres in the Cypress Hills. The fauna of the Foothills Fescue Subregion is not as extensive as in the other subregions of the Grassland Natural Region. Upland wildlife is most diverse on the extensive plateaus of the Cypress Hills and the Milk River Ridge.

Wildlife in the forests and shrublands of the southwest rivers is similar to that of the Milk River area in the Mixedgrass Subregion. Along the western edge of the Foothills Fescue Subregion, some Rocky Mountain species also occur.

PARKLAND NATURAL REGION

The Parkland Natural Region forms a broad transition between the grasslands to the south and the forests to the north. It is present only in the prairie provinces of Canada. Only the Central Parkland and Foothills Parkland Subregions occur in the SAL study area.

CENTRAL PARKLAND SUBREGION

The Central Parkland Subregion extends in a broad arc, as much as 200 km wide, between the grasslands and the boreal forest. Elevations range from 500 metres above sea level, where the Battle River enters Saskatchewan, to around 1100 metres above sea level in the west. Lakes and permanent wetlands are common.

Within this subregion, there is a gradual transition from grassland with groves of aspen in the south, to closed aspen forest in the north. Native vegetation is scarce because most land has been cultivated to grow agricultural crops. The majority of the remaining natural land is on rougher terrain or poorer soils.

►► Ecosystems and Natural Regions

Aspen and balsam poplar forests are the two major forest types that occur in the Central Parkland; both are characterized by a lush, species-rich understorey (the area that grows under the canopy of the forest). Within the grasslands of this subregion, plant species are essentially the same as those found in the Northern Fescue Subregion. Shrub communities of snowberry, rose, chokecherry, and saskatoon are more extensive in the northern portion of the Central Parkland Subregion. Animals of the Central Parkland Subregion include a mixture of species from the grasslands to the south and the forests to the north. Occurring at the southern edge of this subregion are grassland species such as upland sandpiper, Sprague's pipit and Baird's sparrow, which becomes less common farther north. Along the northern fringe, boreal forest species such as woodchuck, broad-winged hawk and rose-breasted grosbeak are more common. Franklin's ground squirrel and piping plover occur primarily in this subregion.

FOOTHILLS PARKLAND SUBREGION

The Foothills Parkland Subregion occupies a narrow band along the eastern edge of the foothills from Calgary south to the Porcupine Hills, and from Pincher Creek south to the U.S. border. The topography is rougher than that of the Central Parkland Subregion and elevations are higher, ranging to somewhat more than 1300 metres above sea level.

Within this subregion there is a gradual transition from grassland with groves of aspen to closed aspen forest. The transition occurs across a short distance (1 km to 5 km) because of rapid changes in topography and climate. This compression results in small geographic areas being very diverse.

Grassland communities of the Foothills Parkland Subregion are similar to those of the Foothills Fescue Subregion, supporting fescue/oat grass communities with a great diversity of forb and grass species. Aspen generally dominate the upland forests, with balsam poplar on moister sites. Willow groves form a distinctive community that occurs in the northern part of the subregion.

Many animal species occurring in the Central Parkland Subregion are absent here, but other species give the Foothills Parkland Subregion a distinctive character. Rocky Mountain species in upland forests and shrublands include dusky flycatcher, MacGillivray's warbler, lazuli bunting, and white-crowned sparrow. In the far south, black-headed grosbeaks and blue grouse are typical birds of the aspen forests.

FOOTHILLS NATURAL REGION

The Foothills Natural Region extends north, from around Turner Valley, along the eastern edge of the Rocky Mountains in a gradually widening belt. Two subregions are recognized, both of which occur in the SAL area.

LOWER FOOTHILLS SUBREGION

The Lower Foothills Subregion includes rolling topography created by the deformed sandstone and shale outcrops along the edge of the Rocky Mountains.

The forests reflect the transitional nature of this subregion, with mixed forests of white spruce, black spruce, lodgepole pine, balsam fir, aspen, white



►► Ecosystems and Natural Regions

birch, and balsam poplar. Lodgepole pine forests occupy extensive portions of the upland, especially where fire has been part of the landscape history.

Many of the animals that inhabit the coniferous forests here occur throughout the Boreal Forest, Foothills and Rocky Mountain Natural Regions. These species include the boreal chickadee, spruce grouse, ruby-crowned kinglet, white-winged crossbill, and red squirrel. Deciduous forests support ruffed grouse, warbling vireo, black-capped chickadee, and Tennessee warbler.



UPPER FOOTHILLS SUBREGION

The Upper Foothills Subregion occurs on strongly rolling topography along the eastern edge of the Rocky Mountains. Upland forests of this subregion are nearly all coniferous and are dominated by white spruce, black spruce, lodgepole pine, and subalpine fir.

Wildlife species of the Upper Foothills Subregion include pine siskin, yellow-rumped warbler, ruby-crowned kinglet, white-crowned sparrow, and varied thrush. Elk, black bear and grizzly bear are characteristic mammalian species. The diversity of animal species is less here than in the Lower Foothills Subregion because of a reduced diversity of plant communities.

ROCKY MOUNTAIN NATURAL REGION

The Rocky Mountain Natural Region along the Continental Divide ranges from about 10 km wide in the Waterton Lakes National Park area to more than 100 km wide in the central portion of the region. It contains the most rugged topography in Alberta. All three subregions of this natural region are represented in the SAL area.

SUBALPINE SUBREGION

The Subalpine Subregion occupies a band between the Montane and Alpine Subregions in the south and between the Upper Foothills and Alpine Subregions in the north.

The lower subalpine is characterized by closed forests of lodgepole pine, Engelmann spruce and subalpine fir; the upper subalpine has open forests near the treeline. Whitebark pine forests occasionally occur and subalpine larch is found south of Bow Pass. High elevation grasslands occur on steep south- and west-facing slopes. Snow avalanches create a diverse mix of shrubby and herbaceous communities.

Present uses include watershed protection, forest management, national parks, recreation, and wildlife habitat.

Wildlife species of the coniferous forests include spruce grouse, gray jay, pine siskin, boreal chickadee, marten, snowshoe hare, black bear, deer mouse, and red squirrel. Subalpine forest birds and mammals that are restricted to the Rocky Mountain Natural Region include the Stellar's jay, varied thrush, Townsend's warbler, willow ptarmigan, golden-crowned sparrow, and mountain caribou.

ALPINE SUBREGION

The Alpine Subregion occurs above treeline and includes vegetated areas, bare rock, snowfields, and glaciers. Alpine vegetation is diverse. Deep, late-melting snowbeds are occupied by black alpine sedge communities. Moderate snowbed communities are dwarf-shrub heath tundra, which is dominated by heathers and grouseberry. Shallow snow areas on ridgetops

►► Ecosystems and Natural Regions

and other exposed sites contain communities dominated by white mountain avens, snow willow and moss campion. Diverse, colourful herb meadows occur in moist sites below melting snow banks or along streams. Lichen communities on rocks struggle to survive at the highest elevations.

Present uses of the Alpine Subregion include watershed management, recreation and wildlife habitat.



MONTANE SUBREGION

The Montane Subregion in southern Alberta occurs on east-west trending ridges that extend out from the foothills. To the north, this subregion occurs mostly along the Bow River Valley.

The montane landscape is characterized by a pattern of open forests and grasslands. Open forests, dominated by Douglas fir and limber pine on the ridgetops, are among the driest forest communities in Alberta. These communities are species-rich, reflecting the diversity of habitats. Limber pine grows on the most exposed rock outcrops. Lodgepole pine forests occur on upland sites. White spruce forests grow along streams and aspen forests are typically found on terraces. Bluebunch wheat grass, fescue grasses and oat grasses, plus a great diversity of forbs, typically dominate the Grasslands.

Douglas fir - limber pine habitats are home to blue grouse, mountain chickadee, Clark's nutcracker, mule deer, elk, and Columbian ground squirrel. Aspen forests typically contain MacGillivray's warbler, warbling vireo and lazuli bunting. Spotted frog and long-toed salamander, found in wetlands in this subregion, are restricted to the Rocky Mountain Natural Region in Alberta.

BOREAL FOREST NATURAL REGION

The Boreal Forest Natural Region is Alberta's largest Natural Region. It consists of broad lowland plains and discontinuous hill systems. The presence of extensive wetlands is also a major characteristic. Bogs, fens, swamps, and marshes are common. While the Boreal Forest Natural Region has six subregions in Alberta, only one, the Dry Mixedwood Subregion, is found in the SAL region, in the northwest corner.

DRY MIXEDWOOD SUBREGION

The Dry Mixedwood Subregion is characterized by level to undulating terrain. The vegetation is transitional between that of the Central Parkland and Central Mixedwood Subregions found to the north and outside the SAL region. Aspen occurs in both pure and mixed stands. Balsam poplar frequently occurs with aspen, especially on moister sites. White spruce and balsam fir may replace aspen and balsam poplar. Coniferous species are more common farther north, with widespread mixed stands of aspen and white spruce.

