Saskatchewan's

2011 State of the Environment Report

The Honourable
Dustin Duncan
Minister of Environment

Minister's Message

On behalf of the Ministry of Environment, I am pleased to present Saskatchewan's *2011 State of the Environment Report*, the province's eleventh such report. Since the first report in 1991, state of the environment reporting in Saskatchewan has evolved. The fundamental objective, however, has remained the same: to improve our understanding of the environment, to monitor its health, and to inform actions for better management and protection. I am confident that this report fulfills this objective.

Saskatchewan's *2011 State of the Environment Report* has adopted a framework of environmental themes and selected key indicators to assess and report on the environment. This report is structured around five major themes: Air, Climate, Land, Forest, and Water. Within these five themes are 17 diverse environmental indicators that provide a broad overview of the condition and trends of Saskatchewan's natural environment, as well as highlighting actions being taken to address environmental challenges.

This report also features something new: "snapshots" of local responses to some of these challenges. These snapshots highlight some of the positive actions taken by industry, business, communities, organizations and the public to improve the state of the environment. Future reports will include more of these stories, to recognize these environmental leaders and, hopefully, to inspire others to follow their example.

As the Ministry of Environment moves forward in adopting a results-based regulatory approach, industry will be responsible for achieving desired environmental outcomes.

An important part of a results-based system, built on a foundation of innovation and accountability, is measuring the results and identifying opportunities for improvement. State of the environment reporting – assessing the condition of the environment and the pressures acting upon it – is an important tool in a results-based approach.

Protection of the natural environment is an investment in an indispensible infrastructure that supports ecosystem and economic health, both essential for human wellbeing. This report reflects the government's ongoing commitment to continually improving environmental protection and sustainable resource management in Saskatchewan.

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State of the Environment Reporting in Saskatchewan

Introduction

This is the eleventh State of the Environment report for Saskatchewan; the first was published in 1991. Progressive reports since 1991 (Table A) have focused and reported on the condition and trend of various key components of the environment from both a regional and provincial perspective. The Saskatchewan *2011 State of Environment Report* identifies the status and key trends for five environmental themes:

AIR | CLIMATE | LAND | FOREST | WATER

Table A - Historical Perspective of State of the Environment Reporting in Saskatchewan

Year	State of the Environment Report	Focus
1991	State of the Environment Report	Broad picture of the condition of the environment and areas of concern
1993	The Need for Environmental Indicators	'Concept' document
1995	The Boreal Plain Ecozone: A Forest Community	Describes current environmental trends, conditions and emerging issues from a regional 'Ecozone' perspective
1997	The Prairie Ecozone: Our Agricutlural Heartland	
1999	The Boreal Shield Ecozone: A Land of Lakes and Forests	
2001	The Taiga Shield Ecozone: Land of the Caribou	
2003	A Provincial Perspective	Provincial overview of previous four reports
2005	State of the Environment Report	Assesses the state of selected environmental components
2007	State of the Watershed Report	Assesses watershed health
2009	State of Saskatchewan's Provincial Forests	Assesses how well forest values are being sustained

Note: Reports listed fulfill the Government of Saskatchewan's legislated commitment to report on the state of the environment every two years.

Background

We have become increasingly aware of our fundamental dependency on ecosystem services for quality air, land, water, food and other resources, and our impact through the pressures of resource use and the emission of pollutants to air, land and water. State of the environment reporting is an internationally accepted approach to assess and improve our understanding of the environment, to monitor its health, and to inform actions for better management.

The *2011 State of the Environment Report* provides timely and accessible information about the condition of Saskatchewan's environment and pressures acting upon it. The purpose of this information is to raise awareness and understanding of the environment, identify emerging issues and trends, and to highlight the actions needed by the public, First Nations and Métis, industry, business, government and non-government organizations to improve the way we use and manage the environment.

Saskatchewan legislation mandates the preparation and tabling of a provincial State of the Environment report every two years as required by *The State of the Environment Report Act, 1990* and, when proclaimed, *The Environmental Management and Protection Act, 2010*. In addition to state of the environment reporting, both the Saskatchewan Ministry of Environment and Saskatchewan Watershed Authority also produce annual plans and reports in which various performance indicators are highlighted and tracked (Saskatchewan Ministry of Environment 2011, Saskatchewan Watershed Authority 2011).

Reporting Framework

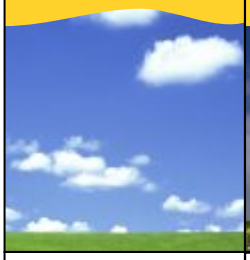
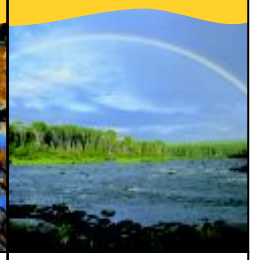
The Saskatchewan *2011 State of the Environment Report* has adopted a framework of environmental themes and selected key indicators to assess and report on the environment. This report is organized around five major themes: Air, Climate, Land, Forest, and Water (Figure A). Reported within these five themes are 17 core environmental indicators that provide a broad overview of the condition and trends of Saskatchewan's natural environment.

As with previous Saskatchewan State of the Environment reports, the 'Condition-Stressor-Response' model forms the basis for reporting. 'Condition' (or state) refers to the quality of the environment and the functioning of important environmental processes. 'Stressor' (or pressure) refers to human activities that affect the environment. 'Response' (or actions) refers to initiatives to address pressures on the environment or to improve or maintain its condition.

The selected 17 indicators, identified within the five themes, together form a core set of diagnostic statistics within the 'Condition-Stress-Response' model. In this model:

- Condition indicators are used to illustrate the environmental state at any point in time or as a trend.
- Stressor indicators measure human activities that affect or impact the condition of the environment.
- Response indicators represent the management programs and planning activities implemented to improve the condition or state of the environment and to mitigate the stresses. Response indicators measure the success (or outcomes) of management actions or strategies.

Figure A - 2011 State of the Environment Framework - Themes and Indicators

AIR	CLIMATE	LAND	FOREST	WATER
				
Air Pollutant Concentration	Greenhouse Gas Emissions	Agricultural Land Cover	Forest Type and Age Class	Surface Water Quality
		Mineral Disposition Activity	Forest Wildfire Disturbance	
Air Pollutant Volume		Area Under Zero-tillage	Forest Insect and Disease Disturbance	Surface Water Quantity
		Private Land Stewardship	Proportion of Sustainable Harvest Level Utilized	
Air Zone Management		Waste Recycling	Forest Regeneration	Water Consumption and Conservation

The basis for the Saskatchewan *2011 State of the Environment Report* and selection of the reporting themes and indicators were determined by the following criteria:

- Comparison of reporting approaches, frameworks, and indicators from other jurisdictions, including British Columbia, Alberta, Northwest Territories, Australia, New Zealand and the United States.
- Themes such as air, land and water represent parts of the environment or a natural grouping of natural resources and are the main components that come to mind when we think of the environment. The use of themes in the *2011 State of the Environment Report* assisted with structuring the report, including streamlining and grouping indicators to more directly relate to the themes.
- The core environmental indicators were chosen from a review of a wider set of indicators from past Saskatchewan reports, especially the *2009 State of Saskatchewan's Provincial Forests*, the 2007 and 2010 State of the Watershed reports, and the 2003 and 2005 State of the Environment reports.
- The 17 indicators found in this report were also selected for their ability to provide: the best representation of information that is currently available; data relevance, analytical soundness, and measurability; data repeatability that is comparable between reporting periods; and sufficient quality to describe changes or trends.

Key Highlights

The themes and indicators found in this report provide a broad picture of Saskatchewan's environmental trends and ongoing efforts by government, industry, business and organizations to manage the province's resources and conserve its natural heritage. Unlike many other areas in the world, including some parts of Canada, Saskatchewan has an abundance of space, fertile soils, and natural resources coupled with a relatively low human population. Cities are smog free, forests are healthy and productive and the environmental health of agricultural lands is improving.

However, challenges remain to maintain and improve the province's environmental quality well into the future. One of the biggest challenges stems from the distribution of our water resources. Provincially, we have an abundance of fresh, clean water, yet most of it lies in the far north where the human population needs are the lowest. In contrast, water availability in the south is much lower in the very area where human demand is the highest and growing. This mismatch of supply and demand has resulted in greater pressures on the limited water resources in the south. As reported here and in the more comprehensive *2010 State of the Watershed Report* (Saskatchewan Watershed Authority 2010), water quality, quantity and consumption remain as issues in some of the southern watersheds.

The outlook for Saskatchewan's future is bright. Its population and economy are both growing and global demand for its resources is high. However, these changes will also increase the pressures on our air, land and water. Saskatchewan is also beginning to experience the increasing effects of a changing climate, and the associated uncertainties that this will bring to the environment. The province has faced similar environmental challenges before. The dust bowl of the 1930s ultimately led to changes in agricultural practices that continue to provide benefits today. The same innovation that bridged the gap between the environment and the economy then can be applied now to ensure sufficient natural resources for both human and ecological needs into the future.

Many indicators have pointed toward opportunities to improve the state of the environment and to areas where more information is required or additional indicators are needed. As the Ministry of Environment moves forward in using a results-based regulatory approach, the information in this report will be used to help set future priorities in measuring the health and state of key components of the environment.

AIR

Key Points

- The Ministry of Environment continuously monitors air quality in the province.
- Air quality in Saskatchewan's urban centers is excellent.
- Levels of air pollutants are low in the province.
- Local stakeholders are actively engaged through the creation of airshed associations.

Clean air is vital to the health and well-being of Saskatchewan's people and natural environment. 'Air' is the everyday term for the atmosphere - the layer of nitrogen, oxygen and other trace gases that surround our planet and make life on Earth possible. The atmosphere is a complex natural system that we interact with every time we breathe. Air pollutants in Saskatchewan originate from local, regional and global sources. Major influences on air quality include industrial emissions, vehicle emissions, forest fires and agricultural operations. Air quality depends on the rate at which pollutants are emitted into the atmosphere and the ability of the atmosphere to disperse these pollutants. As a result, air pollution can be pervasive and does not recognize property or political boundaries. The first indicator, air pollutant concentration (reported as an Air Quality Index) describes the general air quality in Saskatchewan and informs the public about the condition of air quality in their area in real-time.

Poor air quality can affect human health, the environment, and the economy. The very young, elderly or sick are often the most susceptible to air pollution. Asthma, lung cancer, cardiovascular disease, allergies and many other human health problems have been linked to poor air quality. Impacts on plant and animal biodiversity and productivity have also been attributed to pollutants in the atmosphere. One example is the decline and loss of forests due to acid rain. Air pollution can also have a significant impact on our economy. The desire to prevent air pollution can affect decisions about what we buy, what we use, and how it is produced. Repairing the damage caused by air pollution, including health and environmental problems, can have economic costs. On the other hand, the creation of new technologies, knowledge, and jobs to address air quality concerns can also produce economic opportunities. The second indicator, air pollutant volume, tracks the total amounts of major air pollutants released annually in Saskatchewan.

While it is important to have regulatory tools to minimize air quality impacts, the province is exploring place-based approaches for effective and efficient air quality monitoring. The third indicator, air zone management, outlines an important collaborative, regional response and strategy to maintain clean air.

Condition Indicator: Air Pollutant Concentration (reported by Air Quality Index)

Why is this indicator important?
Measuring and evaluating air quality in Saskatchewan is an important activity in maintaining air quality and in implementing the Ministry of Environment's strategy to prevent and reduce risks to human and environmental health. The Air Quality Index (AQI) describes the general air quality in Saskatchewan by transforming ambient concentration measurements of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO) and particulates into a single number, or index, that represents the measured quality of the air. The index is also used to monitor long-term trends in air quality. Table 1.1 provides a description of the categories of AQI results.

Table 1.1 Air Quality Index (AQI) Rating System

AQI Rating	AQI values	Effects
Excellent	0 – 15	No known harmful effects to soil, water, vegetation, animals, materials, visibility or human health.
Good	16 – 25	No known harmful effects to soil, water, vegetation, animals, materials, visibility or human health. Persons with severe respiratory ailments sensitive to air pollution may notice some minor effects.
Fair	26 – 50	Adequate protection against harmful effects to soil, water, vegetation, animals, materials, visibility and human health. Persons with severe respiratory ailments sensitive to air pollution may need to modify their usual outdoor activities if experiencing effects.
Poor	51 – 100	Not all aspects of the environment and human health are adequately protected from possible adverse effects. The general population should consider reducing or rescheduling strenuous outdoor activities and higher risk populations should reduce or reschedule outdoor activities.
Very Poor	value >100	Continued air quality in this range could pose high risk to environment and public health.

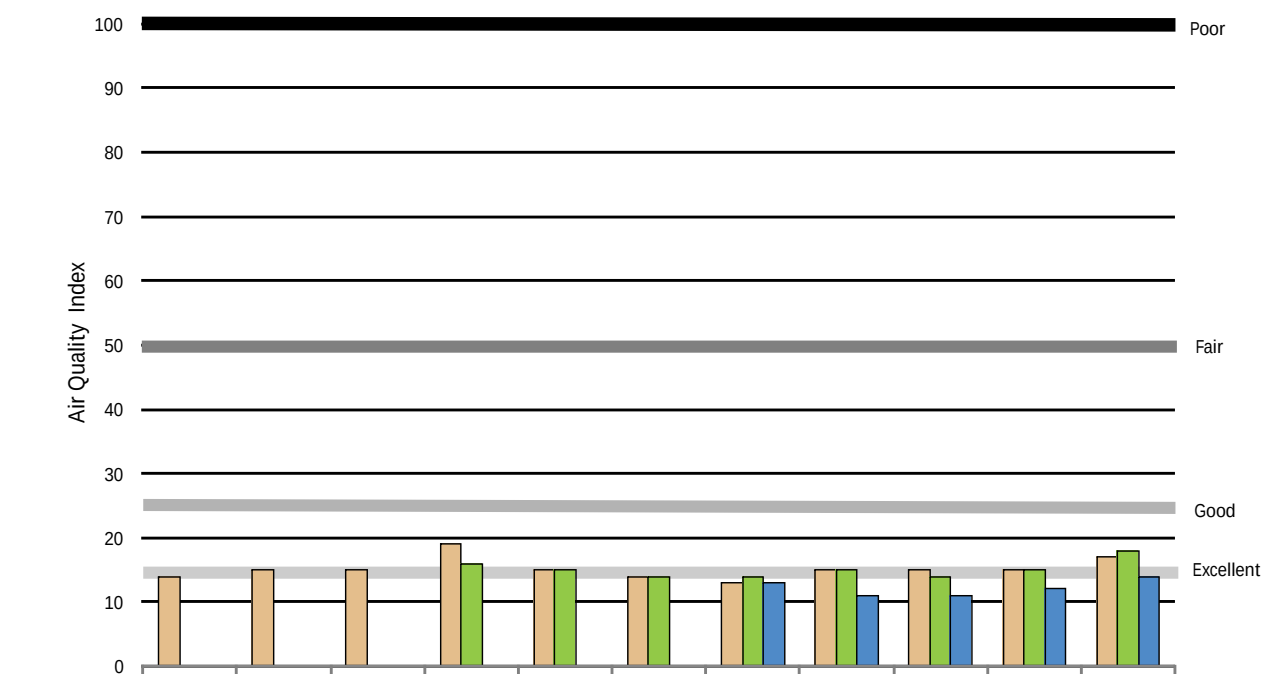
Source: Ministry of Environment, Technical Resource Branch

What does this indicator show?

Figure 1.1 shows the yearly averages of Air Quality Index ratings for Regina from 2001 to 2010, for Saskatoon from 2004 to 2010, and for Prince Albert from 2006 to 2010.

The indicator shows that air quality in Saskatchewan is primarily excellent with no harmful effects. The AQI for the three cities has consistently rated as 'Excellent' and there has been a relatively stable trend in this measure. The slightly elevated AQI levels in 2010 are due to forest fire activity in British Columbia. Forest fire smoke resulted in two consecutive days of poor air quality for most of the province and caused the AQI to be slightly higher than what is typically recorded.

Figure 1.1 Annual Air Quality Index for Regina, Saskatoon, and Prince Albert, 2001-2010



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Regina	14	15	15	19	15	14	13	15	15	15	17
Saskatoon				16	15	14	14	15	14	15	18
Prince Albert							13	11	11	12	14

Source: Ministry of Environment, Technical Resource Branch

What actions are being taken?
The Ministry of Environment ensures new industrial developments use the most appropriate technology to reduce air emissions. The ministry conducts continuous air quality monitoring at five sites in the province - Regina, Saskatoon, Prince Albert, La Loche, and Swift Current (the last two were recently added). Results from the two new sites will be reported in future State of the Environment reports.

The public can now access air quality information for the five sites, in real-time, on the Saskatchewan Ministry of Environment's website (Saskatchewan Ministry of Environment, 2011). Saskatchewan also receives and analyzes data from the federal government on the amount of pollutants released by major industry sectors through the National Pollutant Release Inventory program (NPRI 2010).

In addition to monitoring ambient air quality in the cities of Regina, Saskatoon, Prince Albert and Swift Current, the Ministry of Environment operates a vehicle equipped to monitor a variety of air pollutants, known as the Saskatchewan Air Monitoring Laboratory (SAML). The convenience of a mobile lab allows the ministry to monitor ambient air quality anywhere in the province that is accessible by road. The SAML was deployed to the northwest communities of Buffalo Narrows, Beauval, Ile-a-la-Crosse, Loon Lake and Tatukose from 2007 to 2009. Results indicated precursors to acid rain (sulphur dioxide (SO_2) and nitrogen dioxide (NO_2)) are well within the provincial ambient air quality standards. In 2010, the SAML was deployed to 21 communities in southern Saskatchewan including: Estevan, Weyburn, Moose Mountain, Esterhazy, Yorkton, Glenside, Maple Creek, Lloydminster, Moose Jaw, Belle Plaine, Dewar Lake, Cypress Hills, Fox Valley, Shaunavon, North Battleford, Unity, Maidstone, Kerrobert, Coronach, Lumsden, and Glen Ewen. Results indicated measured pollutants of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3) and hydrogen sulphide (H_2S)are well within the provincial ambient air quality standards.