Aspen forests have a diverse understorey. Coniferous forests generally have a less diverse understorey, but a greater cover of moss species. Dry, sandy uplands are usually occupied by jack pine forests. These may be quite open and may have a prominent ground cover of lichens. Peatlands are common, but not as prevalent as in other boreal forest subregions.

Characteristic wildlife species of the deciduous forests include least flycatcher, house wren, northern oriole, and rose-breasted grosbeak. Species of the mixedwood forests include yellow-bellied sapsucker, Swainson's thrush, magnolia warbler, white-throated sparrow, pileated woodpecker, and northern goshawk.

▶▶ Watersheds



Water is a constant concern in the landscape in the SAL region, where 80% of the province's population has access to just 20% of the province's water.¹

Urban municipalities, including Calgary and the 'Four Cities,' now make up more than 90% of the estimated 1.5 million people presently reliant on drinking water from the South Saskatchewan River Basin (SSRB). The steady, significant urban growth in Calgary and the 'Four Cities' means increasing demands are being placed on the rivers and tributaries of the SSRB.

Due to the increasing demand on water resources, the diminishing capacities of private sources, and increasingly higher industry standards and public expectations of water quality, many smaller communities are looking to the larger urban municipalities for partnerships in regional water facilities.

HISTORY

During the Pleistocene period in geological history, from 1.6 million years ago to about 10,000 years ago, major ice sheets scoured the landscape of western Canada as they advanced and retreated over several ice ages. The immense runoff from the last retreat of the glaciers, some 10,000 years ago, shaped southern Alberta's watersheds. It changed the course of some rivers and deepened all their channels, a process that has continued with the erosion of the soft, sedimentary bedrock. Except for isolated igneous outcrops in the Milk River watershed, all exposed valley bedrock in the SAL region is

composed of soft sedimentary rocks. Erosion has etched each of the main river valleys with numerous coulees and ravines, with badlands forming where the bedrock has been deeply carved.

During the last 10,000 years, periodic floods and drought have affected southern Alberta's rivers and other surface waters. Indications from scientific studies are that severe droughts have occurred during the past 2000 years, with an average duration of more than 10 years. At least 20 short droughts occurred during the 20th century. The drought of the 1930s, with subsequent "dust bowl" conditions, is the most notable from the early part of the century and was the most severe and prolonged drought since the beginning of western settlement. Its impact on the economy and the life of prairie settlers was magnified, as it coincided with the worldwide economic depression. Another dry period that was to last about 10 years began in 1977. The 2001-2002 drought had the driest back-to-back years in 74 years.

SURFACE WATER

Water management in the SAL region is concerned primarily with the three main sub-basins of the SSRB – the Oldman River Basin, the Bow River Basin, the Red Deer River Basin – and the Milk River Basin (see figure 6). Of this total land surface, rivers, streams, lakes and man-made reservoirs occupy only 248 km², or about 2% of the total area of the approximately 112,500 km² in the SAL region.

Natural drought cycles, glacial shrinkage and climate change predictions have all led to concerns about possible shortages in water supplies in the future. Alberta Environment has studied historical flows in the major river basins in the SAL region in response to these concerns. While flow rates in the SSRB have fluctuated during the years, the average natural flow has not changed much. However, such flow volumes cannot be assured in the future. If climate change predictions prove accurate, higher temperatures on the prairies will mean more evaporation from rivers, reservoirs and fields. Historic records also indicate the 20th century was wetter than usual and that, if pre-20th century patterns return, more prolonged droughts exacerbated by climate change might be expected in the future.²

¹ Based on 'SSRB Non-irrigation Water Use Forecasts', Canadian Resource Economics Ltd. and Hydroconsult EN3 Services Ltd., 2002

▶▶ Watersheds

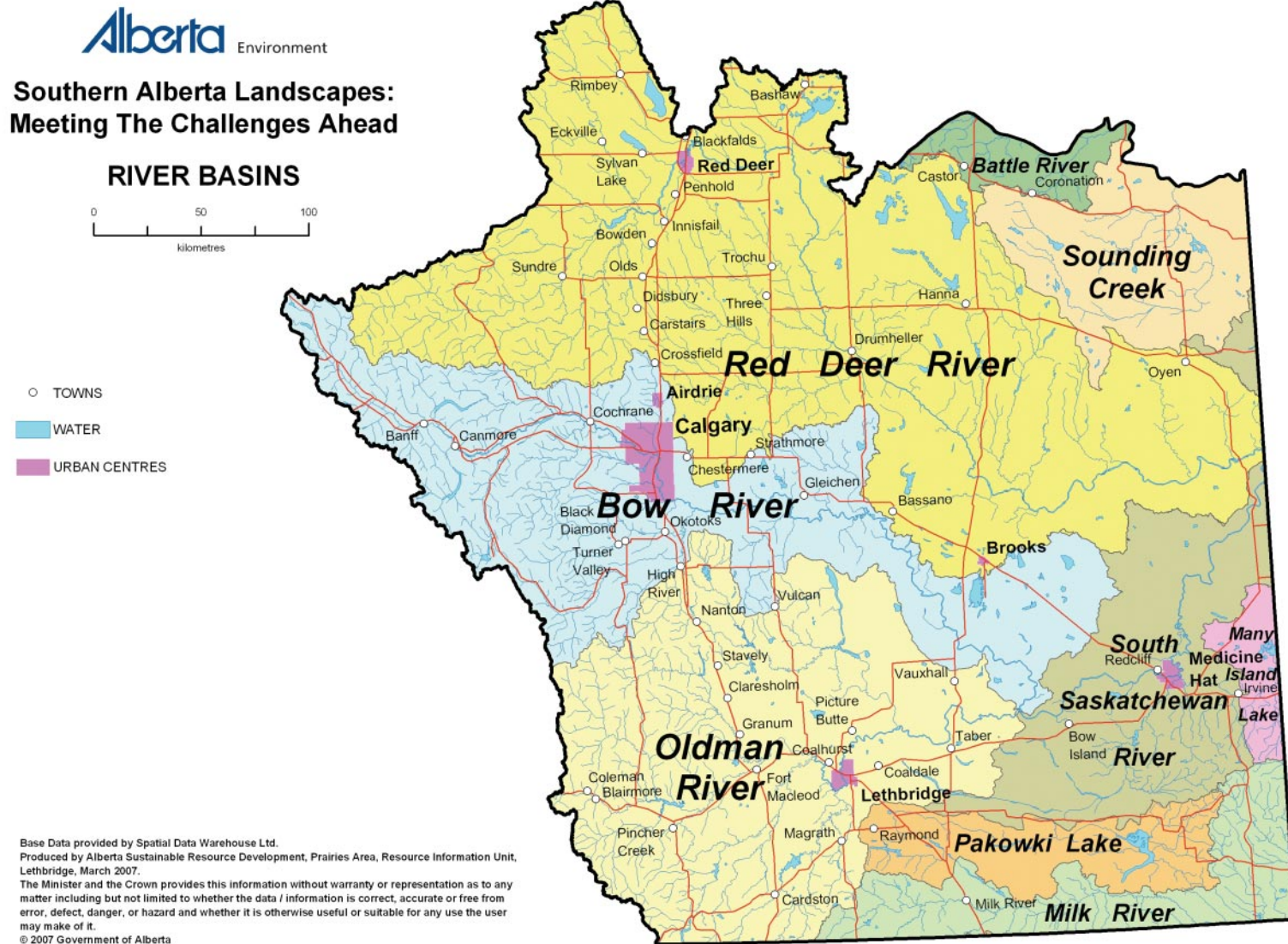


Figure 6. Map of River Basins

▶▶ Watersheds



SOUTH SASKATCHEWAN RIVER BASIN

The South Saskatchewan River Basin is a diverse landscape, including parts of the Rocky Mountain, Foothills, Boreal Forest, Parkland and Grassland natural regions. The combination of fertile soils and dry climate in the southern part of the basin has led to the development of irrigation farming. All of the province's 13 irrigation districts are located in this basin.³

As well, the watershed supports about half the province's population. The bulk of the SSRB's stream flow, about 75% of the volume of the Oldman, Bow and Red Deer Rivers combined, originates in the Rocky Mountains' eastern

slopes. These flows arise as melt water from snow packs and glaciers, augmented by seasonal runoff. Thus, natural river flows are highest in spring and early summer, taper off in the fall, and remain low over the winter.

The combined watershed of the SSRB basins is 121,095 km², of which 41% is from the Red Deer sub-basin, 22% from the Oldman, 21% from the Bow, and 16% from the South Saskatchewan sub-basin. The mean annual discharge from the SSRB into Saskatchewan is 9,460,000 dam³ (cubic decametres), representing about 7% of Alberta's total river flow.⁴

The average contributions of each of the rivers to the total flow is 43% for the Bow River, 38% for the Oldman River, 18% for the Red Deer River, and 1% for the lower South Saskatchewan River (below the confluence of the Bow and Oldman Rivers).