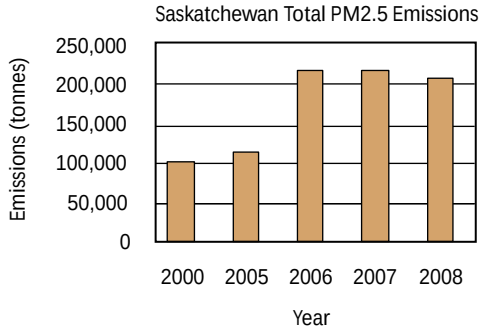
Stressor Indicator: Air Pollutant Volume

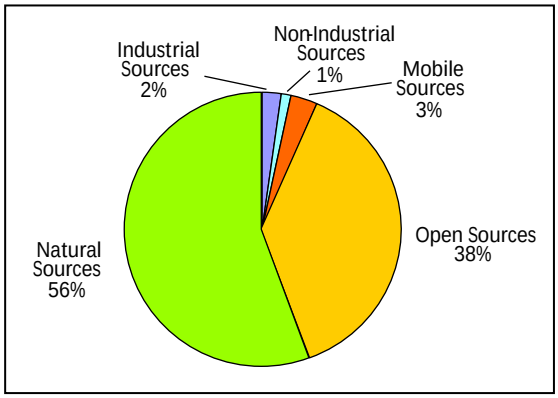
Why is this indicator important?
This indicator shows the total amounts, (tonnes per year) of major air pollutants released annually in Saskatchewan. Levels of specific air pollutants are reported either as Criteria Air Contaminants (CACs) or non-CACs (Environment Canada 2010). CACs are a group of air pollutants that affect human health and contribute to air pollution problems such as smog, acid rain, and poor air quality. They include particulate matter (of varying sizes), sulphur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), ground level ozone (O_3), and volatile organic compounds (VOCs). In most cases, they are the products of burning fossil fuels or industrial processes.

What does this indicator show?
Figures 1.2. 1.3, and 1.4 show the annual levels of the three major CACs as reported by the National Pollutant Release Inventory (NPRI 2010) accompanied by a breakdown of pollutants by provincial sector for 2008. Definition of sector terms used in figures are found in report glossary. CAC levels have remained relatively constant over the reporting period. Exceptions are particulate matter increases in 2006, 2007 and 2008 (Figure 1.2), likely due to above normal forest fire activity.

Overall, releases of air pollutants in Saskatchewan are low compared to other provinces (Environment Canada 2000). For example, in comparing Saskatchewan with Alberta, Alberta's CAC releases have been about two times higher for particulate matter ($PM_{2.5}$); around three times higher for sulfur oxides (SO_x); and three times higher for nitrogen oxides (NO_x) (Alberta Environment 2008, NPRI 2010).

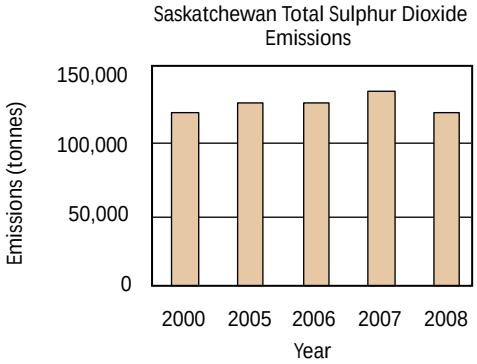
Figure 1.2 Particulate Matter ($PM_{2.5}$ microns) Emissions in Saskatchewan

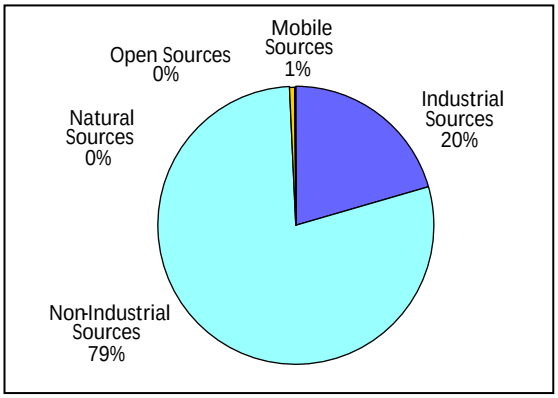




Source: Environment Canada

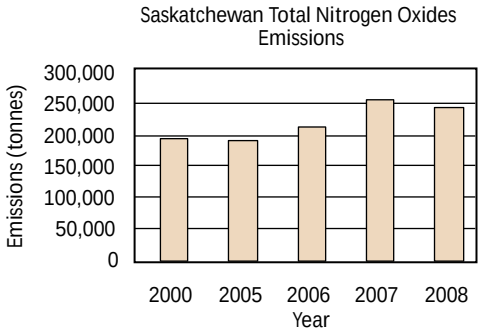
Figure 1.3 Sulphur Dioxide Emissions in Saskatchewan

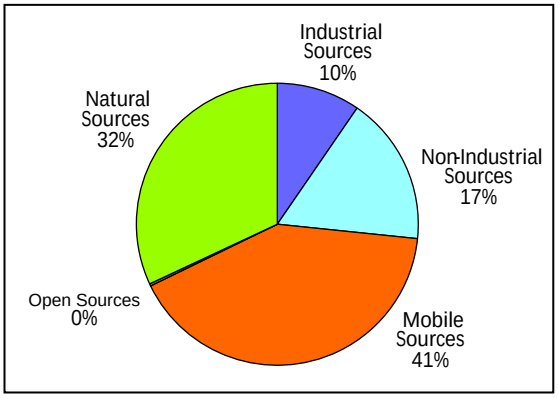




Source: Environment Canada

Figure 1.4 Nitrogen Oxide Emissions in Saskatchewan





Source: Environment Canada

What actions are being taken?
The Ministry of Environment continues to collaborate with Environment Canada and supports the National Pollutant Release Inventory program that collects, stores, and distributes annual air emissions data from all sources in Saskatchewan and other provinces and territories. Saskatchewan reports particulate matter (PM) and ozone levels on a five year basis to the Canadian Council of Ministers of the Environment (CCME 2010).

Saskatchewan has a wide-range of regulatory tools to ensure activities in the province minimize air quality impacts. *The Clean Air Act 1989* (and subsequent amendments) demonstrates the government's commitment to a healthy environment along with continuous improvements to maintain clean air in the province.

The legislation applies to any facility, operation, activity or equipment that is a source or potential source of an air contaminant in Saskatchewan. The Ministry of Environment issues clean air permits to operators of industrial sources, incinerators and fuel burning equipment in the province that contain conditions and requirements such as monitoring, modeling, reporting, and compliance. The ministry continues to work with larger and more complex operations to maintain good air quality through the issuance and review of permits. The ministry is also improving regulation for simpler operations through research and implementation of efficient new tools. These tools include policies, codes of practice, industry association requirements, and the development of a results-based regulatory model and the Saskatchewan Environmental Code (Saskatchewan Ministry of Environment 2009).

The Ministry of Environment monitors operational performance through compliance inspections of regulated activities, review of compliance reports, investigation of infractions, and enforcement when warranted. Industry continues to operate and make improvements to ensure air quality in their region meets Saskatchewan's Ambient Air Quality Standards, minimizing the impacts on human and ecosystem health.

One issue in Saskatchewan is the possibility of higher than normal acidic precipitation originating in Alberta. The Ministry of Environment assessed acid sensitivity for 259 headwater lakes in northwest Saskatchewan in the fall between 2007 to 2009, within 300 kilometres of the Athabasca Oil Sands Region mining activities in Alberta. Results show that 68 per cent of the surveyed lakes can be classed as sensitive to very sensitive to acid deposition (Scott *et al.* 2010); that is, a high frequency of lakes with low to very low acid neutralizing capacity. No lakes were acidic to the extent of having negative acid neutralizing capacities. Continued monitoring is required to interpret any changes in acid neutralizing capacity and pH over time and to determine what portion of the change may be caused by natural organic acidity or human-caused acid deposition.

Environment Canada conducted similar lake surveys across northern Saskatchewan in 2007 and 2009 (Jeffries *et al.* 2010). The results of both surveys have been used to update national maps of aquatic critical loads of acidity (maximum acid input tolerable as a long-term annual average to minimize biological damage). Comparing these maps to modeled acid deposition for northern Saskatchewan suggests that acidification risks may exist for some lakes and closer monitoring and evaluation is required.

Response Indicator: Air Zone Management

Why is this indicator important?
The maintenance and expansion of air zones in the province demonstrates the Ministry of Environment's progress towards improved models of air pollutant management that best protect human health and the environment. An air zone is a regional geographic area that shares similar air quality characteristics and challenges. Its boundaries are typically established by considering topographic features, meteorology, economic activities, pollution sources, political boundaries and common air quality issues.

What does this indicator show?
Air zones are a viable management strategy that provide improved communication of air quality to members within its boundaries. It allows for a more focused, local approach to air quality management, and shows in a timely fashion if the regional air quality meets provincial standards as well as identifying 'hot spots'.

Currently, Saskatchewan has one active air zone, encompassing an area of approximately 36,800 square kilometers (Figure 1.5). The air zone is administered by the Southeast Saskatchewan Airshed Association (SESAA), a non-profit organization (operating since 2005) of public, industry, government and non-government members managed by an Executive Director and Board of Directors with committees for finance, science, communications and governance. Real-time data on air quality and the association's annual reports (which report on passive and continuous air monitoring data) are available on its website (SESAA 2010).

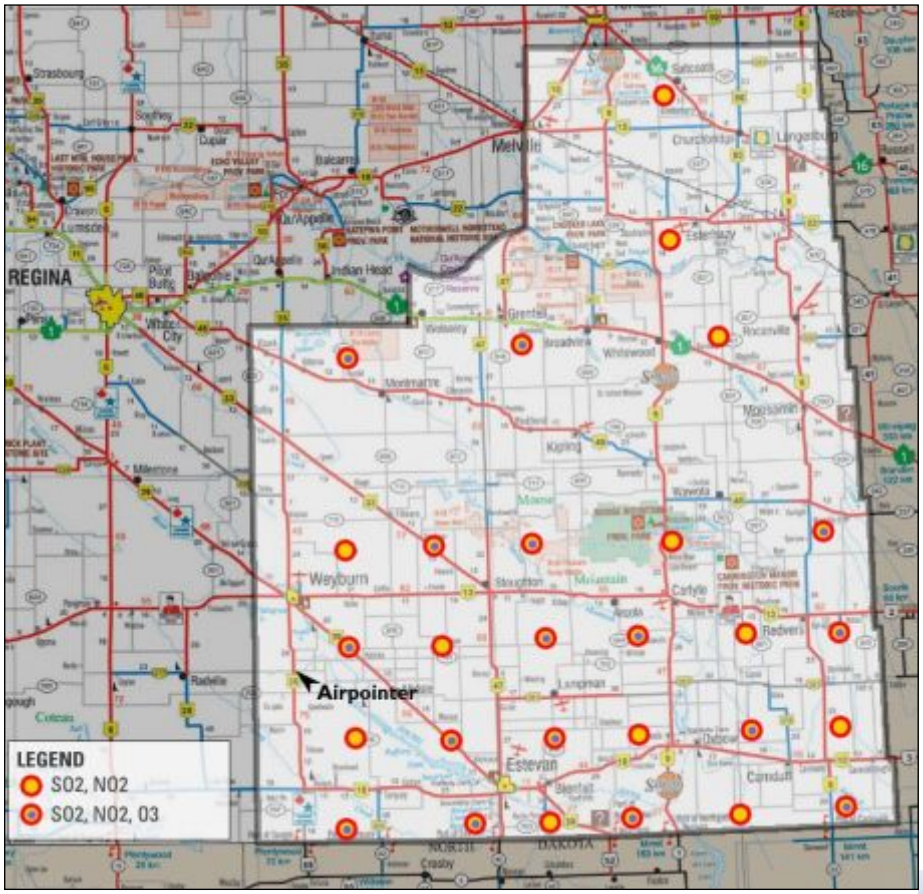
Saskatchewan plans to develop two to three new airshed associations over the next couple of years. The Saskatoon-Lloydminster Airshed Association is the next proposed airshed to be established in Saskatchewan.

What actions are being taken?
The Ministry of Environment intends to have air zones set up across the entire province. They will be based on the existing Southeast Saskatchewan Airshed Association model and will integrate with the new national Air Quality Management System (AQMS). The AQMS is in the process of being developed by federal, provincial, and territorial jurisdictions and the current plan is to implement the system across Canada in 2013 (Comprehensive Air Management System Steering Committee 2010). The new comprehensive air management system is outcomes-based, defining the desired ambient air quality through setting Canadian Ambient Air Quality Standards. It is also a place-based system with air zones for management, established within provinces and territories to ensure local needs and circumstances are effectively addressed.

Saskatchewan continues to contribute to various aspects of AQMS including: establishment of base level emission guidelines for industrial sectors such as electricity, potash, chemicals, steel production, pulp and paper, upstream oil and gas, oil sands and petroleum refining;
review of the Canadian Ambient Air Quality Standards that provide an enhanced level of protection for human health and the environment; and the creation of agreements on regulatory assurance and mechanisms for stakeholder engagement. Environmental non-government organizations have been invited to join working groups to help develop performance standards with industry and government representatives.

Airshed management fits with the ministry's new results-based regulatory model and Saskatchewan Environmental Code. Airshed associations in Saskatchewan will become valuable organizations that will monitor industrial point sources and other sources. Airshed management can provide flexibility to consider regional differences while ensuring national consistency, managing issues associated with trans-boundary influences and providing a level playing field for industry.

Figure 1.5: Air Zone Map



Source: Southeast Saskatchewan Airshed Association

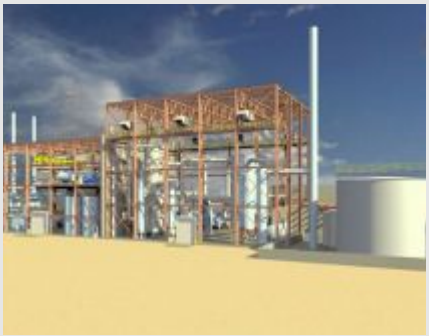
Snapshots of Local Responses

Saskatchewan's First Airshed Association

The province's first airshed, Southeast Saskatchewan Airshed Association (SESAA), was established as a legal entity in October 2005. Southeast Saskatchewan was chosen due to air quality concerns and the numerous industrial point and area sources. SESAA was established with a mandate to collect credible, scientifically defensible air quality data and to make this data available to the public. The association also provides a forum for open communication of air quality concerns among all sectors of society. SESAA set up a continuous air quality monitoring station 12 kilometres south of the City of Weyburn in 2010 (pictured here) and since 2006 has been carrying out passive monitoring for nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) at 28 sites, while ozone is monitored at 12 sites.

Reducing Mercury Emissions

A Canada-wide Standard for mercury aimed at reducing atmospheric mercury (Hg) emissions from coal-fired power plants became effective in 2010. To meet the standard, SaskPower commissioned an Emissions Control Research Facility (ECRF) at their Poplar River Power Station located near Coronach in 2004. The ECRF was designed to capture mercury from the flue gas before it escapes into the atmosphere. At the ECRF, powdered activated carbon is injected into a fabric filter to absorb mercury from the flue gas. As a result of this research, SaskPower commissioned a mercury control system at Poplar River Power Station in June 2009. The innovative system is designed to capture at least 65 per cent of the mercury, with increased capture rates achievable as improvements are made. For SaskPower's outstanding innovation, the Canadian Electricity Association honoured the company with an Environmental Stewardship Award.



Reducing Sulfur Dioxide Emissions

Two projects to lower sulphur dioxide (SO_2) emissions are now underway at Cameco's Key Lake and Rabbit Lake mills. On September 1, 2010, Cameco commissioned acid plant upgrades at its mine at Rabbit Lake in northern Saskatchewan. Since operating with the upgrades, the acid plant has shown a clear improvement in acid production and the reduction of air contaminant emissions. The plant efficiency for acid production has been measured at greater than 99 per cent while the stack emissions of sulphur dioxide have been reduced by approximately 65 per cent. Construction upgrades to reduce sulphur dioxide emissions at Cameco's Key Lake acid plant (pictured here) continued in 2010, with completion expected in 2011. The current plant has sulphur dioxide emissions of approximately 300 parts per million. The new plant will have emissions ranging from 12 to 75 parts per million.

Conclusion

In general, Saskatchewan's air is of high quality and poses little cause for concern. Pollutant levels are low and are continuously monitored and reported by the ministry. Saskatchewan currently has one established airshed association that monitors air quality. One issue that has recently emerged is the possibility of higher than normal acidic precipitation originating in Alberta. The ministry conducted lake acid sensitivity assessments in northwest from 2007 to 2009, along with a similar assessment across northern Saskatchewan in collaboration with Environment Canada. These programs are ongoing, with initial data indicating there are sensitive lakes, but none are considered acidified (Saskatchewan Ministry of Environment 2010).

CLIMATE

Key Points

- Saskatchewan's greenhouse gas (GHG) emissions are increasing in conjunction with the growing economy.
- GHG emissions produced per unit of Gross Domestic Product (GDP) have declined by 43 per cent since 1990, but could reverse in the future.
- The Province is working with industry and other stakeholders to reduce GHG emissions through new results-based regulations, the creation of a carbon trading market and investments in innovative technology.

Climate Change

Human activities and the release of greenhouse gases (GHGs), such as carbon dioxide (CO_2) and methane (CH_4), are causing the planet's climate to change in unprecedented ways with unknown consequences (Barrow 2009; IPCC 2007; Tans 2010). Globally, the level of atmospheric carbon dioxide has increased by about 95 parts per million since 1780 to 390 parts per million today. Of this increase, 84 per cent is estimated to be due to emissions from fossil fuel combustion (Environment Canada 2004).