Glaciers found in the mountainous headwaters of southern Alberta's rivers are important to the region's water cycle. While annual snowmelt and precipitation provides the bulk of stream flow in the spring and early summer, flow from melting glaciers also contributes and becomes more important in the late summer. Studies carried out in the headwaters of the Bow River Basin have indicated that melt water from glaciers generally contributes about 2.5% of the annual flow of the Bow River at Banff, but may be as high as 9% in dry years. In the late summer, the contribution can be as much as 40% of the flow in extremely dry years.

As in other parts of the world, the glaciers of the southern Canadian Rockies are retreating. In the period since the last cold period (the Little Ice Age of the second millennium), the shrinkage of these glaciers has been in the order of 25% to 75%. This trend has raised concerns about potential impacts on water supplies in the SAL region.

The upper cold water reaches of the South Saskatchewan river system contain mountain and lake whitefish and many kinds of trout: – bull, brook, brown, cutthroat, golden, lake, and rainbow. Downstream reaches contain northern pike, goldeye, mooneye, yellow perch, walleye, sauger, and lake sturgeon.

² Source: The State of Southern Alberta's Water Resources, Confronting Water Scarcity conference, 2004

³ Source: State Of the Environment, Aquatic Ecosystems, 1996

⁴ Source: Alberta Environment, <http://www3.gov.ab.ca/env/water/basins/basinform.cfm?basins=10>

►► Watersheds

The Red Deer River sub-basin, which includes portions of Foothills, Boreal Forest, Parkland and Grassland natural regions, contains the largest number of lakes and wetlands. The other sub-basins, situated (apart from their headwaters) primarily in the Grassland Natural Region, contain only a few natural lakes, including Tyrrell Lake near Lethbridge and Eagle Lake near Strathmore. Both these lakes and others in the Grassland Natural Region are shallow, saline, and high in nutrients.

These rivers and their tributaries are the only supply for most water needs in the Grassland Natural Region. Groundwater is in insufficient supply and often of poor quality. Heavy agricultural use takes place along the south flowing tributaries downstream from Finnegan. North flowing tributaries are used



as return flow channels for the irrigation districts. Towns and cities, such as Sundre, Red Deer, Drumheller, and Bindloss, use the Red Deer River for their water supply.⁵

Water allocation licences in the SSRB have been issued since 1894. Between 1894 and 1931, the Federal Government issued licences under the Northwest Irrigation Act. After 1931, licences were issued by the province. The legislation has supported four principles of allocation since 1894. These are:

- The Crown owns the water,
- Allocations are designed to promote development,
- Licences will be issued for allocations, and
- There will be a priority system for all allocation.

The 1999 Water Act confirmed these principles and instituted new approaches based on conservation and water management planning.

On August 30, 2006, the Government of Alberta announced a new water management plan for the SSRB. Alberta Environment will no longer accept new water licence applications for the Bow, Oldman, and South Saskatchewan sub-basins. Water allocations may still be obtained through water allocation transfers. The SSRB plan was developed to safeguard existing water user's supply while protecting the aquatic environment, as outlined in *Water for Life: Alberta's Strategy for Sustainability*. More information on *Water for Life* and the South Saskatchewan River Basin Water Management Plan is available at www.environment.gov.ab.ca.

⁵ Source: South Saskatchewan River Basin: Water Allocation, Alberta Environment, May 2003 (Revised January 2005) www3.gov.ab.ca/env/water/regions/ssrb/pdf_phase2/SSRBWaterAllocations_Jan2005.pdf, and Alberta State of the Environment, Aquatic Ecosystems, 1996

►► Watersheds

Table 1 shows the percentage of water currently allocated for different uses in the SSRB.

Table 1. SSRB Water Allocations

Water Use	% Used
Irrigation	74.58%
Agricultural	1.72%
Commercial	3.73%
Deadfish Sheerness	0.16%
Dewatering	1.25%
Habitat Enhancement	0.68%
Gas/Petrochemical Plants	0.01%
Oilfield Injection	0.91%
Management of Fish	0.31%
Management of Wildlife	<0.01%
Municipal	13.42%
Other Purposes	<0.01%
Recreation	0.28%
Registration	0.07%
Water Management	2.83%

OLDMAN RIVER BASIN

The Oldman River flows for 450 km, from its headwaters in the Rocky Mountains through rangelands in the foothills and eastward across the arid prairie. It is similar in size to the Bow River Basin, with an area of about 26,000 km², constituting nearly 24% of the total area of the SSRB. The basin includes three major tributaries – the St. Mary, Belly and Waterton Rivers. The Oldman River Dam, a major impoundment on the main stem, is located near Pincher Creek. The water supply diversion for the Lethbridge Northern Irrigation District is located upstream of Fort Macleod. One hundred and ninety kilometres downstream of the Oldman River Dam, the river flows through the City of Lethbridge. Between Lethbridge and the “Grand Forks”, the confluence of the Oldman and Bow Rivers, the river is warm and turbid.

BOW RIVER BASIN

The Bow River flows for about 625 km, from its headwaters in the Rocky Mountains to its confluence with the Oldman River. It constitutes nearly 23% of the total area of the SSRB, with a total area of about 25,000 km². Impoundments for hydroelectric generation are located in the upper reaches of the basin and just upstream of the City of Calgary. In its middle reaches, the river continues to be fast flowing, moving over a rocky substrate, but the flow is affected by development in and around the City of Calgary. In the middle of the urban area, the first major diversion for irrigation provides a water supply for the Western Irrigation District. The reach of river downstream of the city is highly productive, supporting a world-class sport fishery. The river continues to flow across the prairie landscape, with major diversions for irrigation water supplies at the Carseland weir, for the Bow River Irrigation District, and at the Bassano Dam, for the Eastern Irrigation District. The lowest reaches of the river are warm, shallow and eutrophic (nutrient enriched and oxygen poor).

RED DEER RIVER BASIN

From its headwaters in the Rocky Mountains, the Red Deer River flows 708 km to the Alberta-Saskatchewan border. With a watershed area of about 47,000 km², it constitutes more than 42% of the total area of the SSRB and is the largest of the three sub-basins. There is one major impoundment on the Red Deer River, the Dickson Dam near Innisfail. Completed in 1983, the dam provides a reliable, year-round water supply for industry and municipalities in the Red Deer River Basin. It also improves water quality, and increases Alberta’s ability to meet its apportionment agreement with Saskatchewan. There is little development in the upstream reaches, which are largely forested watershed. Below the Dickson Dam, the river flows through the City of Red Deer and is affected by municipal effluents. Farther downstream, the river receives inflows from the Medicine and Blindman Rivers, which carry natural organic materials from their headwaters and runoff from agricultural lands. The lowest reaches are slower moving and subject to high sediment loads from the badlands area.

▶▶ Watersheds

THE BATTLE RIVER BASIN

Located within the Parkland Natural Region, the Battle River Basin is a key watershed in east-central Alberta. It is a sub-basin of the North Saskatchewan River Basin.



Geographically, the basin covers approximately 30,000 km², with 25,000 km² within Alberta's borders. Rich and diverse in plant and animal life, the basin's water supply is derived entirely from local surface runoff (rain and snow melt) and from groundwater flows, without the benefit of the mountain/foothill snow packs and glacial melt that contribute to many of the other river basins in the SAL region.

Maintaining water quantity and quality in the Battle River Basin is an ongoing challenge given the river's low flow volumes, the natural conditions of the basin and the cumulative impact of municipal, industrial and agricultural activities.⁶

SOUNDING CREEK BASIN

The Sounding Creek Basin originates in headwaters south of the Town of Castor and flows for approximately 370 km. The total drainage area for the watershed area of Sounding Creek, including the area that drains directly to Sounding Lake, is 8220 km². The basin forms part of the

Special Areas Zone of the province and is considered to be water short. Land use within the basin is primarily agricultural grazing land for the production of cattle. The vegetation is predominantly in grasses. While the soils are widely classified as irrigable within the basin, the limited availability of water restricts irrigation to just a few backflow or surface irrigation projects.

THE MILK RIVER BASIN

The Milk River Basin is found in the southernmost part of the province. It is the smallest major river basin in the province, draining about 6500 km² in the arid Grassland Natural Region, or about 1% of the provincial land mass. This river basin is the most northerly part of the vast Missouri-Mississippi River Basin of the United States. It starts southeast of Cardston, where the Milk River enters Alberta from Montana, flows eastward across the prairie landscape for about 170 km, and then flows back into Montana south of Medicine Hat. In the lower reaches sediment load increases significantly due to erosion of unstable badland slopes. This gives the lower river its milky colour. The westernmost portion of the basin is extensively cultivated. Farther east, the major land use is cattle ranching and cattle feedlots are common.

Dryland crops predominate, with some irrigated crops also grown. The Cypress Hills occupy the northeast corner of the basin. With no cities and few towns, the basin has a population of fewer than 2500 people.

The amount of water allocated in the basin, 41 million metres³, is less than 1% of the total water allocation in the province. This water is used mostly for irrigation and to a lesser extent other agricultural uses. The Milk River's annual average flow is about 1,000 million cubic metres (100,000 dam³) when it enters Alberta, and about 160 million cubic metres (160,000 dam³) when it leaves the province.