Climate scenario studies have explored how these projected global climate changes may be manifested in Saskatchewan (Barrow 2009). For both the forested and prairie regions of Saskatchewan, overall increases in both precipitation and mean annual temperatures are predicted. Trends have shown a larger increase in daily minimum as compared to maximum temperatures and the largest warming has occurred during winter and early spring, resulting in a longer frost-free period and more growing degree days. With a warmer, longer summer, the deficit between precipitation and potential water loss by evapotranspiration has been growing in southern Saskatchewan (Sauchyn *et al.* 2009). Thus, in the long term, water deficits are forecasted due to water loss from evapotranspiration exceeding precipitation. In addition, variability in weather patterns, due to climate change, has the potential for a greater frequency of extreme weather events.

The expected effects of these measured and predicted changes in Saskatchewan's climate on our natural resources, and industries dependent on them, include the following:

Water Resources
Studies suggest that a dramatic drying of the prairies is not anticipated in the short term as the climate changes and that, in some cases, stream flow will either be reduced by small amounts or even increase. While this may happen, progressively longer summers and longer periods of evapotranspiration will result in drier soils for more days in summer. The water needed for agriculture will likely increase, along with increasing competition for scarcer water resources.

Land Resources
Saskatchewan faces major climate change effects on ecosystems and landscapes. Drier growing seasons will be the single most important ecosystem impact and will represent a major challenge to the conservation of fish, wildlife and biodiversity. Changes in climate will alter environmental conditions, to the benefit of some species and the detriment of others, often with economic consequences (Sauchyn et al. 2009). For example, changes in the composition of native grasslands may be expected, as drought-tolerant species out-compete less tolerant species. The increased stress on aquatic ecosystems from warmer and drier conditions and subsequent loss of wetlands could also place prairie aquatic species at greater risk and cause declines in migratory waterfowl populations.

Agriculture

Agriculture is an important sector of the Saskatchewan economy and already experiences naturally occurring extreme weather conditions. Climate impacts on the agricultural sector and adaptive responses are already occurring and are likely to accelerate in the future. The climate scenarios predicting longer, drier summers occurring more often could cause local soil instability and erosion. Predicted climate change impacts on crop production are still uncertain, but they are consistent with recent changes and tend to indicate increasing productivity in the short term. Once certain thresholds of climate change are reached, annual decreases in production are predicted, including large losses accompanying severe climatic events, such as droughts or excessive moisture.

Forests

Forests in Saskatchewan are already subject to a range of climate and other natural disturbance factors, and may be more susceptible to climate change than other forest regions in Canada. Northern Saskatchewan experiences one of the highest rates of fire disturbance in Canada (Balshi *et al.* 2009). Fires, insects and drought have always had major impacts on the forest and will continue to do so regardless of climate change. However, warmer and drier conditions in the future will likely magnify these impacts. Increases in forest fire frequency, more severe fire behaviour and increased area burned are expected (Sauchyn *et al.* 2009) with the possible loss of forest cover, especially in the southern boreal forest and island forests (Carr *et al.* 2004; Hogg and Bernier 2005).

An indicator dealing with greenhouse gas emissions examines the trends in total GHGs in Saskatchewan, as well as emissions by sector. It also shows the comparison of GHG emissions with Saskatchewan's Gross Domestic Product (GDP).

Stressor Indicator: Greenhouse Gas Emissions

Why is this indicator important?

The level of greenhouse gas emissions is an indicator of human activity affecting the global atmosphere and causing most of the increase in global temperatures. GHGs include mainly carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and water vapour.

Saskatchewan's GHG emissions form a small fraction of the total global output considering Canada produces 1.9 per cent of the world's carbon dioxide (World Resources Institute 2003) and about 1.5 per cent of total global GHG emissions (Environment Canada 2010a). However, the province accounts for 10 per cent of Canada's total GHGs (Environment Canada 2010b) with three per cent of the country's population. As global citizens, and citizens of Saskatchewan and Canada, we must also acknowledge our role in contributing to human-induced climate change. As well, we all have a responsibility to do our part to reduce and/or offset emissions and address the adaptation challenges that climate change will bring. For example, Saskatchewan is the steward of extensive natural (forests, wetlands, grasslands) and agricultural ecosystems that capture and store carbon from the atmosphere.

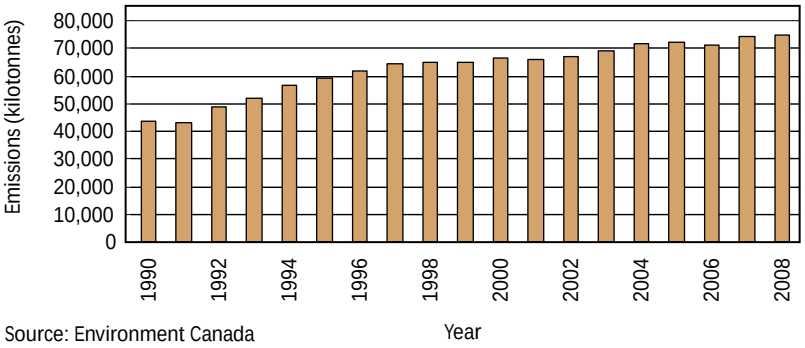
What does this indicator show?

GHG emissions can be interpreted in various ways. Figure 2.1 shows the total annual GHG emissions in Saskatchewan from 1990 to 2008. Figure 2.2 provides the provincial sources of these GHGs in 2008 and Figure 2.3 illustrates the annual emissions per unit of Saskatchewan's Gross Domestic Product (GDP) from 1990 to 2008 (Environment Canada 2010b, Saskatchewan Bureau of Statistics 2010).

GHG emissions in Saskatchewan have increased by 72.8 per cent from 1990 to 2008 (Figure 2.1) and, as of 2008, stand at 75,029 kilotonnes per year. As shown in Figure 2.2, most of the emissions are generated by stationary sources of energy combustion such as electricity and heat generation (38 per cent), so-called 'fugitive' sources (coal mining, oil and natural gas 22 per cent), transportation (19 per cent) and agriculture (18 per cent).

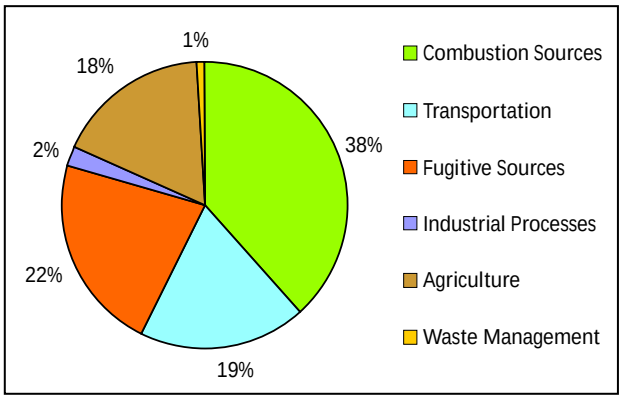
Despite the overall increase in GHG emissions, the amount of emissions released per unit of provincial GDP has decreased by 43 per cent since 1990 (Figure 2.3), indicating that the Saskatchewan economy is becoming more efficient at creating wealth and that some sectors of the economy are becoming less resource intensive. This trend might change as recent investments in resource development infrastructure give way to increases in natural resource production and corresponding increases in GHG emissions.

Figure 2.1 Annual Greenhouse Gas Emissions in Saskatchewan, 1990-2008



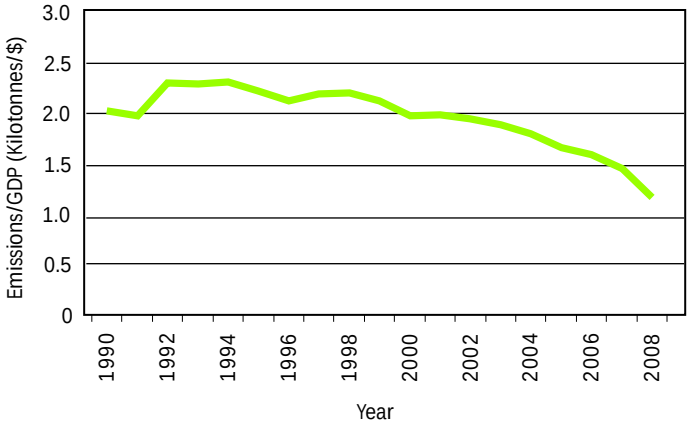
Source: Environment Canada

Figure 2.2 Sources of Greenhouse Gas Emissions in Saskatchewan, 2008



Source: Environment Canada

Figure 2.3 Annual Greenhouse Gas Emissions per Unit GDP in Saskatchewan, 1990-2008



Source: Environment Canada

What actions are being taken?

The Government of Saskatchewan is committed to finding solutions to the environmental challenges facing our province (Saskatchewan Ministry of Environment 2010). *The Management and Reduction of Greenhouse Gases Act* was passed in May of 2010 and will come into force upon proclamation. The legislation establishes the framework for reducing greenhouse gas emissions to meet the provincial targets of a 20 per cent reduction from 2006 levels by 2020, while minimizing industrial cost increases. The framework includes the creation of the Office of Climate Change, the Technology Fund, and the Saskatchewan Climate Change Foundation to deliver Saskatchewan's climate change plan. The Ministry of Environment is continuing to work with stakeholders to establish *The Management and Reduction of Greenhouse Gases Regulations*.

The Go Green Fund is a $70 million commitment from the Government of Saskatchewan to help Saskatchewan's people, communities, non-government organizations and businesses address the province's most important environmental issues. The reduction and mitigation of GHGs is one of the primary Go Green Fund objectives. Funding has been allocated to support research and demonstration of emission-reducing technologies, energy efficiency and conservation, water conservation, biodiversity and education and public awareness initiatives to support this objective.

Since its inception in November 2005, the Saskatchewan EnerGuide for Houses Program has provided grants to over 37,500 households for energy retrofits. Eligible retrofits include furnace replacements, insulation and air sealing, window and door replacements, and installation of newer technologies such as instantaneous gas water heaters and drain heat recovery systems. These retrofits have resulted in an annual reduction of approximately 111,000 tonnes of carbon dioxide from the air, a reduction roughly equivalent to permanently removing 20,180 cars from the road. Although other provinces and territories offer similar programs, Saskatchewan has the highest participation rate per capita in Canada. In March 2011, the Government of Saskatchewan extended the program to October 13, 2013.

The ministry has also worked with the Prairie Adaptation Research Collaborative at the University of Regina to examine the long-term impacts of climate change on prairie ecosystems, and adaptation options to support sustained economic growth in different sectors (Saskatchewan Ministry of Environment 2010).

Snapshots of Local Responses

Urban Initiatives
Municipal governments across the province have been very active in promoting and supporting initiatives that reduce greenhouse gas emissions.

City of Regina: Hydraulic Launch Assist Garbage Truck
The City of Regina has partnered with the Go Green Fund to purchase and test a Hydraulic Launch Assist (HLA) garbage truck. The addition of the HLA unit on the truck is expected to result in a 25 per cent increase in fuel efficiency. While the HLA garbage truck has proven to be reliable in other cities, this project will be the first extreme cold weather testing of this technology. A 25 per cent increase in fuel efficiency could result in a reduction of 8.1 tonnes of GHG emissions per year of service per truck.

City of Saskatoon: H. McIvor Weir Wastewater Treatment Facility
The H. McIvor Weir Wastewater Treatment Facility in Saskatoon is working towards building sustainable processes. Methane capture through a heat recovery project is saving the City of Saskatoon approximately 1,441,750 cubic metres of natural gas per year, with an annual carbon dioxide reduction of 2,641 tonnes per year. There are also plans to install a co-generation facility on site which will utilize methane gas production from an existing 50 per cent usage to 100 per cent while offsetting the electricity demand of the plant by 70 per cent, further reducing carbon dioxide emissions.

Small Business Initiative: Confederation Inn
In 2007, the Confederation Inn in Saskatoon decided to reduce the hotel's carbon footprint. By taking advantage of existing provincial and federal government incentive programs and investing $130,000 of their own money, the owners now estimate that they save $60,000 a year on utility costs. One of their main investments was the installation of 40 solar thermal panels, the largest commercial solar hot water system in Saskatchewan, which helps supply hot water for guest rooms, dishwashers and the swimming pool.

Wind Power
The 26 megawatt Red Lily Wind Project near Moosomin, completed in February 2011, is the latest addition to SaskPower's renewable energy portfolio. When new wind power is brought into service through the Red Lily Wind Project, the Green Options Plan and the Green Options Partners Plan, wind power will make up about 8.5 per cent of SaskPower's total generating capacity. The expansion of wind power will reduce the corporation's carbon dioxide emissions by approximately 225,000 tonnes per year.

Conclusion

Even though Saskatchewan emits a small percentage of the world's GHG emissions, the province's emissions continue to increase largely because of its resource-based economy. The Government of Saskatchewan is addressing this through legislation, the creation of a carbon trading market and investments in new technology. At the same time, we must plan for climate change and its impacts. It is important for individuals, organizations and government to work together to mitigate and adapt to the long-term impacts of climate change.

LAND

Key Points

- Southern Saskatchewan has lost much of its natural land cover, such as prairie grasslands and wetlands.
- Improvements in agricultural practices, such as reduced summerfallow and increasing zero-till, are improving the environmental health of agricultural lands.
- Pressure on land from industrial developments is increasing.
- Industry and government are continuously improving their environmental management practices.
- Waste recycling efforts are increasing, reducing the pressure on land.
- Private conservation stewards, together with Government of Saskatchewan conservation programs, play a critical role in monitoring and maintaining a healthy environment.

Saskatchewan has an abundance of land, space and natural resources. From cattle ranching and farming on the southern prairies to hard rock mining on the northern Shield, land use in Saskatchewan is varied. Prior to European settlement, Aboriginal people occupied the land area now known as Saskatchewan. Primarily mobile hunters and gatherers, these societies relied on the ability of the natural environment - its land, water and forests - to sustain them. Although these patterns of use have changed over time, First Nations and Métis people in Saskatchewan continue to rely on the land for many traditional social, economic and cultural uses. Since European settlement began in southern Saskatchewan in the late 19th century, the natural landscape has been radically altered through increasing demands for urban land, recreation areas, transportation corridors, and by industries such as agriculture and mining.

Farming and ranching are the most common uses today, with approximately 46 per cent of the province's 651,036 square kilometres devoted to agricultural uses, mostly annual cropping (Stewart 2006a). Slightly more than half of Saskatchewan's land area is covered by forest, mostly in the north. While transportation uses occupy only approximately two per cent of the total land area, their linear extent is very significant. Saskatchewan has the largest municipal (grid) road network in Canada, totaling 165,000 km. In combination with the provincial highway network, the province contains over 190,000 kilometres of rural roads alone - the most per capita of anywhere in the world (Stewart 2006b).

While these changes on the land have brought significant wealth and opportunity to the people of Saskatchewan, they have also created a number of environmental challenges, particularly in the south. Principal among these has been the conversion of native prairie to cropland and the changes to its associated natural disturbances, such as fire and large herbivore grazing by animals like the plains bison (*Bison bison*). In Saskatchewan, it is estimated that between 17 per cent and 21 per cent of the original native prairie remains intact. Despite increasing awareness of the value of this ecosystem, loss of native prairie continues, albeit at a slower pace (PCAP 2010). Modern agriculture is also intensive, and requires the use of chemicals to control unwanted competition and damage from weeds and insect pests. Saskatchewan's extensive road network also creates ecological effects, some of them quite subtle. For example, predators and invasive weeds can move along roads and gain easier access to the interior of native grasslands where they can affect native species.

All of these factors are thought to have put additional pressures on native prairie biodiversity (Federal, Provincial and Territorial Governments of Canada 2010). For example, of the 74 species or populations considered to be at risk in Saskatchewan, most are associated with native prairie (SCDC 2010). However, it is worth noting that only one provincial species, the passenger pigeon (*Ectopistes migratorius)* is known to have become extinct, and another five species extirpated, suggesting that many prairie species were already adapted to high levels of natural disturbance before human disturbance became pervasive. Two of the extirpated species, the swift fox *(Vulpes velox)* and black-footed ferret *(Mustela nigripes),* have since been successfully re-introduced into Saskatchewan.

While it is important to pay attention to the conservation of native prairie, it is just as important to assess the landscape that surrounds it – farmland, which makes up 80 per cent of the prairie ecozone. Because of this overwhelming presence, farming practices play a direct role in the health of natural prairie ecosystems like grasslands, wetlands and streams. The first indicator, agricultural land cover, tracks trends in land cover and management practices over time and serves as a proxy for agri-environmental health. Later in this chapter, two response indicators – area under zero-till and private land stewardship – track conservation trends in the agricultural landscape. Complementary government actions will also be featured for maintaining healthy ecosystems that support native biological diversity.

Two other indicators are explored in the land theme: mineral disposition activity and waste recycling. Mineral disposition activity provides an indication of interest in Saskatchewan's mineral resources and possible future expansion of industrial activity. The waste recycling indicator tracks trends in the proportion of materials recycled in Saskatchewan.

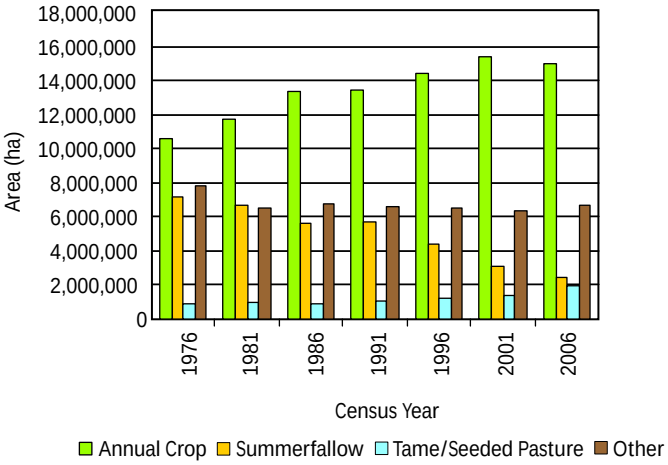
Condition Indicator: Agricultural Land Cover

Why is this indicator important?
Just as the diversity in forest types reflects forest landscape biodiversity, so do the land cover types in the agricultural areas of Saskatchewan. In general, agro-ecosystem land cover types like annual crops, summerfallow, and tame or seeded pasture support lower levels of native biodiversity than do natural areas like native grasslands, wetlands and woodlands. This is not surprising as the main intent of farming is food or forage production. Examining the status and trends of agricultural land cover and management practices over time provides the ability to track whether the trend is either towards or further away from enhancing biodiversity.