LAKES AND RESERVOIRS

Lakes are scattered throughout the SAL region, ranging in surface area from tens of square kilometres to just a few hectares. The natural permanent lakes of the region formed in the large depressions and blocked waterways left by

⁶ Source: <http://www3.gov.ab.ca/env/water/regions/battle/>

►► Watersheds

the retreating ice sheets. They include Buffalo Lake, Pine Lake, Sylvan Lake, Bow Lake, Lake Louise, Crowsnest Lake and Waterton Lake. Man-made weirs maintain the water levels of some lakes including Little Fish Lake, Beauvais Lake, and Elkwater Lake in the Cypress Hills. Man-made diversions have raised water levels in others including Gull Lake, Namaka Lake and Reesor Lake.

Major onstream reservoirs in the SAL region include the Oldman Reservoir, the Ghost Reservoir and Glennifer Lake (formed by the Dickson Dam). Major offstream reservoirs include Lake McGregor, Lake Newell, Keho Reservoir, Travers Reservoir and the Chain Lakes. Onstream reservoirs are created when the flow of a major stream is blocked by the construction of a dam, creating a water storage area. Off-stream reservoirs are created when a structure is built across a minor stream or coulee to form a storage area for water diverted from outside its natural drainage basin.

IRRIGATION CANALS

Using their length and width as measures, irrigation canals occupy about 30 km² of the SAL region – about half the area occupied by natural streams. These canals are confined by steep banks lined with clay, gravel or cobbles, and in many cases plastic, to prevent losses of water through seepage. The main canals are generally about 10 metres wide and the smaller lateral canals average about 3 metres in width. River flows are diverted into irrigation canals during the growing season, from early May until late October, with flows fluctuating, depending on changing demands for water. Between October and May, the canals are dry except for natural rainfall and snowmelt. The canals are managed to ensure efficient water conveyance, including flushing of sediments and control of aquatic vegetation. As a result, they provide only marginal habitat for wildlife. Fish that are swept through the diversion structures and into canals generally do not survive.

SURFACE WATER ALLOCATIONS

The SAL region's water supplies are subject to both interprovincial and international agreements. Under a 1969 interprovincial agreement, Alberta is required to pass approximately 50% of the South Saskatchewan River Basin's natural flow to Saskatchewan and to ensure the departing flow meets certain water quality guidelines. About 55% to 75% of annual natural discharge will typically be deliv-



ered to Saskatchewan on an annual basis. An increase in frequency of flows in the lower range is expected due to increasing utilization of existing licences and additional allocation from the Red Deer River in the future. In wet years volumes in excess of 80% will continue to be passed to Saskatchewan.

Alberta remains committed to meeting all of its apportionment obligations to Saskatchewan. A committee is being formed that will include representatives of each Alberta SSRB sub-basin to advise on measures to meet Alberta's needs in dry years and respect apportionment.

Similarly, apportionment agreements between Canada and the United States (the Boundary Waters Treaty of 1909 and the Order of the International Joint Commission in 1921) entitle Canada to 50% of the natural flow of the Milk River during the winter. From April to October, Canada is entitled to 25%.

The Government of Alberta owns the rights to all waters within its borders and allows water to be diverted and used by licence holders. It allocates these licences on a first-in-time, first-in-right basis, which means that in times of shortage, the older the license, the higher its priority for receiving water, regardless of the purpose for which the water was allocated. Some licences date back to 1894, when water resources were controlled by the federal government.