What does this indicator show?
Figure 3.1 shows the area extent of cropland, summerfallow, tame/seeded pasture and other land types in Saskatchewan from 1976 to 2006 (Statistics Canada 2009a). 'Other' land types include natural land for pasture and other land including woodlots, marshes, yards, etc.

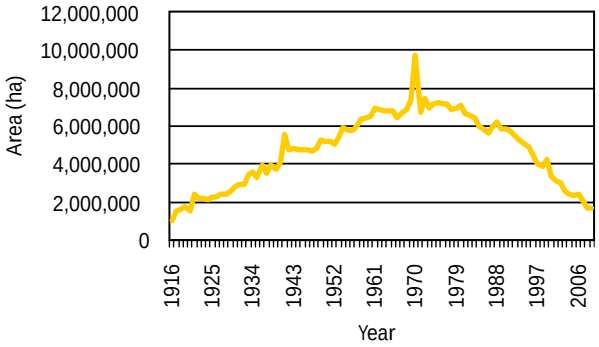
The amount of farmland devoted to annual cropping has steadily grown through the reporting period, along with a significant decline in summerfallow. This increase in cropped land is mostly due to the declining popularity of summerfallow. The area devoted to tame or seeded pasture has doubled from 1981 to 2006, while the amount of land in 'other' categories has remained relatively constant since 1981.

Figure 3.1. Land Cover Type on Saskatchewan Farmland, 1976-2006



Source: Statistics Canada

Figure 3.2 Area of Land under Summerfallow in Saskatchewan, 1916-2009



Source: Statistics Canada

A closer examination (Figure 3.2) shows changes in the area of summerfallow on Saskatchewan farmland from 1916 to 2009 (Saskatchewan Ministry of Agriculture 2011a). The area of farmland devoted to summerfallow steadily increased up to the 1960s and 1970s, and has declined ever since. In fact, 2009 was the lowest provincial acreage in summerfallow since 1918, representing 11 per cent of total cropland. Its decline is associated with the growing awareness of summerfallow's negative environmental effects such as soil erosion, soil organic depletion and increased soil salinity. It is estimated that up to 50 per cent of the soil's organic matter had been lost in Saskatchewan since cultivation began and before the uptake of more sustainable practices such as conservation tillage and zero-tillage (Saskatchewan Ministry of Agriculture 2011b).

What actions are being taken?
Farmers in Saskatchewan are broadly adopting alternatives to summerfallow, such as zero-till. The organic matter of Saskatchewan's farmland soils is now being actively restored (West and Post 2002), resulting in higher levels of agri-environmental health. Various permanent cover programs have also contributed to some cropland being re-seeded back to grass. Pressures on natural areas like wetlands, woodlands, and native grasslands continue and are the focus of conservation efforts like the Prairie Conservation Action Plan (PCAP 2010).

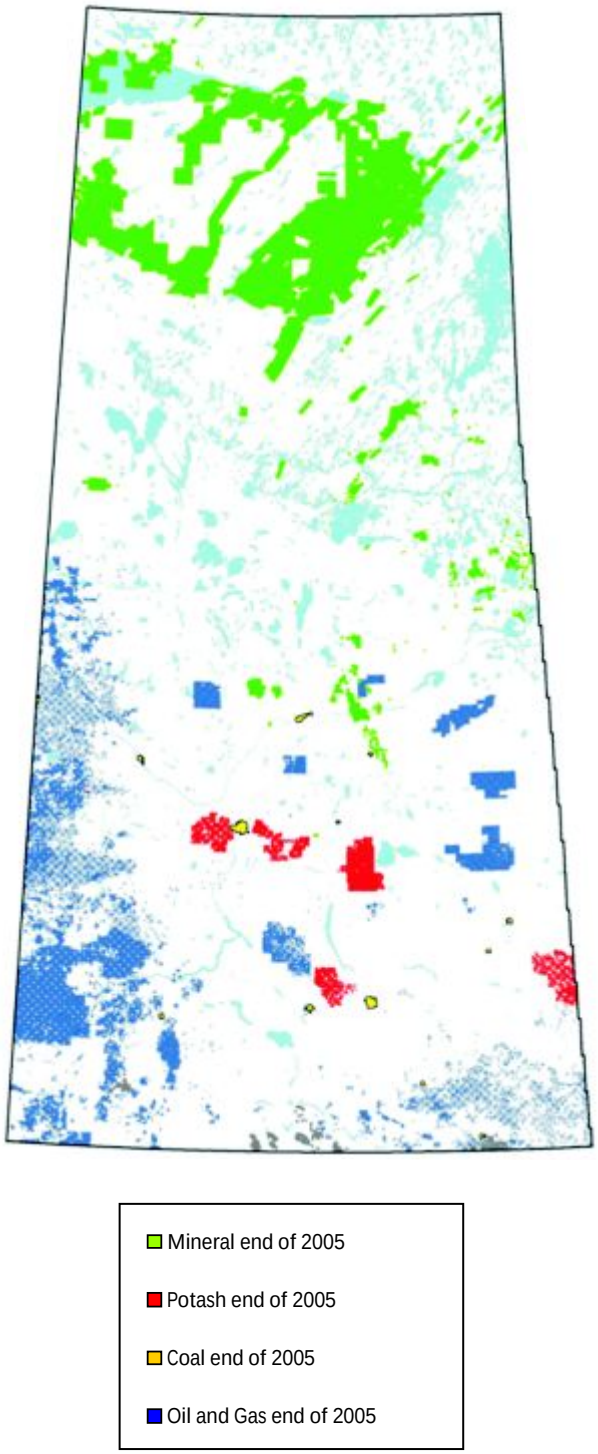
Stressor Indicator: Mineral Disposition Activity

Why is this indicator important?
The development of Saskatchewan's non-renewable resources is critical to its future growth and prosperity. For example, mining companies operating in the province made Saskatchewan the highest mineral-producing jurisdiction in Canada in 2008, with production valued at a record $9.7 billion (Saskatchewan Mining Association 2009). Mining is therefore a major contributor to Saskatchewan's economy, directly contributing almost $2 billion in revenue to the provincial government in 2008 and creating 25,000 jobs in the process. Other important industrial activities in the province include forestry, oil and natural gas. The environmental effects of industry can include such things as fish and wildlife habitat disturbance and the release of airborne and waterborne pollutants. The key to the management of these is corporate social responsibility coupled with effective government environmental controls.

What does this indicator show?
Figures 3.3 and 3.4 illustrate the geographic growth of industrial activity between 2005 and 2008 in Saskatchewan as reflected by the sale of sub-surface mineral leases (Saskatchewan Ministry of Energy and Resources 2009). Figure 3.5 shows the value of these Crown land sales for mineral exploration and development from 1968 to 2010 (Saskatchewan Ministry of Energy and Resources 2011).

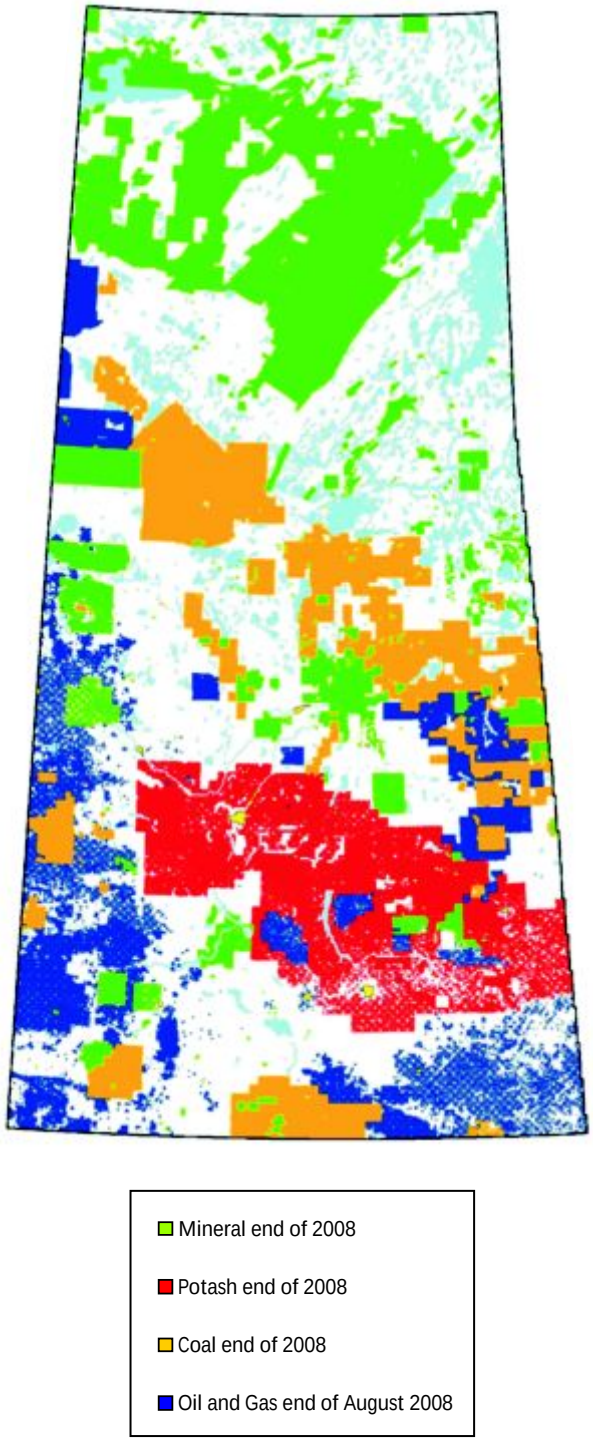
The disposition of minerals is an indicator of interest in Saskatchewan's mineral resources. This, in turn, may lead to exploration and possible industrial activity and expansion. From an ecological perspective, industrial activities can be classified as either intensive or extensive. An example of the former is mining, in which very little land surface is actually disturbed during the process, and an example of the latter is natural gas development, in which many well sites can be distributed across a much larger area than is occupied by a single mine site. In both types of industrial development, linear developments such as the creation of new roads and trails are of concern, particularly for their cumulative implications for biodiversity, habitat fragmentation and the spread of non-native species.

Figure 3.3 Mineral Lands Activity
in Saskatchewan as of December 2005



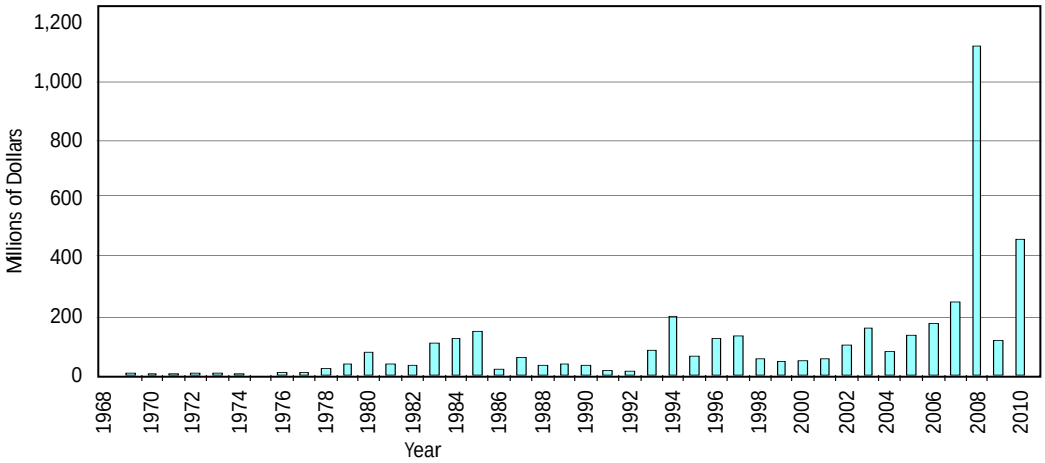
Source: Saskatchewan Ministry of Energy and Resources

Figure 3.4 Mineral Lands Activity
in Saskatchewan as of August 2008



Source: Saskatchewan Ministry of Energy and Resources

Figure 3.5 Value of Crown Land Sales in Saskatchewan, 1968-2010



Source: Saskatchewan Ministry of Energy and Resources

What actions are being taken?

Environmental stewardship and sustainability are important to industry. The various non-renewable resource industry sectors in Saskatchewan employ environmental practitioners at their operations throughout the province, and invest in researching, predicting, monitoring, preventing and mitigating their effects on the environment. Environmental stewardship is a part of industrial planning from conception to production through to reclamation and decomissioning. For example, all mining, forestry and energy companies incorporate reclamation and/or restoration and decommissioning plans as part of their Environmental Impact Statements that are submitted to the Ministry of Environment prior to development. Major plans go through a thorough public review process before a licence to operate is granted. As part of their licence to operate, all mines are now required to provide financial assurance to government so that, in the event that a mine is abandoned in the future, the funding is in place to reclaim the site.

All industrial activities are also governed by both federal and provincial acts and regulations. A major regulatory milestone was the passing of the provincial government's *The Reclaimed Industrial Sites Act 2007*. The act is intended to form the basis of permanent institutional control over decommissioned industrial sites on Crown land. A perpetual care fund established by industry and administered by the province will finance the long-term monitoring of these sites (Saskatchewan Mining Association 2009).

On the exploration side, industry continues to show leadership as the Prospectors and Developers Association recently released their Environmental Excellence in Exploration initiative (e3). This is an unparalleled online resource of data and environmental management practices designed to promote and ensure that the highest levels of environmental stewardship are practiced on mineral exploration projects worldwide (Prospectors and Developers Association of Canada 2011).

One specific example of regulatory review of industrial development in Saskatchewan was the establishment in 1991 of the Joint Federal - Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Joint Panel) followed by regular reviews of the Panel's recommendations with the most recent review in 2010. Between 1993 and 1997, six uranium mining and milling proposals for both new projects and expansions to existing projects were submitted for regulatory review. These included: Dominique Janine Extension at Cluff Lake (October 1993); Midwest Joint Venture (October 1993); McClean Lake Project (October 1993); Cigar Lake Project (November 1993); McArthur River Project (February 1997); and Midwest Project (November 1997).

To ensure that the potential effects from both individual and combined projects are considered, the federal and provincial regulatory agencies established the Joint Panel to conduct and oversee the reviews with the objective of making recommendations to government and improving environmental management and outcomes. Regulatory agencies included the provincial ministries of Environment, Labour Relations and Workplace Safety, Health, First Nations and Métis Relations, and Energy and Resources, along with the federal agencies of the Canadian Nuclear Safety Commission, Environment Canada, and Fisheries and Oceans Canada.

As part of the review process, the panel made recommendations regarding development of the proposed operations. The Province of Saskatchewan agreed to implement most of these recommendations. Chief among the responses to the recommendations are the following:

- The establishment of human resources development agreements incorporated into the project surface leases
- The establishment of the Environmental Quality Committees under the Northern Mines Monitoring Secretariat
- The incorporation of requirements for financial assurances for decommissioning and reclamation of projects into *The Mineral Industry Environmental Protection Regulations, 1996*
- The establishment of a fund for research by uranium producers
- The establishment of a program to monitor cumulative effects of uranium mining on northern Saskatchewan
- Health studies in northern Saskatchewan communities including the Community Vitality Monitoring Partnership
- Enactment of T*he Reclaimed Industrial Sites Act* (previously mentioned in this chapter) providing the framework for institutional control decommissioning and reclamation

A detailed description of each recommendation, the provincial government response, the status of work completed respecting each recommendation in 2006, and the status of work in 2010 is presented on the Ministry of Environment website (Saskatchewan Ministry of Environment 2011a).

Response Indicator: Area Under Zero-Tillage

Why is this indicator important?
Adoption of conservation farming practices like zero-tillage is producing significant improvements to Saskatchewan's air and water quality, biodiversity conservation and soil carbon storage (Hofmann 2008, Wicklum and Gray 2010). It also makes economic sense for the farmer (Gray 2010). Conventional tillage, conservation tillage and zero-till (or no-till) are defined by the amount of crop residue left on the ground (Hofmann 2008). Crop residue is the vegetative material, often referred to as trash or litter, left after a crop has been harvested. It can include straw, stubble, leaves and stalks. Conventional tillage incorporates or buries most of the crop residue into the soil.

Typically this approach involves multiple passes in fields. Since this method plows under much of the crop stubble, it leaves the surface relatively bare and without cover protection. Tillage that retains most of the crop residue on the surface and involves minimal tillage is known as conservation tillage. Some straw, stubble, leaves and other residue remain on the surface. Seeding that involves direct seeding into crop residue/soil is known as zero-till or no-till. The zero-till approach avoids any mechanical tillage of the soil and attempts to keep soil disturbance to an absolute minimum. In contrast to the multiple passes of equipment in the conventional approach, zero-till can involve just one pass through the fields for planting.

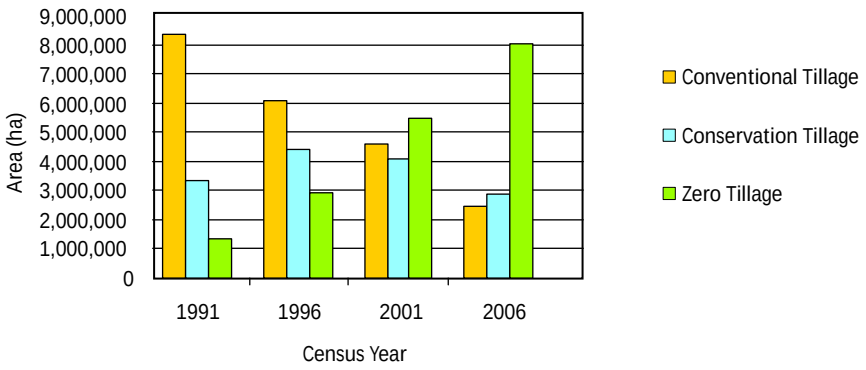
The greater the level of tillage, the greater the loss of soil organic matter. Organic matter is important for supporting soil biodiversity such as bacteria, fungi and earthworms that help cycle nutrients and increase the speed of pesticide breakdown. Soil organic matter also plays a role in climate change, since organic matter stores carbon. By lowering the number of passes through the fields with conservation tillage or zero-till, farmers gain savings in fuel and labour. Nationally, total fuel expenditures and repair costs on farms using zero-till systems were approximately one third of those in typical conventional tillage (Hofmann 2008). Reduced use of fuel not only lowers farmer costs, but also reduces air pollution and greenhouse gas emissions.