▶▶ Watersheds

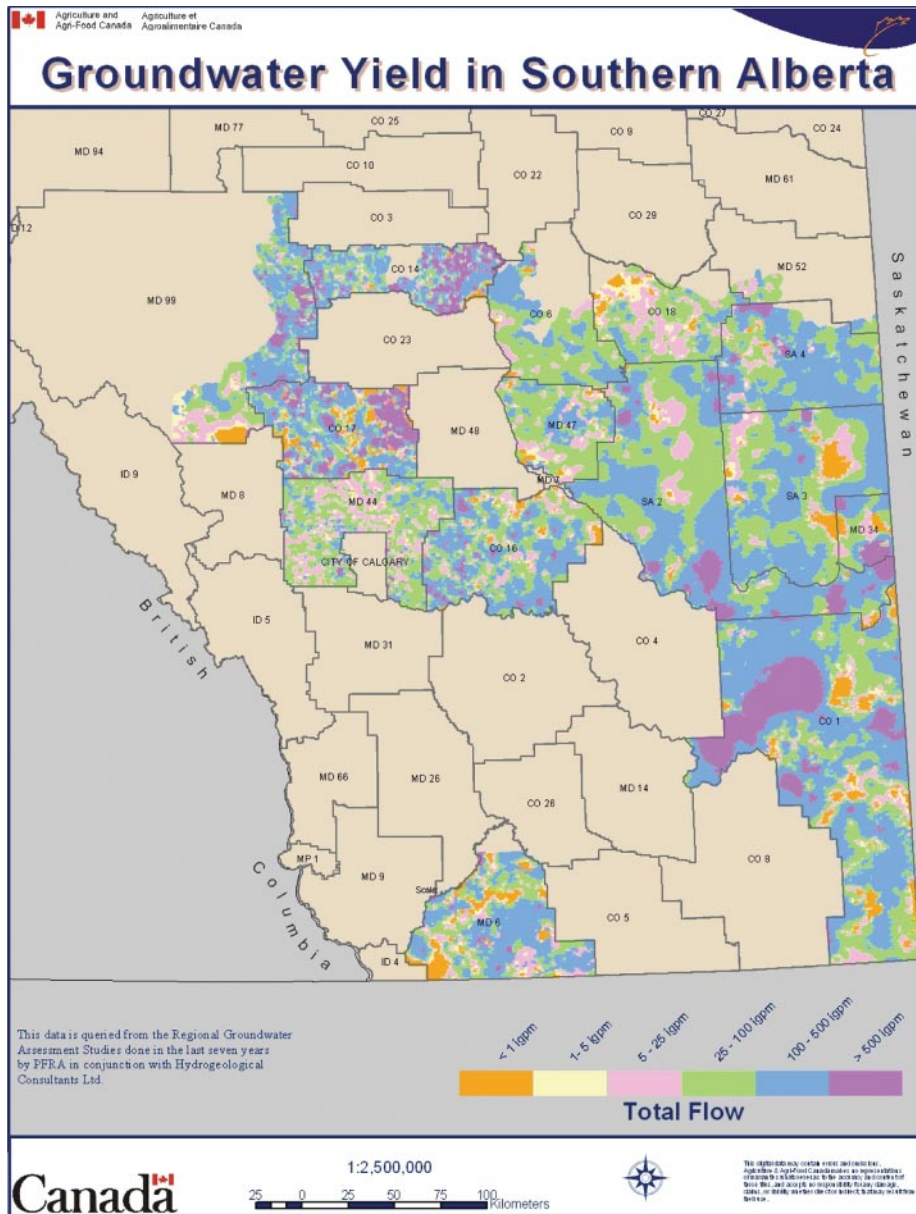


Figure 7. Groundwater Yield in Southern Alberta

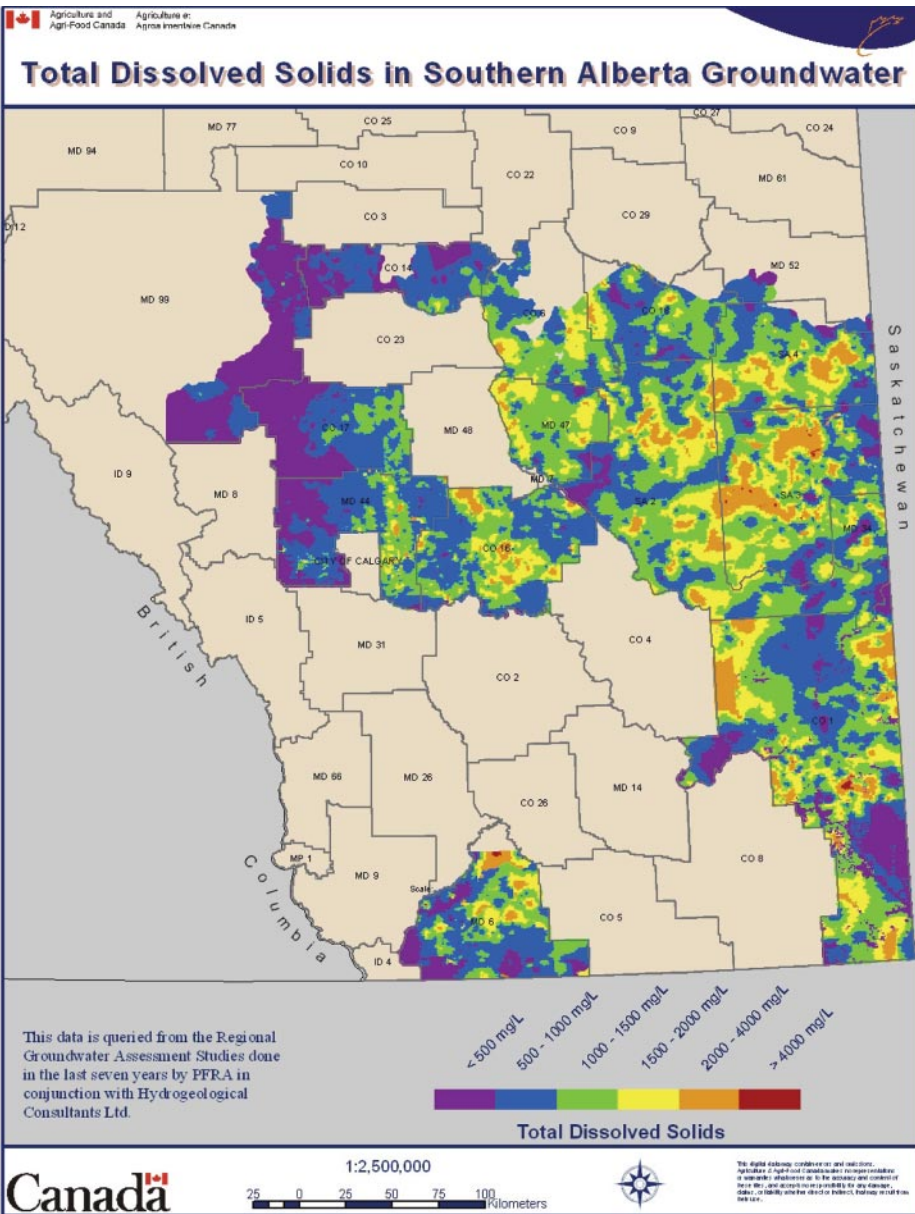


Figure 8. Total Dissolved Solids in Southern Alberta Groundwater

►► Watersheds

There are approximately 20,000 licences and registrations in the SSRB, accounting for 61% of all the water allocated in Alberta. In the SSRB, irrigation accounts for 75% of the allocation volume (more than 3.8 million dam³ of water), followed by municipalities (13%), industry (3.7%) and other agricultural uses (1.7%). A total of approximately 600,000 hectares of land in SAL are irrigated.⁷

GROUNDWATER RESOURCES

Groundwater is water in the pore spaces in subsurface sediments and rocks. Aquifers are subsurface layers, such as sand, gravel and sandstone, in which groundwater is plentiful enough to be used as a water supply. Aquitards are sediments such as clay, shale and deep clay-rich glacial till, through which groundwater moves so slowly it cannot be used as a water supply.

Farm acres on which commercial pesticides and fertilizers are used have almost tripled in Alberta in the last 25 years, and cattle numbers increased by



25% between 1991 and 1996. As agriculture becomes more intense, incidences of agricultural contamination of groundwater are increasing. The influence of irrigated agriculture on groundwater quality in Alberta was assessed by several studies conducted by Alberta Agriculture, Food and Rural Development in the 1990s. The results indicate a high potential for contamination of shallow aquifers in areas with intensive agriculture.

Shallow groundwater is used by many farm families, and is therefore a valuable resource that requires protection. Once aquifers become contaminated, remediation is extremely difficult and expensive. In addition, discharge of contaminated shallow groundwater that occurs either naturally or through subsurface tile drain effluent can add significant amounts of contamination to surface water. Finally, contaminants in shallow groundwater may leach to deeper groundwater over long periods of time.

From the early 1970s to the early 1980s, the Alberta Research Council (ARC) systematically mapped the groundwater resources in Alberta.

Since 1996, Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration (AAFC-PFRA) has been partnering with municipalities to map their groundwater resource at a regional scale. These new studies are based on additional water well data that has been accumulated by Alberta Environment since the 1980s. Figure 7 is a mosaic of the groundwater yield for 17 municipalities from 14 of those reports. Figure 8 shows groundwater quality with regard to Total Dissolved Solids only. Mapping of groundwater in the SAL region is not complete.

Even if these groundwater supplies have adequate yields for a particular use, they may not have the water quality required. Many groundwater supplies in southern Alberta are high in salt, due to natural sources in sediment. Hence, most groundwater supplies in the SAL region are not suitable for irrigation because excess salinity (total salt content) and sodicity (sodium) in irrigation water can reduce crop productivity.⁸

⁷ State of Alberta's Water Resources, 2004 and Alberta Agriculture, Food and Rural Development, Irrigation Branch, Lethbridge, June 1, 2005. 496,000 hectares are irrigated through the thirteen irrigation districts in southern Alberta, and 110,000 ha are privately irrigated.

⁸ Agricultural Impacts on Groundwater Quality in the Irrigated Areas of Alberta, Alberta Agriculture, Food and Rural Development [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/irr4452?opendocument](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr4452?opendocument)

▶▶ Watersheds



Groundwater quality is best represented regionally by Total Dissolved Solids (TDS), which is a measure of the relative mineral content of the water. Canadian guidelines set an aesthetic level for TDS at 500 milligrams per litre (mg/L). However, many wells in Alberta produce safe, potable water in the 500 – 1000 TDS range and even the best water quality in any given area tends to be above 500 TDS. As Figure 8 shows, there is a general water quality trend from west to east, with better quality in the west and poorer quality in the east. The most significant areas to note are those that are coloured yellow and orange. As with the yield maps, however, these are regional trends and local conditions may differ, for better or for worse.

GROUNDWATER YIELD

Figure 7 indicates the cumulative 20-year safe yield of all aquifers occurring to a depth of 500 feet. It shows the amount of water that can be safely withdrawn, in a given area, if all available aquifers are utilized.

Typically, groundwater use can be divided into two categories, domestic (or low) use and higher use required by farming or industry. Daily domestic use normally averages about 1.1 m³/day (This is equivalent to 240 imperial gallons per day, the value used on the Groundwater Yield map, Figure 7). In reality, to

keep up with peak daily demands, yields greater than 6m³ of water per day are usually required for domestic use. Any demand for groundwater in addition to domestic use is likely to require much greater yields.

The Groundwater Yield Map shows lower yield levels occurring mostly in the east and south regions, with areas of higher yield throughout. There is also a region with generally higher yields in the Lacombe/ Red Deer area.

WATER QUALITY⁹

The SAL region is characterized by low water flows relative to population pressures. The major areas of concern are:

- Increases in total loadings of such solids as nitrogen, phosphorus and sediments,
- Non-point source loadings from agriculture, including manure,
- Regulation of point source loadings, and
- Safety of drinking water.

Water quality measurements in the SAL project documents are represented as an index that simulates relative change based on:

- Export of nutrients and sediment from landscape types (vegetative) and footprints (mostly non-vegetated) in kilograms per hectare per year (kg/ha/yr), and
- Total amount of water in the system.

The Alberta Water Quality Index includes measures of bacteria, metals, pesticides and nutrients.

OLDMAN RIVER WATER QUALITY

Water quality in the Oldman River Basin has improved downstream of Lethbridge since 1999, as a result of upgraded municipal wastewater treatment. The Alberta Surface Water Quality index rates water quality near Bocket, upstream of Lethbridge, as excellent, or “best” quality. Upstream of Lethbridge at Highway 3 and downstream of Lethbridge at Highway 36, water quality is rated good, though guidelines are occasionally exceeded, usually by

⁹ Source: Alberta Environment, 2005

▶▶ Watersheds

small amounts. Pesticide detections were slightly higher downstream in 2003/04. Water quality during very high river flows, such as those experienced in 2002/03 and again in 2005, show elevated nutrient and bacteria values when measured during late spring when there is increased runoff and non-point source loading.

In Reporting Year 2003/04, the Alberta Water Quality Index near Brocket was 100; upstream of Lethbridge it was 90, and downstream 89.