What does this indicator show?
Figure 3.6 shows changes in the area of farmland in Saskatchewan under zero-till and other forms of tillage from 1991 to 2006 (Statistics Canada 2009b).

There has been a dramatic increase in the adoption of zero-till in Saskatchewan over the reporting period with a simultaneous decline in the use of conventional tillage. The level of conservation tillage has remained relatively unchanged. In 2006, 82 per cent of cropland in Saskatchewan was either conservation tilled or zero-tilled (Statistics Canada 2009b).

An increase in soil cover over time indicates an improvement in environmental sustainability since the soil is more protected from degradation and is less likely to contribute to water contamination and atmospheric emissions (Eilers *et al,* 2010).

Figure 3.6. Area of Land Under Zero Tillage in Saskatchewan, 1991-2006



Source: Statistics Canada 2009b

What actions are being taken?
The Saskatchewan Soil Conservation Association (SSCA) continues to advocate for the increased adoption of zero-tillage (SSCA 2010). The SSCA and individual farmers' efforts, along with the rising costs in fuel, will likely mean that zero-till will continue to gain popularity across Saskatchewan to the benefit of agricultural ecosystems.

Response Indicator: Private Land Stewardship

Why is this indicator important?
Land management activities by private conservation organizations and individuals are a key component of sustainable land and water management. These conservation stewards play an important role, not only in maintaining and conserving natural areas through their activities, but also in providing social and economic benefits to the people of Saskatchewan as a whole.

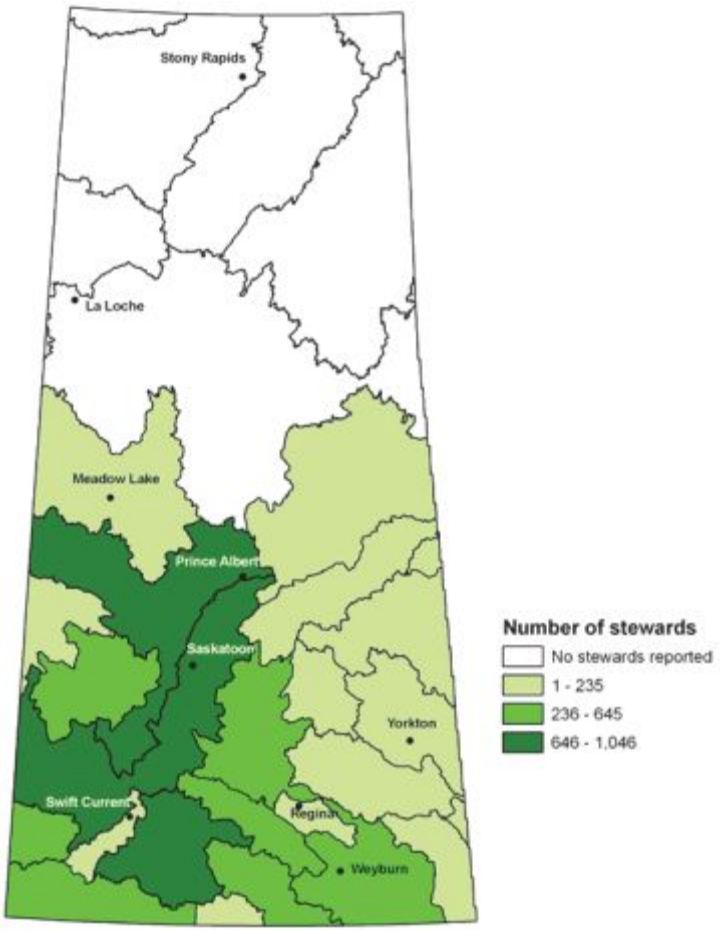
What does this indicator show?

Figures 3.7 and 3.8 show the number of voluntary private conservation stewards in Saskatchewan by watershed (Figure 5.1) and the number of hectares covered under conservation agreements by watershed (Saskatchewan Watershed Authority 2010). Refer to Figure 5.1 on page 53 for watershed names. The numbers of conservation stewards and the hectares covered under conservation agreements is the combined total of the stewards in the Prairie Stewardship Program, the Permanent Cover Programs I and II, and the Greencover Canada Programs and the latter also reflects the hectares conserved through conservation steward agreements with Ducks Unlimited Canada.

The number of voluntary conservation stewards is greatest in the North Saskatchewan River, Old Wives Lake and South Saskatchewan River Watersheds. The number of hectares covered under conservation agreements is greatest in the Big Muddy Creek, Carrot River, North Saskatchewan River, Old Wives Lake and South Saskatchewan River Watersheds.

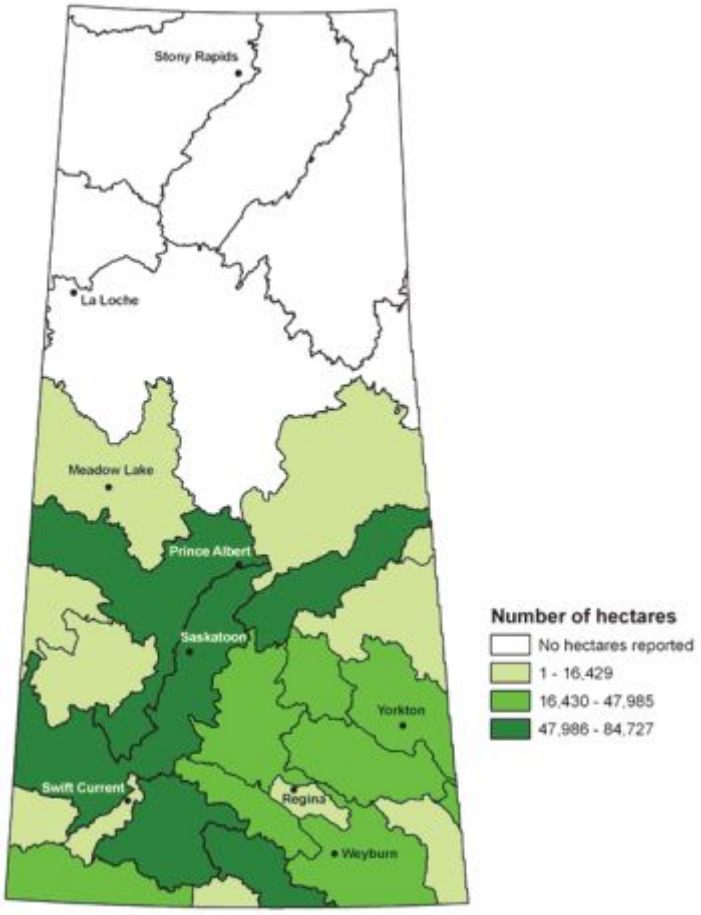
Further information on this indicator, detailing agreements and hectares covered by these voluntary land stewardship programs, can be found in the most recent *2010 State of the Watershed Report* (Saskatchewan Watershed Authority 2010). Not included in these figures are the significant land conservation efforts of groups like the Saskatchewan Wildlife Federation and the Nature Conservancy of Canada. The indicator should therefore be considered an underestimate. The current total number of hectares in conservation easements as of 2010 was over 86,000 hectares (Ministry of Environment 2011b).

Figure 3.7 Number of Conservation Stewards in Saskatchewan by Watershed 2008.



Source: Saskatchewan Watershed Authority 2010

Figure 3.8 Area Covered Under Conservation Agreements in Saskatchewan by Watershed 2008



Source: Saskatchewan Watershed Authority 2010

What actions are being taken?
In addition to the programs mentioned above, there are a number of land and watershed stewardship groups, local associations and volunteer stewardship organizations that have been formed in Saskatchewan to promote environmental stewardship. An overview of many of these groups can be found in the *2010 State of the Watershed Report* (Saskatchewan Watershed Authority 2010).

Information included in this indicator is based on programs that primarily focus on conservation stewards who own/manage private land in the agricultural areas of Saskatchewan. Complementary government conservation efforts, such as the Representative Areas Network (RAN), are also a key component to land stewardship in the province.

The RAN is intended to conserve representative and unique landscapes throughout the 11 ecoregions of the province. The RAN includes designated Crown lands that have been given a level of protection by legislation and private lands that are managed for biodiversity by agreement. The RAN not only conserves biodiversity in a variety of recognized conservation lands (parks, ecological reserves, federal and provincial pastures, etc.), representative areas also act as benchmarks for measuring environmental change and ecological health.

To maintain healthy ecosystems that support native biological diversity, the Ministry of Environment continues to identify, protect and manage sites within the provincial Representative Areas Network. There are 5.96 million hectares, or approximately nine per cent of the province, in the RAN. The number of hectares remained unchanged between 2004 to 2009; however, a number of sites have been identified within integrated land use plans and, as these land use plans are approved and recommendations for designation of proposed representative areas are implemented, hectares will be added (Saskatchewan Ministry of Environment 2010).

Response Indicator: Waste Recycling

Why is this indicator important?
Diverting waste before it reaches landfills is an important way to reduce its impact on the environment. Along with that is the rapidly growing recognition of the need to transcend the 'throw away' mentality of the past. Much of what used to be called 'trash' or 'waste' is a valuable resource that can be re-used for environmental, social and economic benefits. Less waste means fewer landfills, less pressure on our natural resources, reduced risk from harmful chemicals, lower carbon emissions, as well job and wealth creation.

What does the indicator show?
Figure 3.9 shows the proportions of various materials recycled in Saskatchewan from 2001 to 2010. In general, recycling rates in Saskatchewan are high and have remained so over the reporting period, with increasing rates in recovery for oil filters and containers. For example, SARCAN Recycling has recycled almost 8 billion beverage containers since it opened its doors in 1988 (SARCAN Recycling 2011). Over 85 per cent of all deposit-paid, ready-to-serve beverage containers sold in Saskatchewan are recycled, which makes this the highest return rate of all beverage container programs in Canada.

Over the last decade, the Saskatchewan Scrap Tire Corporation (SSTC) has been delivering a province-wide tire recycling program. In 2009 alone, 42 million pounds (784,000 tires) were reclaimed for recycling. Since SSTC began operating in 1996, over 13 million tires have been reclaimed, and all 300 stockpile sites were cleaned up by the end of 2009 (SSTC 2011).

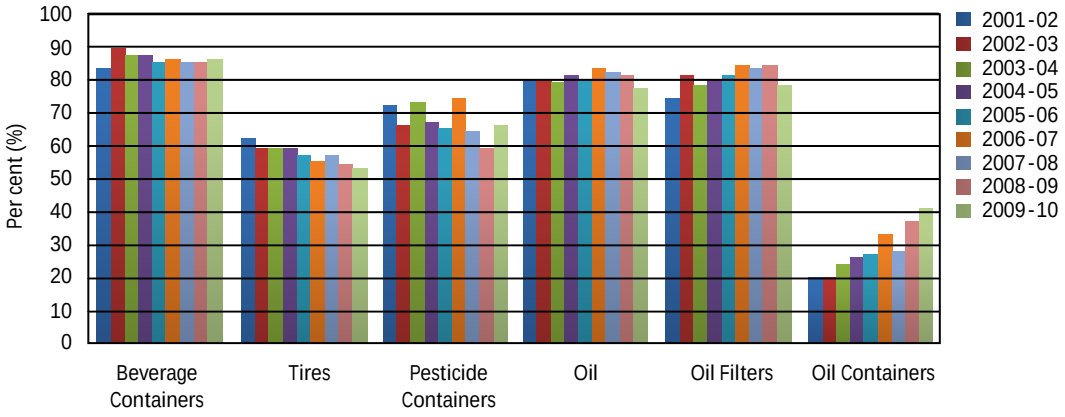
CropLife Canada's Pesticide Container Collection Program (CCPCCP) provides consumers, mainly agricultural producers, with an environmentally safe and convenient way to dispose of empty pesticide containers. Saskatchewan's agricultural producers generated approximately 2.4 million empty plastic pesticide containers in 2007. With proper cleaning, these containers can be recycled economically and in an environmentally safe fashion (CCPCCP 2011).

The Saskatchewan Association for Resource Recovery Corporation (SARRC) is responsible for recycling used oil materials in Saskatchewan. Since its program began in 1996, 2.7 million kilograms of oil containers, 21.6 million oil filters, and 195 million litres of used oil have been recycled (SARRC 2011).

More recent recycling efforts include electronic waste and paint. Total amounts of electronic waste and paint are provided as recycling rates are not available at this time. The Saskatchewan Waste Electronic Equipment Program (SWEEP) co-ordinates the collection and recycling of obsolete electronic equipment. Between 2007 and 2010, 5,962 tonnes of electronic waste was collected with increasing amounts in consecutive years (Saskatchewan Ministry of Environment 2011c, SWEEP 2011).

The Saskatchewan Paint Stewardship Program is managed by the paint industry through its non-profit association, Product Care. In 2007, the second year of the Saskatchewan Paint Stewardship Program, over 200,000 litres of waste paint was handled. This includes 33,000 litres of paint collected and reused through the "Paint Exchange" program (Saskatchewan Ministry of Environment 2008). In 2009, 109,900 litres of paint was collected or exchanged. The decline in the number of litres of waste paint collected and recycled can be attributed to the decrease in the amount of waste or unwanted paint that the public has remaining in storage (Saskatchewan Ministry of Environment 2010).

Figure 3.9 Proportions of Materials Recycled in Saskatchewan, 2001-2010



Source: Saskatchewan Ministry of Environment, Municipal Branch

What actions are being taken?

Waste recycling in Saskatchewan is growing each year thanks to the efforts of a number of organizations working with local and provincial governments. Additional information is available from Recycle Saskatchewan (2011) and the Saskatchewan Waste Reduction Council (2011).

Snapshots of Local Responses

Soil Conservation

The Saskatchewan Soil Conservation Association (SSCA) is a non-profit, producer-based organization formed in 1987 that actively promotes soil conservation in Saskatchewan through an annual conference, workshops, producer networking opportunities, and soil conservation extension materials. The SSCA publishes the *Prairie Steward* newsletter; has developed a peer reviewed e-Journal *Prairie Soils and Crops: Scientific Perspectives for Innovative Management* that provides current perspectives on soil and crop management issues on the prairies; and is an active proponent of conservation agriculture including the recent launch of a dedicated website - conservationagriculture.ca.

Stewards of Saskatchewan

Nature Saskatchewan's Stewards of Saskatchewan (SOS) is a suite of voluntary stewardship programs - Operation Burrowing Owl, Shrubs For Shrikes, Plovers On Shore, and Rare Plant Rescue - that engage rural landowners and land managers in conserving habitat in southern Saskatchewan to benefit species at risk, ecosystem integrity, and people. Through the use of ambassador species (e.g., the Burrowing Owl, Prairie Loggerhead Shrike, Piping Plover, and 16 endangered, threatened, or provincially rare plant species), the SOS programs aim to conserve natural and wildlife habitat, increase the public's awareness and knowledge of the species, provide support to land steward participants, enhance prairie habitat for species at risk, and search for and monitor target species at risk populations over time. While the focus is on species targeted by SOS programs, ultimately an array of prairie species and their habitat benefit from these programs.

Waste Reduction in Saskatchewan

The Saskatchewan Waste Reduction Council celebrates its 20th Anniversary in 2011. Activities of the Council include: organizing Waste Minimization Forum events held twice a year; promoting composting; working closely with provincial recycling programs and advocating for more recycling options; coordinating the Saskatchewan portion of Waste Reduction Week in Canada; publishing a bi-monthly newsletter, *WasteWatch*; and hosting the annual Saskatchewan Waste Minimization Awards. Their website, SaskWasteReduction.ca, has resources on a wide variety of waste-related topics and can help in finding information on what and where things can be recycled in Saskatchewan.

Used Oil Recycling

The Saskatchewan Association for Resource Recovery Corporation (SARRC) is a non-profit organization formed in 1996 by the oil and filter industry in Saskatchewan to develop, implement and maintain a province-wide Used Oil, Filter and Container Recycling Program. This highly successful industry-driven program has been widely accepted and supported by consumers, industry, environmental groups, governments and other stakeholders and has been adopted by other provinces.

Conclusion

Various land uses and management practices determine the current status of land health and environmental sustainability in Saskatchewan. Changes in land use influence whether the trend is either towards or away from enhancing biological diversity. The key to maintaining the health of the environment is the sustainable use of our resources through greater integration between our economy and the ecosystems that support it. The soil conservation story is an excellent example of how this can be achieved, as illustrated by the agricultural land cover condition indicator and zero-till response indicator. A substantial increase in soil cover, with the resulting benefits of increased organic matter and soil biological diversity, indicates an improvement in environmental sustainability in both agricultural land and adjacent natural areas. Healthy soils not only benefit farmers and the environment, but also ultimately our society as well.

The pressures on Saskatchewan's land are high and could increase with future industrial development as shown by the increase in mineral leases in the province. Continued industry leadership and innovation in environmental sustainability is required, in partnership with current regulatory reform, to help the province move towards a result-based approach to environmental management.

Working together is key in both private and public land stewardship, as shown by the efforts of individuals, organizations and government to secure and maintain healthy ecosystems that support native biological diversity. A private stewardship response indicator provides the status of programs that primarily focus on conservation stewards who own and manage private land in the agricultural areas of Saskatchewan. The Representative Areas Network (RAN), a complementary government conservation effort, is also a key component to land stewardship in the province.

Recycling waste is another example where the Government of Saskatchewan and local governments are working together with the private sector to establish recycling industries. Waste recycling in Saskatchewan is available for beverage containers, scrap tires, pesticide containers, used oil, oil filters and oil containers and now more recently with electronic waste and paint. Recycling rates have been generally steady with increasing rates in recovery for oil filters and containers and consecutive increases in recycled electronic waste in the program's first three years of operation.

FOREST

Key Points

- Saskatchewan's forests are diverse, healthy and productive.
- All age classes and forest types are represented in the forest.
- One-third of the commercial forest is old or very old.
- Natural disturbances, such as fire and insects, play a key role in maintaining forest diversity across the landscape.
- It is uncertain how climate change will affect natural disturbance regimes.
- In 2009/10, only 23 per cent of the annual allowable cut was harvested.
- Forest regeneration backlogs have been largely addressed, with 96 per cent of harvested areas successfully regenerated.

Forests are an important part of Saskatchewan's economy and environment. Over half of the province is forested, providing many benefits. As stewards of the forest resource, the Government of Saskatchewan is committed to its sustainable management. This means that the government will balance the human use of the forests for various socio-economic and cultural purposes with the need to protect the long-term health of forest ecosystems (Saskatchewan Ministry of Environment 2009).

Saskatchewan forests are also home to many thousands of species of plants and animals within a variety of ecosystems – this biological diversity or 'biodiversity' is often used as an indicator of ecosystem health. One measure of biodiversity, ecosystem diversity, is the variety and relative abundance of ecosystems and the plant and animal communities that they contain (Canadian Council of Forest Ministers 2003). Boreal forests have a variety of such ecosystems that are influenced over time by natural disturbances, such as insect and disease outbreaks and wildfires. Maintaining the natural range of ecosystems also results in a more resilient forest, better equipped to recover from human or natural disturbances. The first indicator, area of forest by type and age class, is intended to track ecosystem diversity over time, and serves as a proxy for total forest biodiversity.

Because the boreal forest ecosystem is dynamic and disturbance-driven, boreal species have evolved over thousands of years in response to the structure and pattern of forest stands created by natural disturbances and stand succession. Woodpeckers, for example, could not thrive without the presence of dead or dying trees and the insects they contain, while woodland caribou (*Rangifer tarandus*) prefer areas that have not burnt for several decades. Wildfire and insects are the dominant natural agents of change in the boreal forest, shaping the northern landscape. The second indicator, forest wildfire disturbance, tracks wildfire over time. In addition to fire, insects such as spruce budworm (*Choristoneura fumiferana)* and diseases are significant agents of disturbance and are natural parts of the ecosystem, periodically affecting large areas of the forest. The third indicator, forest insect and disease disturbance, tracks the levels of insect and disease disturbances in the boreal forest.

Harvesting is another type of disturbance affecting the forest landscape. However, the area of forest harvested each year is much less than that disturbed by wildfires and forest insects. Forest managers are working diligently to make human disturbances associated with logging more closely resemble natural disturbances in an effort to achieve sustainable forest management. The fourth indicator, the proportion of sustainable harvest level utilized, tracks this important measure of sustainability over time. The fifth and final indicator of long-term forest productivity and sustainable forest management practices is the proportion of timber harvested area successfully regenerated or, in other words, that the trees are restored in harvested areas to an accepted and measurable standard. Forests that are regenerated successfully are essential to a long-term sustainable flow of wood products and the maintenance of ecosystem diversity and productivity.

Condition Indicator: Forest Type and Age Class

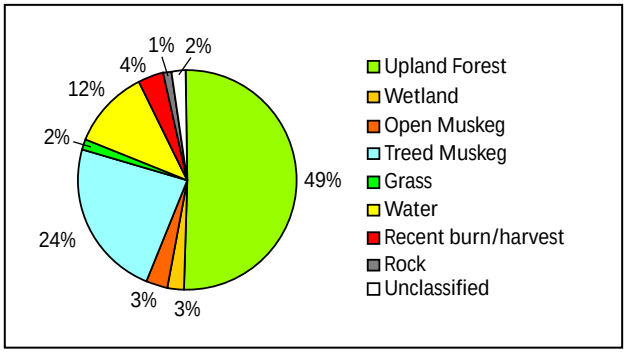
Why is this indicator important?
In order to maintain the forest values important to Saskatchewan residents (such as wildlife, pristine mature forests, forest products, forestry jobs etc.) in perpetuity, the natural forest condition and changes to it must be understood and sustainable forest management practices employed.

The Provincial Forest covers the northern half of Saskatchewan, an area of approximately 343,000 square kilometers or 53 per cent of Saskatchewan. Of this, about 60 per cent is covered by upland forest. Wetlands encompass about 12 per cent and land not covered with growing trees (open water, recent burns and harvested areas) make up the remaining 28 per cent. The area of the Provincial Forest that is viable for timber harvesting and receives the most impacts from human activities is called the Commercial Forest Zone, the area south of the Churchill River and North of the agricultural forest fringe. The Commercial Forest Zone has a diversity of forest types and ages. Maintaining the natural range of ecosystems results in a more resilient system, helping to sustain overall biological diversity.

What does this indicator show?
Figures 4.1, 4.2 and 4.3 illustrate the current status of forest types and forest age as a proxy of ecosystem diversity within the commercial forest of Saskatchewan, approximately 12.7 million hectares. Figure 4.1 shows that about half of this area is forested, while the rest is made up of other ecosystems such as muskegs, wetlands and open water. Figure 4.2 shows the diversity of ecosystems that exists within the forested portion of the commercial forest. This diversity is largely the result of differing soils, moisture regimes and previous disturbance history, mostly natural but sometimes human-caused. Figure 4.3 shows the combined hardwood-softwood age of these ecosystems following such disturbances. More than half of the commercial forest is currently either mature (70-90 years), old (91-120 years), or very old (120-plus years).

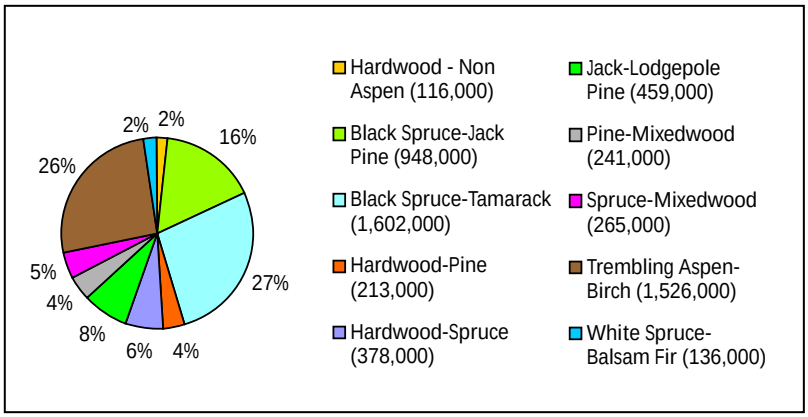
Although there is a fairly complete forest inventory for the Commercial Forest Zone, comparison to pre-industrial forest condition is not easily assessed. A comparison made between two forest inventories with source data of 1987 and 2002 in a sub-sample covering approximately 40 per cent of the Commercial Forest Zone indicated a trend in the reduced proportion of mixedwood cover types (forest composed of a mixture of hardwood and softwood species). The reduction in mixedwood forests was a reflection of a general shift to hardwood dominated forest types and, to a lesser extent, a shift to softwood types. A general shift towards more hardwood dominated forests is likely a result of the absence of forest renewal standards in the province until the mid-80s. Analysis over a longer period of time using additional inventories (as they become available) may clarify whether trends are occurring (Saskatchewan Ministry of Environment 2009).

Figure 4.1 Forest Inventory Stand Types in the Commercial Forest Zone in Saskatchewan as of April, 2009



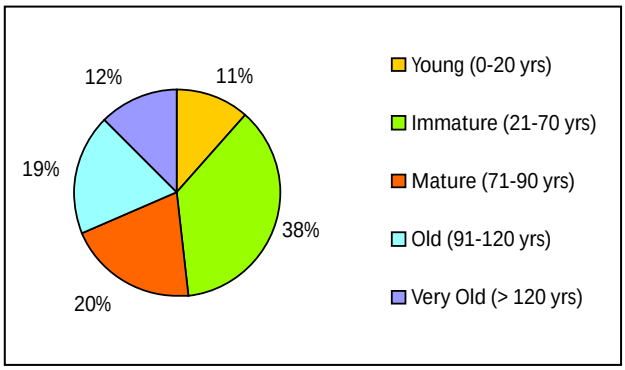
Source: Saskatchewan Ministry of Environment, Forest Service Branch

Figure 4.2 Forest Types (ha) in the Commercial Forest Zone in Saskatchewan as of April, 2009



Source: Saskatchewan Ministry of Environment, Forest Service Branch

Figure 4.3 Seral stages of Forest in the Commercial Forest Zone in Saskatchewan as of April, 2009



Source: Saskatchewan Ministry of Environment, Forest Service Branch

What actions are being taken?

The Forest Service Branch of the Ministry of Environment has a mandate to promote the sustainable use of forestland for the benefit of current and future generations by balancing the need for economic, social and cultural opportunities with the need to maintain and enhance the health of forestland. Two cornerstone Forest Service Branch programs that promote sustainable use of forestland are the Forest Practices program and the Forest Inventory and Planning program.

The Forest Practices program is responsible for development and amendment of legislation, regulation and code. *The Forest Resources Management Act*, amended in 2010, authorizes the development of codes and standards to govern the forest practices for those harvesting forest products in the Provincial Forest. Results-based codes and standards are being developed and the forest industry will be held accountable to them.

The Forest Inventory and Planning Program, working with the forest industry, develops and maintains forest inventories to facilitate proper management, through reporting of forest resources and accurate calculation of sustainable harvest levels. The program establishes tree growth and yield productivity data and provides computer modeling solutions such as wood supply analysis. The program also assists in the development of long-term forest management plans (FMPs) and monitors the progress of licensee's FMPs and Environmental Impact Assessments through collaborative Management Implementation Teams.

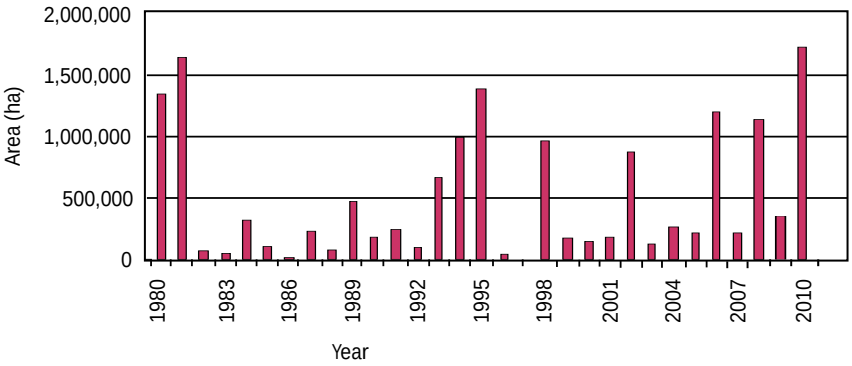
Stressor Indicator: Forest Wildfire Disturbance

Why is this indicator important?
Forest wildfires are the single largest source of natural disturbance in the boreal forest in Saskatchewan. Over time, they create the mosaic of ecosystems and their associated biodiversity that characterize the forest and provide the template for sustainable forest management. Some experts have predicted that boreal forest wildfire activity may increase due to global climate change (PARC 2010). Indicators like this may be useful to detect these potential changes in the future.

What does this indicator show?
Figure 4.4 shows the annual area of forest burned in Saskatchewan from 1980 to 2010.

The total amount of area burned by wildfires each year is extremely variable. In some years, practically nothing burns, and in other years, over one million hectares can be affected. This variation can be largely attributed to weather, particularly precipitation and temperature.

Figure 4.4 Annual Forest Area Burned by Wildfires in Saskatchewan



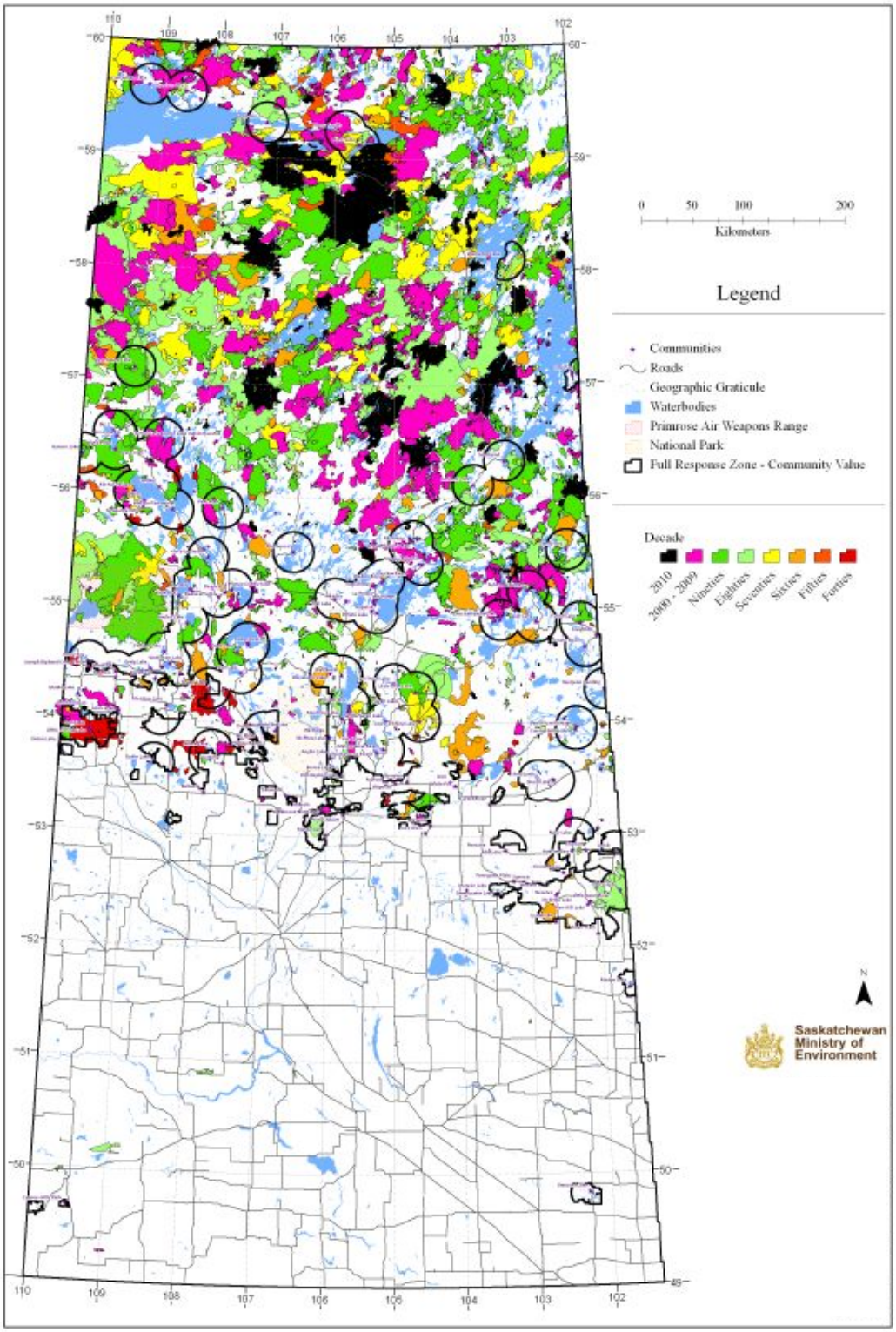
Source: Saskatchewan Ministry of Environment, Forest Service Branch

What actions are being taken?
The Wildfire Management Branch of the Ministry of Environment has adopted a number of wildfire management strategies (Saskatchewan Ministry of Environment 2010a) in conjunction with forest fire management strategy zones (Saskatchewan Ministry of Environment 2010b). The objectives of the management strategies are to continue to protect the things people value, while allowing fire to play a more natural and beneficial role on the landscape and reducing the extreme costs sometimes associated with managing all forest wildfires. The Wildfire Management Strategy Zones direct the way the province responds to wildfires and many factors are considered when deciding what actions to take on any particular forest fire. The Ministry of Environment believes that healthy, vibrant forests that are naturally renewed by fire, or through forest harvesting practices that approximate the disturbance created by wildfire, are in the best interest of northern residents, businesses and the province. However, aggressive suppression is sometimes the only appropriate action, such as in the full response zones around northern communities. The Commercial Forest Zone also receives significant fire suppression attention.

New forest fires are mapped every year (Figure 4.5), creating a database of landscape disturbances caused by fire in northern Saskatchewan for more than 60 years (Saskatchewan Ministry of Environment 2010c). This is an important planning tool for predicting future forest fires, timber volume allocations and wildlife management.

Other elements of the wildfire strategy include daily reporting during the fire season, fire bans during periods of high fire risk, the operation and maintenance of weather and fire observation towers, wildfire education and prevention, and aviation operations. Current capital infrastructure projects include the Cypress Hills Fire Base re-development, La Ronge Tanker Base apron, Buffalo Narrows bunkhouse, and the Southend Fire Base re-development.

Figure 4.5 Wildfire History 1945-2010



Stressor Indicator: Forest Insect and Disease Disturbance

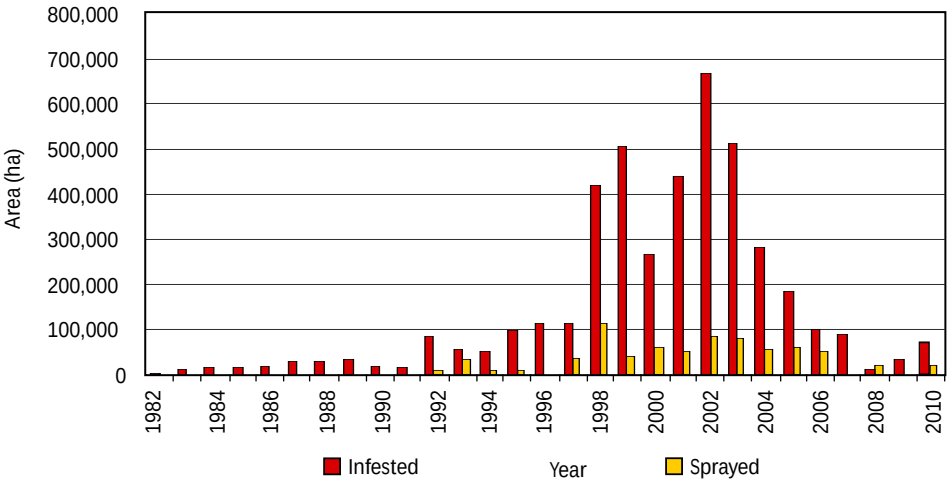
Why is this indicator important?
Disturbance to Saskatchewan's forests by various insects and diseases also plays a significant role in forest composition and structure and, therefore, in sustainable forest development (Saskatchewan Ministry of Environment 2009). There are a number of native species that serve as agents of change in the forest. However, climate change and changes in annual weather patterns may be affecting the numbers and distribution of native and invasive forest pests. Range expansion and changes in biology and the timing of life cycles may cause their effects to be greatly magnified over time (Logan and Powell 2004).