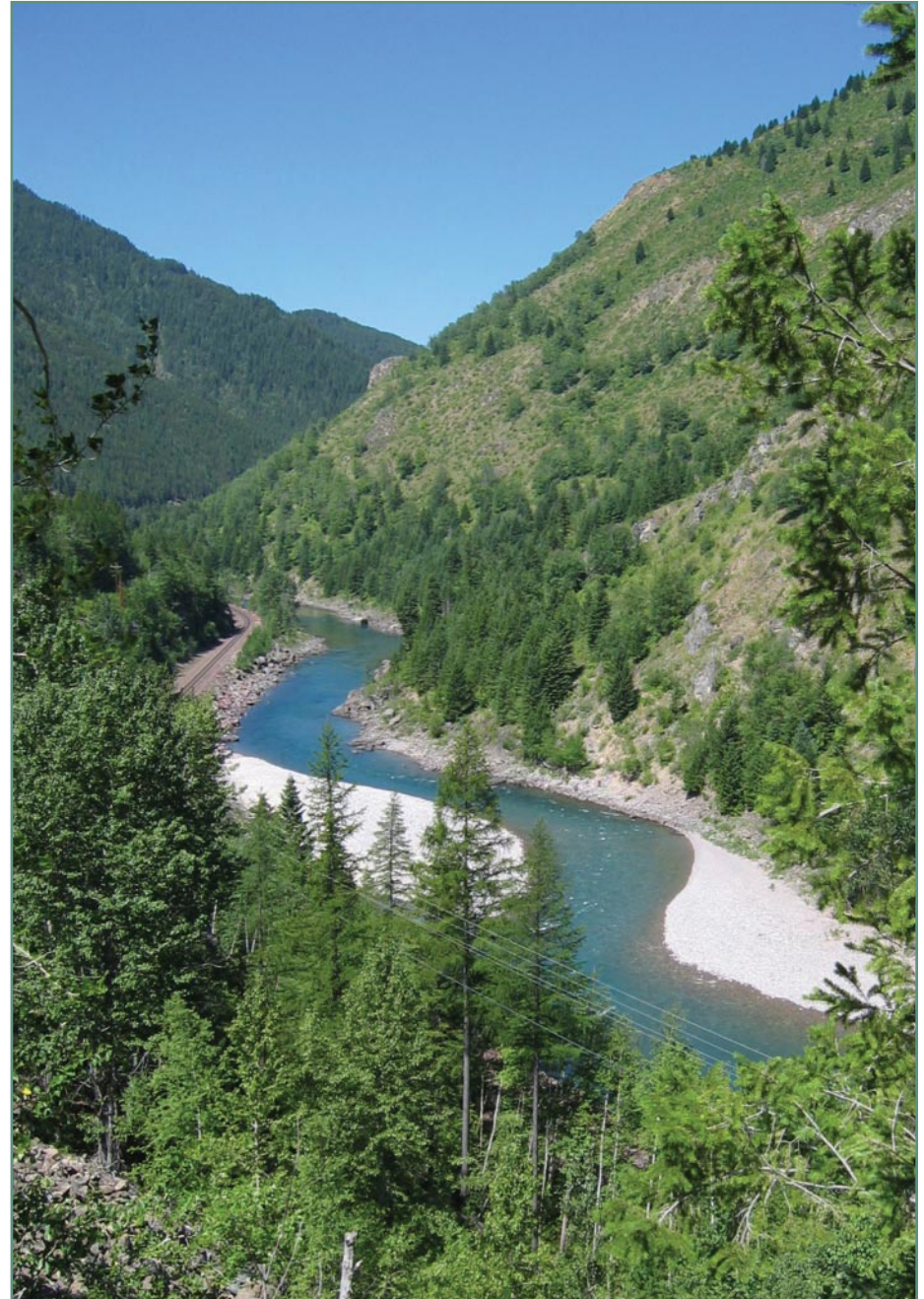
Water quality measured at Cochrane, upstream of Calgary, is better than downstream. Upgraded municipal wastewater treatment, including full disinfection (1997), has resulted in improved conditions downstream. The pesticide index is also slightly lower downstream. A slight decrease in the upstream index in reporting period 2003/04 is due to increased spring nutrient concentrations; a similar downstream decrease reflects a small increase in pesticide detections and spring bacteria values.

In Reporting Year 2003/04, the Alberta Water Quality Index upstream of Calgary near Cochrane was 98 (excellent) and downstream of Calgary at Carseland was 90 (good).

RED DEER RIVER WATER QUALITY

Water quality is slightly better upstream of Red Deer, relative to downstream site measurements. However, upgraded wastewater treatment installed in 1999-2000 has resulted in generally improved downstream conditions.

In Reporting Year 2003/04, the Alberta Water Quality Index upstream of Red Deer, at Fort Normandeau, was 94 (good); at the downstream site at Morrin Bridge the index was 89. The slight decrease in the index compared to the previous year was the result of higher nutrient and metal concentrations during spring run-off, and, at the downstream site, to slightly more frequent pesticide detections.



▶▶ Airsheds



Airsheds are geographic areas that, because of emissions, topography and meteorology, typically experience similar air quality. Air quality is important to Albertans and is an integral part of the southern Alberta landscape.

Air quality is a measure of how clean the air is. Substances such as carbon monoxide, ozone, sulphur dioxide and hydrogen sulphide are considered to be air pollutants when concentrations in the air are high enough to cause adverse effects. A number of natural and anthropogenic sources release substances to the air. When they accumulate in the atmosphere, air quality is reduced and both human and ecosystem health can be affected.

In Alberta, the Air Quality Index is used to measure general air quality. This index associates concentrations of five major air pollutants to provincial air quality objectives and federal air quality objectives. Concentrations of carbon monoxide, nitrogen dioxide, ozone, sulphur dioxide and fine particulate matter are used to determine whether the quality of the air is Good, Fair, Poor, or Very Poor. Figure 9 shows long-term air quality trends in the major population centres within the SAL area, where data is available.

HISTORY

Over the past two decades, there have been a number of improvements in air quality control and monitoring technologies. These improved technologies have led to improvements in air quality, especially in urban centres. In fact, levels of many air pollutants have shown significant declines, as reported by the Clean Air Strategic Alliance.

For example, in downtown Calgary, from the early 1980s to the year 2000, carbon monoxide concentrations have decreased by 65%, nitrogen dioxide levels have decreased by 38%, lead concentrations have decreased by 98%, and inhalable particulate values have decreased by 46%. Inhalable particles refer to those capable of entering the human respiratory tract.

Figures 10-13 show annual average concentrations for carbon monoxide, ozone, sulphur dioxide, and hydrogen sulphide. The accumulation of pollutants, no matter the source, depends on the rate at which they are emitted into the atmosphere and how quickly they are dispersed. The dispersion of pollutants is influenced by wind, temperature, turbulence, and the changes in these factors caused by local topography.

AIRSHED ZONES

In Alberta, air quality is now monitored and managed by the Clean Air Strategic Alliance (CASA). CASA was established in March 1994 as a way to manage air quality issues in Alberta. It is a multi-stakeholder partnership, composed of representatives selected by industry, government and non-government organizations.

CASA is responsible for strategic planning related to province-wide air quality issues in Alberta. To guide this process, CASA has endorsed a Comprehensive Air Quality Management System (CAMS) for the province. CAMS promotes the locally-driven establishment of airshed zones to address local air quality issues, when and where appropriate.

¹ Source:<http://www3.gov.ab.ca/env/air/Info/aboutaq.html>

▶▶ Airsheds



Airshed zones are guided by local or regional multi-stakeholder non-profit societies who use the CASA consensus model to make decisions. These societies work within a designated area to monitor, analyze, and report on air quality and to recommend and implement actions to improve air quality within that zone. Stakeholders involved in airshed zone management may also develop a response plan to deal with air quality concerns in their region. Airshed zones typically implement air quality monitoring programs within their designated area and supply data to the CASA data warehouse.

There are seven airshed zones now operating in Alberta. Thus far, two airshed zones are operating in the SAL region – the Parkland Airshed Management Zone and the Palliser Airshed Society. A new zone is being formed in the Calgary-Bow Valley region, called the Calgary Regional Airshed Zone (CRAZ) (See Figure 14).²

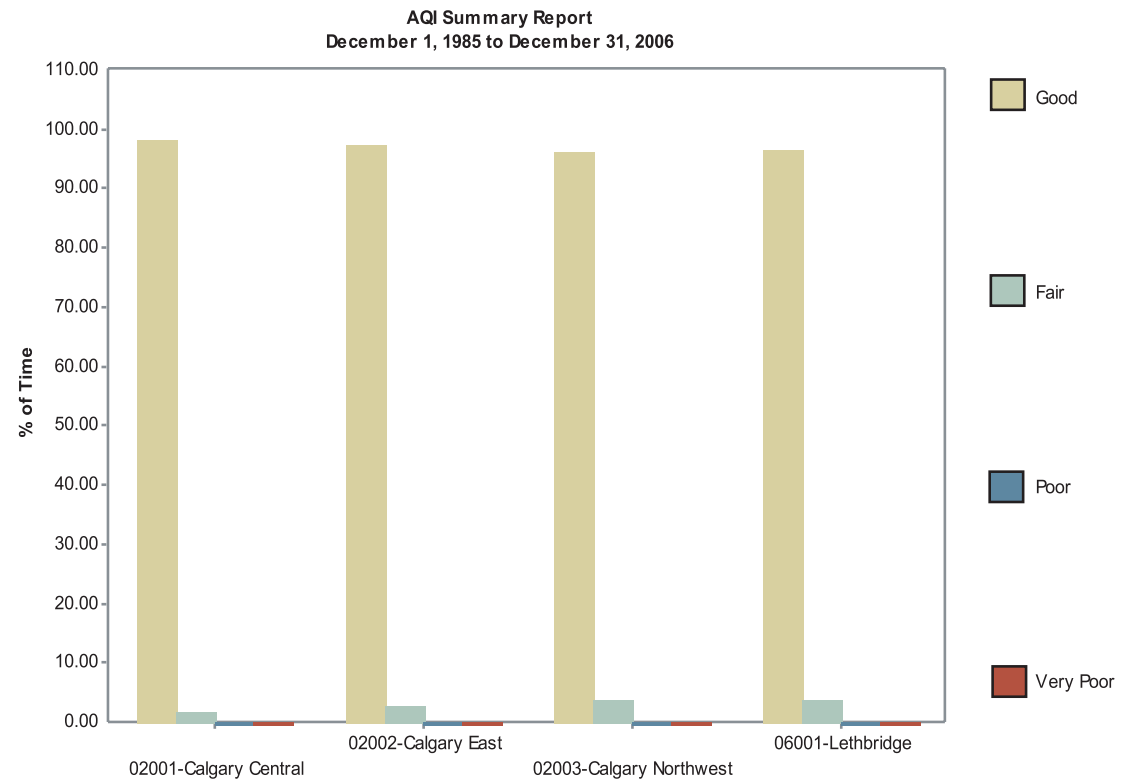


Figure 9. Long Term Trends in Air Quality

² Sources: http://www.casahome.org/airshed_zones/index.asp, <http://casadata.org/zones/index.asp>, <http://www.palliserairshed.ca/>