In addition to spruce budworm, the most significant and potentially devastating forest insect threat is mountain pine beetle *(Dendroctonus ponderosae)*, which is presently only found in Saskatchewan in the Cypress Hills area in association with lodgepole pine. However, in British Columbia this insect has killed millions of hectares of lodgepole pine forest and is moving eastwards, having reached Grande Prairie and east of Slave Lake in central Alberta where there are lodgepole pine and jack pine hybrid trees. Potentially, the mountain pine beetle could kill jack pine forests throughout Saskatchewan and right across to eastern Canada if it continues to spread eastward unchecked and becomes established in Saskatchewan's northern jack pine forests.

What does this indicator show?
Figure 4.6 shows the annual area of forest infested by spruce budworm in Saskatchewan from 1982 to 2010. It also shows the annual area treated with the natural insecticide Btk *(Bacillus thuringiensis kurstaki)* in efforts to manage the outbreak of the insect and to preserve high-value merchantable forest stands.

Spruce budworm is a recurring disturbance; outbreaks typically occur on 30- to 35-year cycles. A substantial outbreak of spruce budworm occurred in Saskatchewan between 1996 and 2005. The Ministry of Environment began spraying affected areas with Btk as early as 1992 in hopes of minimizing the area affected. However, area sprayed is relatively small in comparison to the total area under attack. The infestation reached its peak in 2002 and returned to pre-outbreak levels in 2008.

Figure 4.6 Annual Area Infested by Spruce Budworm and Sprayed



Source: Saskatchewan Ministry of Environment, Forest Service Branch

What actions are being taken?
The ministry has prepared a draft Forest Insect and Disease Action Plan for Saskatchewan. The plan sets the strategic and tactical framework for monitoring and mitigating insects and diseases in the province.

The ministry maps defoliated areas each July, using aerial surveys followed by ground surveys. Predictions of defoliation for the following year are determined by sampling over-wintering larvae in the autumn. The spruce budworm management program uses specific criteria in selecting areas for treatment, with the objective of keeping economically valuable trees green so they can be harvested within six to 20 years. If required, aerial spraying of the biological pesticide Btk to kill spruce budworm occurs during late May or early June.

Saskatchewan has banned the transport and storage of pine forest products with bark attached from British Columbia, Alberta and the United States to reduce the risk of inadvertently transporting mountain pine beetle into Saskatchewan's northern forests. Mountain pine beetle aerial surveys and ground-truthing activities have been completed on pine stands within the northern commercial forest and in the Cypress Hills Inter-provincial Park. Pine forest inventory information in the transitional agriculture lands south of the Crown forest has been collected and linked to the provincial inventory so that the disturbance and extent of susceptible forests can be used in risk analysis. The ministry is currently preparing a mountain pine beetle strategy for Saskatchewan.

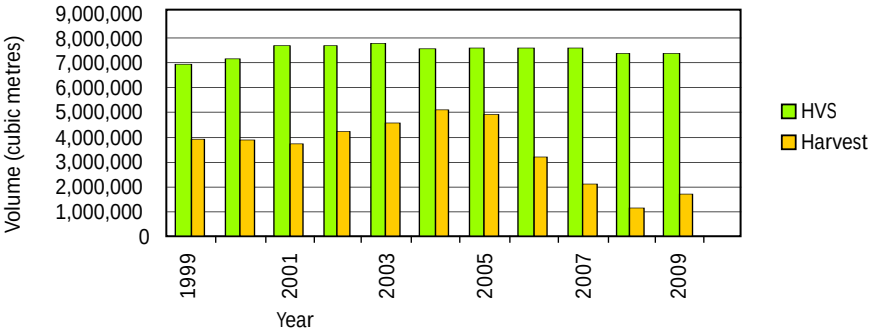
Stressor Indicator: Proportion of Sustainable Harvest Level Utilized

Why is this indicator important?
Annual sustainable timber harvest is called Harvest Volume Schedule (HVS) in Saskatchewan, or Annual Allowable Cut (AAC) in other jurisdictions. The HVS is determined for a licence area, based on assessments of economic, social and environmental values as processed through forest estate models over a 200-year timeframe. Keeping the annual harvest level under or equal to the HVS is one of the principles for sustainable forest management.

What does this indicator show?
Figure 4.7 shows the total annual calculated HVS relative to the actual total annual volume of timber harvested from 1999 to 2009 in Saskatchewan's commercial forests. For comparison with natural disturbances (Figures 4.4 and 4.6), the 10-year average harvested area within the Commercial Forest Zone is 22,000 hectares per year.

The HVS for Saskatchewan's forests has been relatively constant, between seven and eight million cubic metres of timber per year. While the forest could sustain this harvest level, in the northern portion of the Commercial Forest Zone the lower quality of wood, higher harvest and transportation costs, and limited infrastructure will affect how much of the available volume can be realized. The actual amount of timber harvested each year has been far less than the HVS and has even declined recently, largely as a result of depressed forest products markets and the global recession.

Figure 4.7 Saskatchewan Harvest Volume Schedule (HVS) and Actual Harvest



Source: Saskatchewan Ministry of Environment, Forest Service Branch

What actions are being taken?
The Ministry of Environment supports the efforts by the Ministry of Energy and Resources to revitalize the forest industry with the long-term goal of full utilization of the HVS.

New standards for 20-year forest management plans are in place to ensure sustainable harvest levels are consistent with long-term management objectives for a variety of environmental, economic and social forest values. These standards will also improve the accuracy of long-term timber supply forecasts.

The assignment of the Pasquia-Porcupine Forest Management Agreement (FMA) jointly to Edgewood Forest Products and Weyerhaeuser was completed in October 2009. The assignment and amending agreements for the Prince Albert FMA were signed in October 2010 with Sâkaw Askiy Forest Management Inc. (Sâkaw). The partnership company includes two First Nations groups (Agency Chiefs Tribal Council and Montreal Lake Cree Nation) and six forest companies (Carrier Lumber, Edgewood Forest Products, L&M Wood Products, Meadow Lake Mechanical Pulp, NorSask Forest Products and Meadow Lake OSB Limited Partnership). Additional volume will be allocated to independent timber operators through a formal Request for Proposals process.

Response Indicator: Forest Regeneration

Why is this indicator important?
Measures of reforestation are important because forests not sufficiently renewed to maintain their long-term productivity lose their commercial value, leading to socio-economic impacts on northern communities. Improperly renewed forests may also be ecologically different from forests prior to being harvested.

What does this indicator show?
Table 4.1 shows, for each timber license area in Saskatchewan, the area of forest harvested and the proportion that is sufficiently regenerated (SR) following reforestation efforts. Sufficiently regenerated means 80 per cent of the available growing area is occupied with trees at least 30 centimetres tall at seven years of age (or 1.5 metres tall at 14 years of age). It should be noted that most forests not sufficiently regenerated (NSR) according to this definition are still functioning boreal forest ecosystems, containing significant numbers of trees and wildlife habitats. However, low stocking levels in these areas diminishes their commercial timber value and, for this reason, they are designated as NSR. The table also shows who is responsible for NSR areas.

Overall, approximately 96 per cent of harvested forest areas in Saskatchewan have been successfully regenerated. Areas with the lowest proportions of successfully regenerated forests are the Island Forests, especially Fort-a-la-Corne, and the Pasquia-Porcupine FMA area. Most NSR forestlands in the province pre-date the establishment of FMAs and are therefore the responsibility of the government to restore to SR status.

Table 4.1 Saskatchewan Forest Harvest and Regeneration Status as of April, 2010

License Area	Harvest Period	Harvest Area (ha)	Sufficiently Regenerated Area (ha)	Sufficiently Regenerated Area (%)	Responsibility for Not Sufficiently Regenerated Areas
Pasquia Porcupine FMA[1]	1995-2010	75,404	73,896	98.0	Industry
Pasquia Porcupine FMA[1]	Pre-1995	225,231	220,006	97.0	Government
Prince Albert FMA[1]	1987-2010	156,504	154,000	98.4	Industry
Mistik FMA[1]	1984-2006	116,348	112,858	97.0	Industry
L&M FMA[2]	1987-2007	8,794	8,794	100.0	Industry
Mee-Toos TSL[2]	1999-2008	2,865	2,722	95.0	Industry and Government
Kitsaki-Zelensky TSL[2]	1999-2008	2,645	2,513	95.0	Industry and Government
North West Communities TSL[2]	2002-2008	237	225	94.9	Industry
Island Forests[1]	Pre-2008	28,325	16,466	58.1	Government
Meadow Lake OSB TSL[2]	2003-2006	3,270	3,270	100.0	Industry
Totals		619,623	594,750	96.0	

[1] Numbers include regeneration surveys and estimates
[2] Numbers are estimates only

Source: Saskatchewan Ministry of Environment, Forest Service Branch

What actions are being taken?
To address government renewal obligations on the Pasquia-Porcupine FMA area, tree planting, stand tending and site preparation activities will continue to be undertaken in 2011, along with a survey of the renewal success of older plantations. Remaining renewal responsibilities of the previous Prince Albert FMA holder were determined and have been assumed by the new licensee, Sâkaw Askiy Management Inc.

To address government renewal obligations in the Island Forests, tree planting and site preparation activities will be undertaken in 2011, along with a reassessment of regeneration surveys to better direct renewal efforts in subsequent years. The Island Forest NSR areas are primarily due to a series of fires in the forest in the early 2000s, which were followed by severe drought. Natural forest regeneration following fire did not occur, leaving areas that require remedial treatment. The ministry anticipates that all treatable NSR areas in the Island Forest will be planted over the next few years. Assessments of approximately 2,000 ha of NSR land within the Island Forests to determine the scale of renewal liability showed much less NSR land than previously estimated.

To assess industry performance against forest management plan assumptions and commitments, audits of regeneration surveys will be undertaken on a historical backlog of surveys on the Mistik and L&M FMAs. This will supplement audits of annually submitted regeneration surveys on other FMAs and Term Supply License (TSL) areas.

Current standards for regeneration are being incorporated into the new Saskatchewan Environmental Code, to be implemented in 2012. The code sets out results-based objectives for assessing forest regeneration.

Snapshots of Local Responses

Awareness and Education on Saskatchewan's Forests
The Saskatchewan Forestry Association is a non-profit organization that promotes public awareness and education about Saskatchewan's forests and related resources.

Much of this is accomplished by providing teachers in the province with information and ideas on teaching their students about this valuable resource. Teachers attend workshops and are directed to resources to help them include this area in their lessons.

Another goal for the Saskatchewan Forestry Association is to get students outdoors to experience the forest environment and draw their attention to the details of life in the forest.

Professionalism in Forest Management
The Association of Saskatchewan Forestry Professionals (ASFP) is a non-profit professional association currently comprising of 165 members, all of whom are either Registered Professional Foresters or Registered Professional Forest Technologists in the province.

The ASFP seeks to promote the profession of forestry to maintain competent and ethical management of the province's forests. The association is home to Saskatchewan's forestry practitioners who wish to demonstrate their dedication and ongoing commitment to the profession. Forestry professionals abide by *The Forestry Professions Act* and ASFP bylaws, which set the standards for members for continuing competency, professional conduct and membership, as well as the requirements of the ASFP's Code of Ethics.

Voluntary Sustainable Forestry Certification
Weyerhaeuser Company Limited Saskatchewan Timberlands' Sustainable Forest Management System has been certified to the 2010-2014 Sustainable Forestry Initiative Standard.

Meadow Lake OSB Limited Partnership's Sustainable Forest Management System has been certified to the CAN/CSA Z809:2002 Standard.

Mistik Management Limited's Sustainable Forest Management System has been certified to the CAN/CSA Z809:2002 Standard and its Forest Management Agreement area is certified to the Forest Stewardship Council (FSC), Canada's National Boreal Standard.

Conclusion

The condition, stressor and response indicators reported in this chapter can stand alone or be viewed as an integrated package, incorporating and reflecting the current environmental status of Saskatchewan's forests. Boreal forests are very dynamic ecosystems, constantly changing in response to landscape level natural disturbances such as wildfires and insect outbreaks.

This constant change produces two important results. First, as forest ecosystems are altered over time by natural forces, their distribution across the landscape becomes a mosaic or patchwork of habitat types. The second consideration is that all boreal forest species have evolved with, and adapted to this ever changing landscape. The woodland caribou (*Rangifer tarandus*), for example, is a species that naturally occurs at low densities and is strongly influenced by forest fires. Fires destroy its primary food source, lichens, over very large areas leaving behind only residual patches. For this reason, the caribou must live in small groups and cover large areas in their search for food. This makes them more sensitive to additional pressure from human activities such as road development, forest harvesting, oil and gas development, mining, and other industrial activities.

There is a growing consensus among scientists and foresters that if forest managers more closely emulate the natural pattern and young forest stand structure caused by natural disturbance, there is a reduced risk of creating undesirable effects, such as the loss of forest biodiversity. The Saskatchewan focus on using natural forest patterns to direct forest management creates landscapes that more closely resemble those naturally found in the boreal forest and should provide sufficient habitat for all forest species, including species like the woodland caribou (Saskatchewan Ministry of Environment 2009). However, it is first important to understand these patterns on the landscape, hence the need to track the type and age of forest habitat stands as outlined in this chapter. Currently, there is a very diverse mosaic of habitat types in our forests reflecting healthy levels of ecosystem diversity. Older forests are present in amounts greater than what would likely occur without human intervention. This is mainly due to several decades of forest fire management and harvest levels lower than the available harvest. This does not mean that there are no challenges and opportunities to improving forest management. The program to replant historic NSR lands is one example where past mistakes are being successfully rectified.

It is also important to understand that natural forces continue to affect the forest, thus the need to monitor and measure the effects of both wildfires and insect damage. Effects of fire, insect and disease disturbances serve to renew vast areas of forest, although the amount varies widely from year to year. The effects of natural disturbances need to be factored into the calculation of the sustainable harvest.

Forestry professionals are actively seeking ways to reduce negative effects on the forest environment. For example, it has been shown that forest bird communities in single-pass (i.e. one visit) harvest areas were more similar to the post-burn forest than were traditional multi-pass harvest areas (Saskatchewan Ministry of Environment 2009). Compared to multi-pass harvests, single-pass harvests are more similar to fire because the size of the harvest area is larger, more residual trees are left behind, there are fewer roads, the area is harvested in a shorter period of time, regenerating forest patch sizes are more similar to natural stands and other areas are left undisturbed for a period of time. This information confirms that using natural forest patterns as a basis for managing the forest brings us closer to the natural condition and increases the likelihood of conserving all species on a managed forest landscape.

WATER

Key Points

- Most surface water in Saskatchewan is found in the north, where the demand is lowest.
- The majority of Saskatchewan watersheds have good water quality, but five southern watersheds are considered stressed.
- Over thirty per cent of the available surface water is used in one quarter of the watersheds in Saskatchewan; all are in the southern half of the province.
- Saskatchewan's per capita water consumption is generally decreasing, except in a few southern watersheds.

Saskatchewan is blessed with an abundant supply of fresh water. More than 12 per cent of its surface is covered by water and seven per cent of Canada's fresh water can be found here. However, most of this water is in the northern half of Saskatchewan where human pressures are low. In the south, where most people live, conditions are semi-arid and the water supply is less abundant. As a result, drought and water shortages are frequent occurrences and maintaining water quality is a challenge.

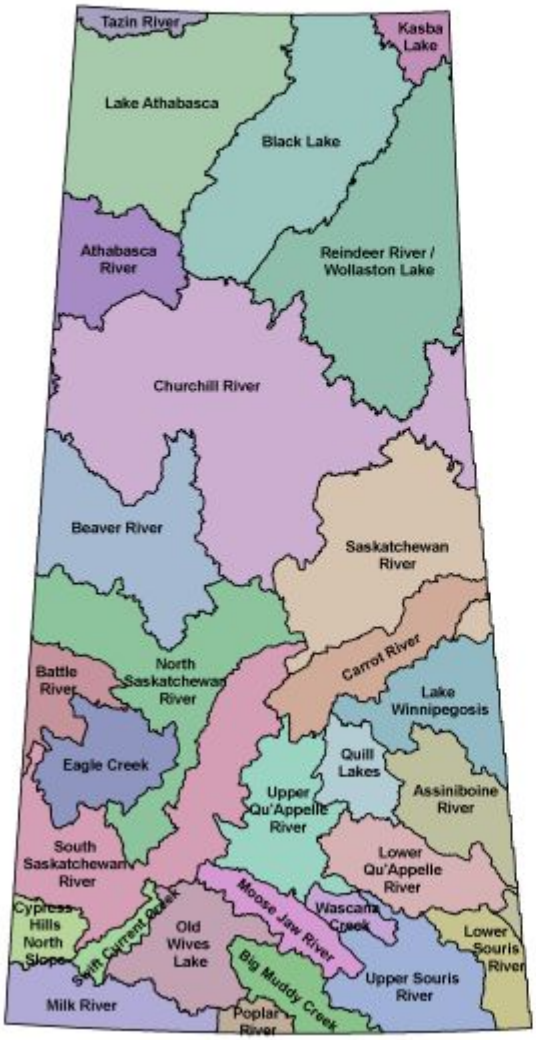
In 2002, the Saskatchewan Watershed Authority was established to manage and protect watersheds. As part of the government's long-term safe drinking water strategy, the Saskatchewan Watershed Authority consolidated the water management components from Sask Water, Saskatchewan Environment, and the Saskatchewan Wetland Conservation Corporation to focus on water management.