►► Airsheds

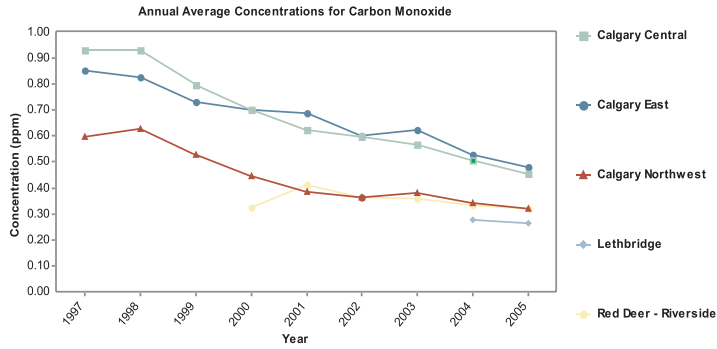


Figure 10. Average Annual Concentrations for Carbon Monoxide

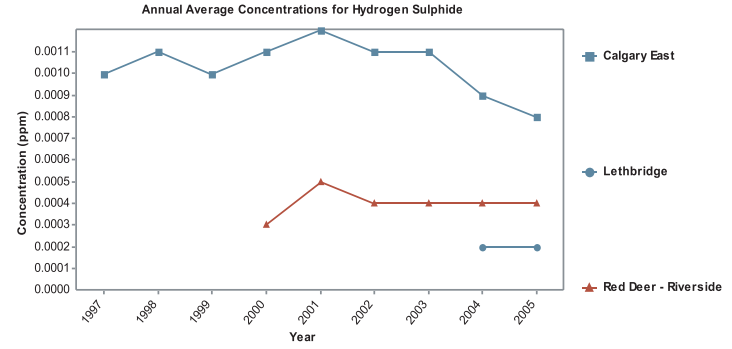


Figure 13. Average Annual Concentrations for Hydrogen Sulphide

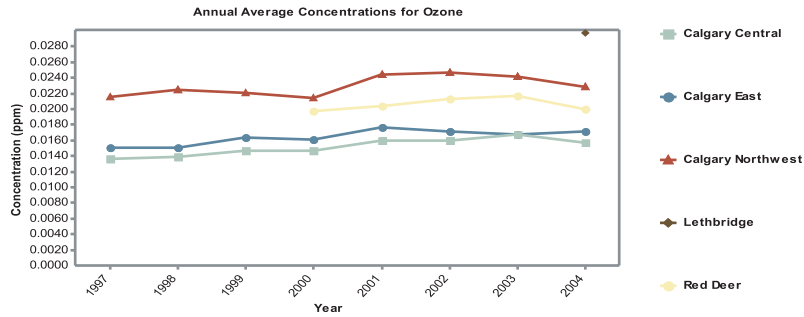


Figure 11. Average Annual Concentrations for Ozone

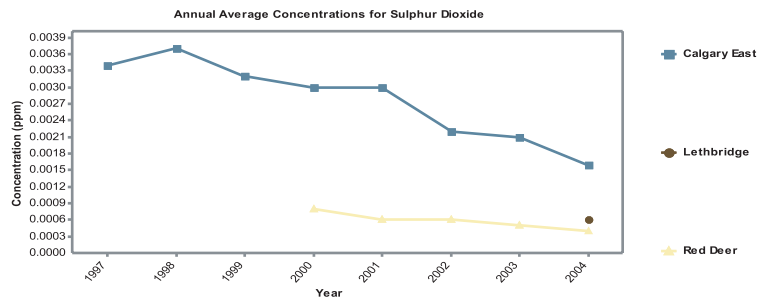


Figure 12. Average Annual Concentrations for Sulphur Dioxide

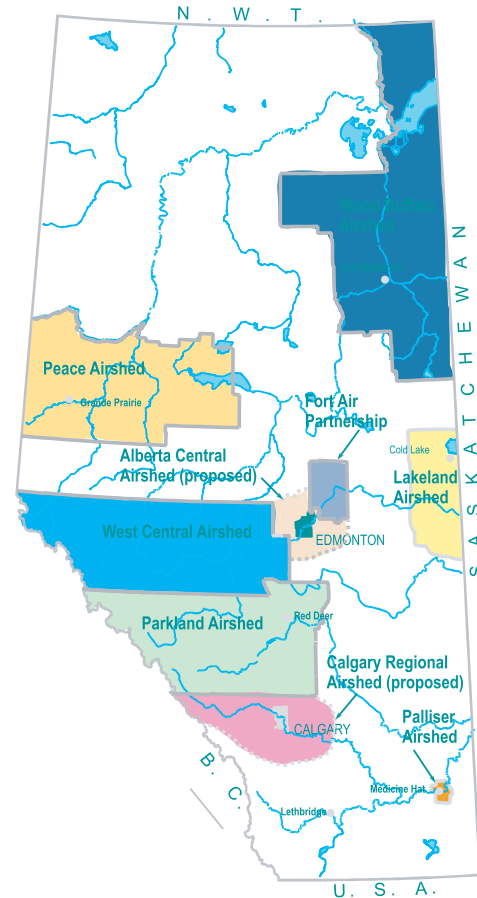


Figure 14. Alberta's Airshed Zones - 2006

►► Biodiversity and Species at Risk

Biodiversity refers to the variety of species and ecosystems and the ecological processes of which they are a part. Human economies are tied to the sustainable development of biodiverse resources. Shifts in biodiversity, caused by natural processes like fire and flooding, or by human activities, can alter the resource base of regional economies. In December 1992, with the support of the provinces and territories, the government of Canada ratified the United Nations Convention on Biological Diversity (also known as the Rio Convention). As required by the Convention, Canada developed the Canadian Biodiversity Strategy (CBS) to guide the conservation of Canada's biodiversity and the sustainable use of biological resources. The Alberta government participated in the development of the CBS and signed a Statement of Commitment supporting the strategy in November 1995.

In order to develop sound biodiversity conservation and sustainable use strategies, the CBS stresses the need to understand the current status of species and their populations, as well as population trends, and the causes of population and species change. The strategy recognizes existing constitutional and legislative responsibilities for biodiversity and incorporates the five major goals of the CBS:

1. To conserve biodiversity and use biological resources in a sustainable manner. Government of Alberta initiatives under this goal include the Special Places policy, the Alberta Forest Conservation Strategy, the Prairie Conservation Action Plan, the Fish Conservation Strategy, the Clean Air Strategic Alliance, the Sustainable Communities Initiative, and a variety of species management plans for threatened or endangered species.
2. To improve our understanding of ecosystems and increase our resource management capability. Initiatives under this goal include research through the Foothills Model Forest, monitoring and inventory programs which contribute to databases such as the Alberta Natural Heritage Information Centres and the Biological Species/Observation Database, Status of Wildlife reports, and a variety of integrated resource management processes.
3. To promote an understanding of the need to conserve biodiversity and use biological resources in a sustainable manner. Government of Alberta initiatives under this goal include annual State of the Environment reports,

Fact Sheets and educational programs and activities for teachers, students, ranchers, farmers and land managers.

4. To maintain or develop incentives and legislation which support the conservation of biodiversity and the sustainable use of biological resources. Legislative frameworks that support this goal include the enhanced Wildlife Act, the Water for Life strategy, the Landuse Framework currently being developed, protected areas legislation, and the creation of legislation to allow for conservation easements.
5. To work with other countries to conserve biodiversity, use biological resources in a sustainable manner and share equitably the benefits that arise from the utilization of genetic resources. Government of Alberta initiatives under this goal include partnership in the North American Waterfowl Management Plan, the protection of four internationally important wetlands, and the Crown of the Continent partnership between Alberta, Montana and British Columbia.¹

The need for a comprehensive, provincial biodiversity monitoring program has resulted in the development of the Alberta Biodiversity Monitoring Program (ABMP). The program involves government, research institutions, academia and industry and is a three phase project: technical design (1998 – 2002), testing and refinement (2002 – 2006) and implementation (2007 – ongoing).

A prototype project will run until Spring of 2007, when full implementation of the ABMP will take place. The objectives of the Prototype Project are to:

- Conduct field work;
- Develop remote sensing protocols for the ABMP;
- Develop cost effective aquatic protocols;
- Finalize all protocols to acceptable cost effective standards;
- Develop a basic data management system and populate it with field data;
- Develop biodiversity indices;
- Develop a range of products and services the program will deliver, and;
- Develop the business plan, governance structure and long-term funding model.

¹ Source: Sustaining Alberta's Biodiversity: An Overview of Government of Alberta Initiatives Supporting the Canadian Biodiversity Strategy. Alberta Environment. 1997.

►► Biodiversity and Species at Risk

Few places in the world have as great a diversity of wildlife as Alberta. The province boasts:

10 species of amphibians	95 species of mammals
402 species of birds	8 species of reptiles
3500 species of plants and fungi	63 species of fish

Watercourses and adjacent riparian areas occupy only 2% of Alberta's surface area, yet are home to 80% of the province's wildlife species. However, the region's population growth and thriving resource-based economy are putting pressure on the sustainability of its natural capital.

HISTORICAL OVERVIEW

The biological diversity and sheer numbers of animals in southern Alberta during pre-settlement times is legendary. Massive herds of bison roamed the land and populations of grizzly bear and wolf were extensive. The western prairies of North America are estimated to have supported between 30 and 60 million bison, based on a carrying capacity of nine bison per km.²

First Nations people have been a prominent part of the southern Alberta landscape for thousands of years. Their traditional way of life relied upon the natural resources available to them in the form of plants and animals. Natural factors of climate, grazing and fire were major components in shaping the landscape.

These rich biological assets, as well as other resources, prompted European exploration in the 1700s. Large grazing leases were issued in the late 1800s, and partly as a result, bison were extirpated by 1880.

Important dates related to biodiversity since Alberta became a province in 1905 include:

1905: Hunting was regulated.

1930: The Natural Resources Transfer Act transferred ownership and management responsibility of most resources to the province.



early 1960s: Alberta Fish and Wildlife was created. The first biologists were hired, with an early emphasis on enforcement.

1970s - 1980s: Land use issues prompted an emphasis on habitat protection.

1989: The first Prairie Conservation Action Plan is developed by the World Wildlife Fund, in cooperation with the prairie provinces.

1990s: Alberta Environment developed an overview of Government of Alberta initiatives supporting the Canadian Biodiversity Strategy.

1995: Alberta's Special Places program, an initiative to complete a network of protected areas to preserve the province's environmental diversity, was begun with the designation of 29 new protected areas.

2003: Alberta Sustainable Resource Development launched the creation of a provincial biodiversity strategy.

2006: The third Alberta Prairie Conservation Action Plan was launched by the Prairie Conservation Forum, with a vision to conserve the biological diversity of native prairie and parkland ecosystems in Alberta, for the benefit of current and future generations.

² Source: How Many Bison Originally Populated Western Rangelands? James H. Shaw, http://www.bisoncentre.com/resources/bce170/bce170_how_many_bison.html

►► Biodiversity and Species at Risk

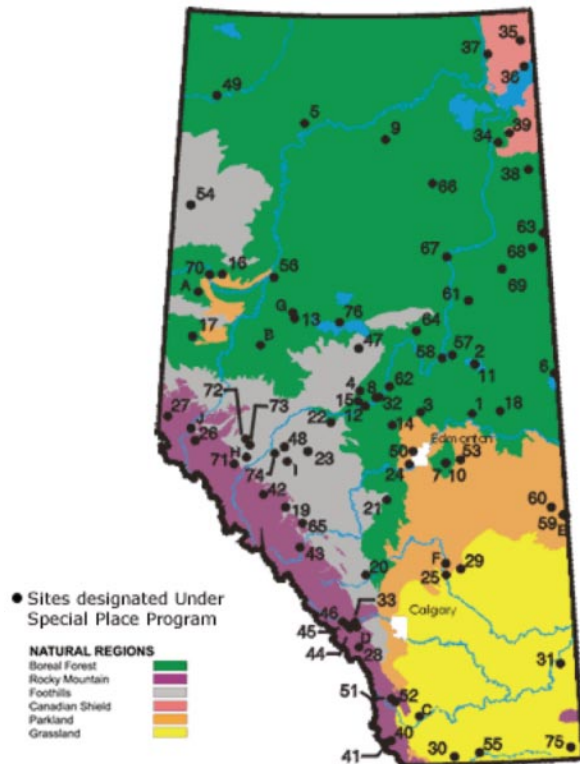


Figure 15. Sites Designated Under Special Places Program

SPECIAL PLACES IN THE SAL REGION

Through Alberta's Special Places program, concluded in July 2001, a total of 20 sites added almost 300,000 hectares to the SAL region's protected areas land base (see www3.gov.ab.ca/env/parks/sp_places/ for more information).

Table 2. Special Places Sites in SAL Area by Natural Region

# on Map	Name of Site	Designation Date	Natural Region	Area (ha)
Parkland Natural Region				
25	Tolman Badlands HR	Oct 4/00	Parkland	3,700
F	Dry Island Buffalo Jump Expansion PP	Oct 4/00	Parkland	419
29	Rumsey NA	Aug 21/96	Parkland	492
Grassland Natural Region				
31	Prairie Coulees NA	Jan 27/97	Grassland	1,788
30	Ross Lake NA	Aug 21/96	Grassland	1,943
C	Head-Smashed-In Expansion PHR	Nov 21/98	Grassland	728
55	Twin River HR	Nov 15/99	Grassland	19,027
29 con't	Rumsey NA	Aug 21/96	Parkland	14,430
25 con't	Tolman Badlands HR	Oct 4/00	Grassland	2,200
75	Onefour HR	Dec 20/00	Grassland	11,165
Rocky Mountain Natural Region				
28	Elbow-Sheep WP	Jan 1/96	Rocky Mountain	79,998
33	Yamnuska NA	May 7/97	Rocky Mountain	1,582
40	Castle Special Management Area FLUZ	Mar 18/98	Rocky Mountain	104,103
41	West Castle Wetlands ER	Aug 26/98	Rocky Mountain	94
44	Bow Valley WP	Dec 9/98	Rocky Mountain	24,576
45	Bow Flats NA	Dec 9/98	Rocky Mountain	1,347
46	Canmore Nordic Centre PP	Dec 9/98	Rocky Mountain	435
51	Bob Creek WP	May 11/99	Rocky Mountain	21,291
52	Black Creek HR	May 11/99	Rocky Mountain	7,350
D	Bow Valley Expansion PP	May 18/99	Rocky Mountain	1,925

HR = Heritage Rangelands
PP = Provincial Park
NA = Natural Area

PHR = Provincial Heritage
WP = Wilderness Park
ER=Ecological Reserve

►► Biodiversity and Species at Risk

SPECIES AT RISK IN THE SAL REGION

The Canadian Species at Risk Act defines species at risk to be those being extirpated, endangered, threatened, or of special concern.³

Though species status differs across the province at the regional level, 61% of native prairie in Alberta's Grassland Natural Region has been lost. Grasslands are considered one of the most threatened natural regions on earth and represent Alberta's endangered species hotspot.

Economists are increasingly recognizing biodiversity as a form of "natural capital" in the sense that it is a stock of resources that produces a supply of goods and benefits. Production from biodiversity takes the form of conventional economic components such as timber and tourism, as well as ecosystem services such as soil fertility, water quality and carbon dioxide sequestration.⁴

From an aesthetic perspective, there are also high public expectations for conservation.

The status of most species in the SAL region is healthy, although there are growing numbers at risk. More than 75% of Alberta's species at risk are in the southeast part of the region.

Reasons for species loss include:

- The land base to support wildlife is diminishing; more than 80% of parklands/grasslands has been lost to fragmentation.
- A high percentage of land is under private ownership, making it more difficult to manage wildlife.
- Habitat for the native grassland vertebrate community is currently at 50% of the pre-settlement area, and slowly declining.
- Habitat for birds that flourish in areas of human activity (the anthropogenic bird community) is currently at 300% of pre-settlement area, and slowly increasing.

- The quantity and quality of habitat of individual species has declined by 80 – 95%.
- Wildlife diseases, often introduced by alien species, can destroy or debilitate significant populations of native wildlife.
- Wildlife-human conflicts are increasing with population growth and land fragmentation.

The species at risk, their habitats and the threats to their survival are described here. Virtually all of the threats to species in the SAL region are the result of anthropogenic activity.



Figures 16 – 19 show how native populations of birds such as Sprague's Pipit, Loggerhead Shrike and Sharp-tailed Grouse are declining as a result of human activity, while the American Robin, which thrives in areas of human settlement, is on the increase.

³ Source: Environment Canada www.pnr-rpn.ec.gc.ca/nature/endspecies/sar/db08s01.en.html

⁴ Source: Maintaining Alberta's Natural Advantage: Proposal for a Provincial Biodiversity Strategy. ASRD. December 15, 2003. Unpublished.