The Authority is responsible for the allocation of ground and surface water, the analysis of water sources, and the administration and control of the majority of water infrastructure in Saskatchewan including operations and planning. It is also responsible to manage watershed and aquifer planning, to develop partnerships and projects that help maintain healthy watersheds, and provide assessment and monitoring practices that ensure the protection and restoration of the province's water sources (Saskatchewan Water Authority 2010a). The Saskatchewan Watershed Authority conducts State of the Watershed reporting to regularly assess watershed health using condition, stressor, and response indicators of environmental health (Saskatchewan Water Authority 2006, 2007, 2010b). Saskatchewan's State of the Watershed report provides governments, decision-makers, industry and the community the scientifically defensible information needed to manage the province's water resources in an integrated fashion.

A watershed, or drainage basin, is a region that drains into a specific body of water, such as a river or lake, and includes all the land, air, plants and animals within its boundary. Each watershed has its own unique mixture of land and water habitats, from wetlands, rivers, and lakes to forests, grasslands, farms and communities. Hills or other heights of land largely determine the boundaries of watersheds, as well as the speed and path of its streams and rivers. All watersheds within Saskatchewan ultimately drain into the Arctic Ocean, Hudson Bay or Gulf of Mexico. The province has 14 major watersheds ranging from the tiny Tazin River in the far northwest to the Souris River Basin in the southeast. For management and reporting purposes, the Saskatchewan Watershed Authority further divides these 14 major watersheds into 29 smaller watersheds (Figure 5.1).

Surface water quality, surface water quantity, and water consumption and conservation have been selected as three key indicators to be reported on in the *2011 State of the Environment Report*. They were selected from an extensive and detailed analysis of indicators found in the *2010 State of the Watershed Report* (Saskatchewan Water Authority 2010b).

Figure 5.1 Watersheds of Saskatchewan as defined by the Saskatchewan Watershed Authority



Source: Saskatchewan Watershed Authority

Condition Indicator: Surface Water Quality

Why is this indicator important?
Uncontaminated water is important for maintaining healthy ecosystems and healthy human populations. The intent of the surface water quality condition indicator, reported as a Water Quality Index (WQI), is to provide a standardized way of comparing and reporting water quality measurements in our rivers, streams, and lakes. It is an assessment of the chemical, biological, and physical constituents of the water at a given place and time. Saskatchewan Watershed Authority collates the many measurements from a number of monitoring stations throughout the province and summarizes them as follows (Saskatchewan Water Authority 2010b):

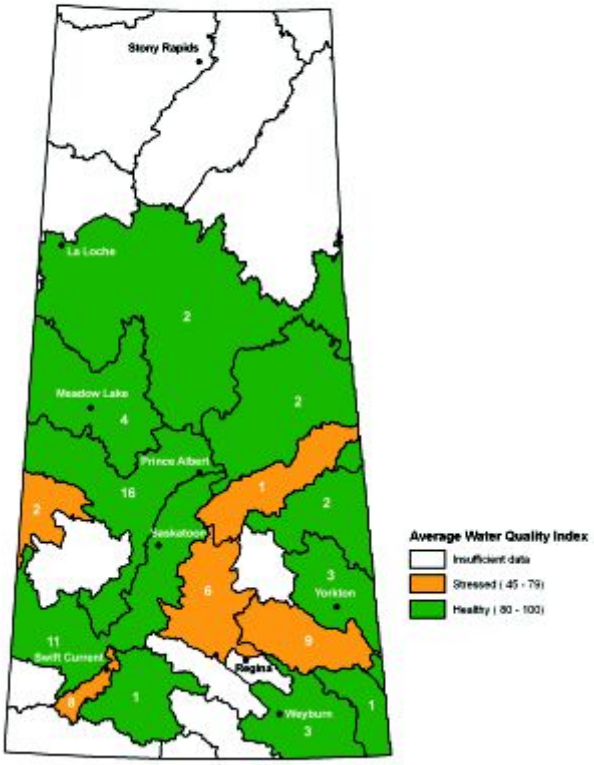
- Watersheds scoring between 80 and 100 are considered to be 'Healthy' (i.e. the watershed has no apparent change in function or services provided by water, and the system is both resistant and resilient to change);
- Watersheds scoring between 45 and 79 are considered to be 'Stressed' (i.e. the watershed has no degradation in function and/or services it provides); and
- Watersheds scoring less than 45 are considered to be 'Impacted' (i.e. the watershed has a change and/or degradation in function and/or services).

What does this indicator show?

Figure 5.2 shows the average Water Quality Index values for the watersheds of Saskatchewan from 2003 to 2007. Sufficient data existed for 15 watersheds to be able to report on their surface Water Quality Index. Of these, five (33 per cent) were judged to be Stressed (Assiniboine River, Battle River, Carrot River, Upper Qu'Appelle River, and Swift Current Creek) and ten (67 per cent) were judged to be Healthy.

Between 2002 and 2007, the average Water Quality Index values increased in eight of the 12 watersheds that had Water Quality Index values in both time periods. Three of these watersheds moved to a more improved condition rating category. The North Saskatchewan, South Saskatchewan, and Upper Souris River Watersheds, which were all classified as stressed in 2002, are classified as healthy in 2007 (Saskatchewan Water Authority 2010b). The Water Quality Index values change as a consequence of changes in water quality and are also a function of the number of sites, frequency of sampling and the variables assessed.

Figure 5.2 Average Water Quality Index Values for the Watersheds of Saskatchewan, 2003-2007.



Source: Saskatchewan Watershed Authority (2010b)
Note: The numbers within the watershed boundaries represent the number of monitoring stations used to calculate the averages.

What actions are being taken?

A range of legislative tools, strategies and policies assist in protecting and improving water quality in Saskatchewan, including:

- *The Environmental Management and Protection Act, 2002,* administered by Saskatchewan by the Ministry of Environment
- *The Fisheries Act*, regulated by Fisheries and Oceans Canada
- The Interim Surface Water Quality Objectives as determined by the Saskatchewan Ministry of Environment
- Saskatchewan's Safe Drinking Water Strategy, Government of Saskatchewan 2002

The Saskatchewan Ministry of Health administers *The Public Health Act, 1994*. This act manages public health issues in Saskatchewan, including ensuring that there is potable water for use by the inhabitants of a hamlet, organized hamlet, town or other municipality, not including rural municipality or northern municipalities. *The Water Regulations, 2002,* administered by the Saskatchewan Ministry of Environment, regulate the operation of public water systems to ensure adherence to the Canadian Drinking Water Quality Guidelines (Health Canada 2008) and Saskatchewan's Drinking Water Quality Standards and Objectives.

To assess the safety and suitability of private water sources for human consumption, the Saskatchewan Watershed Authority uses the Canadian Drinking Water Quality Guidelines (Health Canada 2008) and Saskatchewan's Drinking Water Quality Standards and Objectives. The Drinking Water Quality Standards are used for all potable water sources, private or otherwise. However, they are only enforced with regulated systems.

In addition to legislative tools, there is a number of federal and provincial government programs in the province that monitor the quality of surface and/or ground water for a variety of purposes. These monitoring programs include:

- The Saskatchewan Ministry of Environment's Surface Water Monitoring Program
- The Prairie Provinces Water Board's Monitoring Program
- The Saskatchewan Watershed Authority's River and Lake Water Quality Monitoring
- The Saskatchewan Ministry of Environment's Intensive Livestock Operations' Monitoring Program
- The Saskatchewan Ministry of Environment's Cumulative Effects Monitoring Program in northern Saskatchewan
- Environment Canada's Environmental Effects Monitoring Program
- The Saskatchewan Ministry of Agriculture's Baseline Environmental Monitoring of Lower Order Streams in Saskatchewan (BEMLOSS) Program
- The Water Survey of Canada, an Environment Canada initiative (water quantity)
- The Saskatchewan Watershed Authority Provincial Streamflow Forecast (water quantity)

Stressor Indicator: Surface Water Quantity

Why is this indicator important?
Surface water quantity is the amount of surface water within a watershed. From an environmental perspective, water quantity stressors relate to departures from the natural flow regime due to human use and development (Saskatchewan Water Authority 2007, 2010b). In Saskatchewan, surface water is used for many purposes, including: human consumption; ecosystem health; and economic activities such as industrial uses, power generation, and agriculture. Natural fluctuations in stream flows are important for conserving the biodiversity and health of ecosystems such as wetlands and riparian areas. Changes in flow regimes affect the aquatic ecology of these ecosystems and may result in alterations in aquatic habitat, aquatic communities, riparian zones, floodplains, wetlands, the stability of river channels, and water levels.

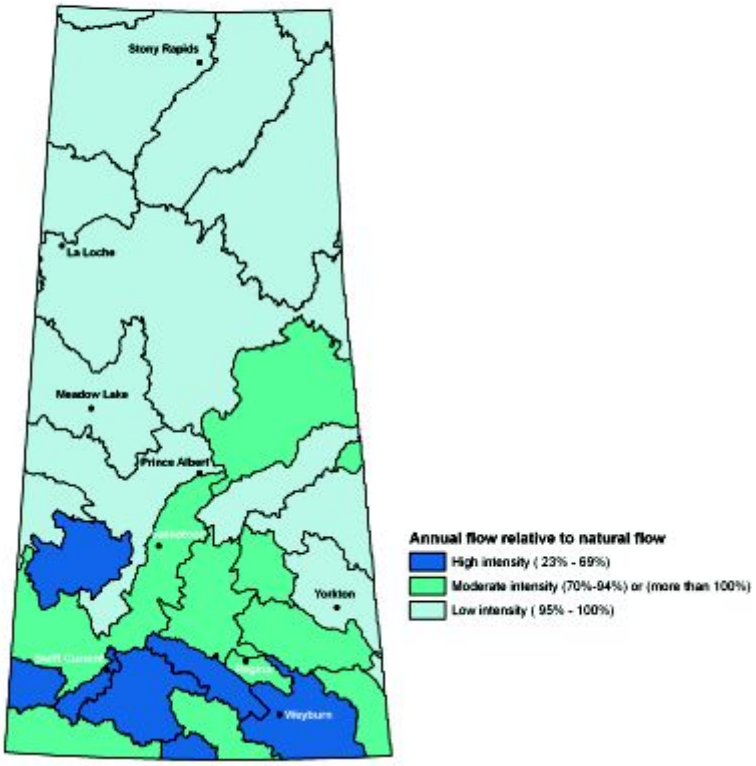
The amount of flow in a river or stream is affected by a number of factors including precipitation, soil infiltration rate, groundwater discharge, evapotranspiration, aquatic fragmentation, water regulation, water withdrawals, and water inputs from human sources such as irrigation, wastewater, and directed storm water runoff. The net available surface water in a watershed can be estimated by subtracting the sum of water allocations and downstream obligations from the estimated natural runoff volume. Other stressors to water supply in Saskatchewan include variability in short-term and long-term weather patterns, and increasing use and diversion in upstream jurisdictions (Saskatchewan Water Authority 2007, 2010b).

What does this indicator show?

Figure 5.3 shows the Surface Water Quantity indicator values (average annual recorded flow volume as a percentage of natural flow volume within the last 30 years) for all watersheds in Saskatchewan (Saskatchewan Water Authority 2010b). Note that the Surface Water Quantity indicator was reported in the *2007 State of the Watershed Report* as a condition indicator (Saskatchewan Water Authority 2007) and a stressor indicator in the 2010 *State of the Watershed Report (*Saskatchewan Water Authority *2010b)*. The change was made to better reflect how variations in surface water flow (either less or more than 100 per cent of the natural flow) affect the amount of water required for various ecological services; and is maintained here for consistency. The indicator is categorized into three classes: Low Intensity; Moderate Intensity; and High Intensity. Low Intensity means 95 to 100 per cent of the water is available to the ecosystem; Moderate Intensity means 70 to 94 (or more than 100) per cent is available; and High Intensity means less than 70 per cent is available.

Seven of the 29 watersheds (24 per cent) are rated as High Intensity and nine (31 per cent) are Moderate Intensity; all are in the southern half of the province where the human population and demand for water are highest. Two watersheds with the recorded flow being more than 100 per cent of the natural flow include the Lower Qu'Appelle River and the Upper Qu'Appelle Watersheds; due to the diversion of water from the South Saskatchewan River and Lake Diefenbaker through the Qu'Appelle conveyance channel. The remaining watersheds (45 per cent) are all rated as Low Intensity.

Figure 5.3 Average Annual Recorded Flow Volume as a Percentage of Natural Flow Volume in Saskatchewan's Watersheds



Source: Saskatchewan Watershed Authority

What actions are being taken?

To address the potential impact of development and climate change on flow, the Saskatchewan Watershed Authority initiated the Water Availability Study in 2009. One of the components of this study is to model and assess the potential impact of current, proposed and potential developments, combined with climate change, on flows in the North and South Saskatchewan rivers and the Qu'Appelle Diversion.

The Saskatchewan Watershed Authority Act, 2005, administered by the Saskatchewan Watershed Authority, in part, accounts for and regulates the alteration of surface water flow. The act regulates:

- The construction, extension, alteration and operation of any works (e.g. dikes, dams, weirs, floodgates, breakwaters, reservoirs, canals, tunnels, bridges and culverts) in Saskatchewan
- Surface water allocation by issuing approvals to construct and operate works and water rights licenses, with the exception of domestic use

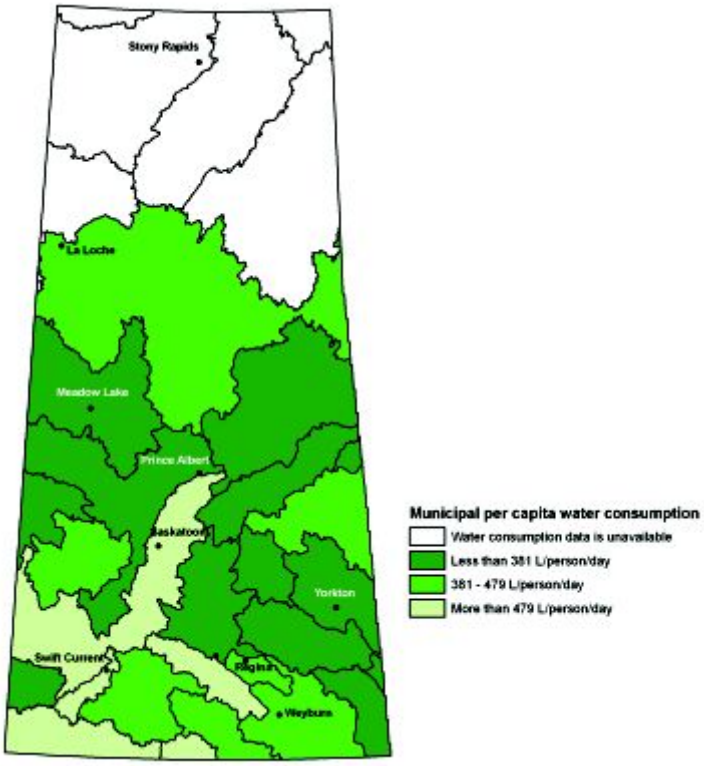
Response Indicator: Water Consumption and Conservation

Why is this indicator important?
Despite the abundance of water in Saskatchewan, most of it is in the northern half of the province, and much of the water in the south is directed for human use. This, combined with the semi-arid climate of the prairies, means that the conservation of water should be a high priority.

What does this indicator show?
Figure 5.4 shows the daily per capita municipal water consumption in Saskatchewan's watersheds in 2007 (Saskatchewan Water Authority 2010b). Municipal water use includes water used mainly for residential, industrial, and commercial uses.

For 2007 (Figure 5.4), municipal per capita water consumption is rated as less than 381 litres/person/day for 11 watersheds, between 381 and 479 litres/person/day for seven watersheds, and more than 479 litres/person/day for five watersheds. For 1997 (not shown), municipal per capita water consumption was rated at less than 381 litres/person/day for five watersheds, between 381 and 479 litres/person/day for 14 watersheds, and more than 479 litres/person/day for five watersheds. Comparing 2007 with 1997, nineteen of the 23 watersheds in which water consumption data is available for both years had, on average, a 12 per cent decrease in per capita water consumption between 1997 and 2007. Reasons for the decrease in water use include, for example, increased water conservation, repaired leaks and improvements in how

Figure 5.4 Estimate of Per Capita Daily Municipal Water Consumption by Watershed: 2007



Source: Saskatchewan Watershed Authority

water use is recorded. The Battle River, Moose Jaw River, Big Muddy Creek, and Milk River Watersheds were the only four watersheds that had an increase in per capita water consumption, with three per cent, 10 per cent, 16 per cent, and 39 per cent increases, respectively. Reasons for the increase in water use in the four watersheds include, for example, a new industrial user (as municipal us includes both domestic and some industries) or an increase in leaks. However, to fully understand these increases or decreases individual studies on these watersheds would be required.

What actions are being taken?
A detailed description of various water conservation programs and measures in use in Saskatchewan can be found in the most recent *2010 State of the Watershed Report* (Saskatchewan Watershed Authority 2010b). The following are some selected examples:

Providing educational information on water conservation to the public
The Saskatchewan Environmental Society, in partnership with the Saskatchewan Watershed Authority, published a booklet entitled *Water Use in Your Home: What you need to know to use less and spend less*. Funding support for the booklet was provided by the Saskatchewan Ministry of Environment through the Go Green Fund. The booklet provides information on how homeowners can conduct an in-home water audit and ways of reducing indoor and outdoor water use. In addition to distributed copies, the booklet is available online (Saskatchewan Environmental Society 2009).

Promoting the purchase and use of water efficient fixtures
In January 2009, the Government of Saskatchewan initiated the Provincial Toilet Replacement Rebate Program. This program, which is funded through the Go Green Fund and administered by the Saskatchewan Watershed Authority, provides a rebate of $50 for the purchase of a toilet that uses six litres or less per flush (including dual flush models) when it replaces a higher volume toilet in single family dwellings and multiple-unit complexes (up to a maximum of three toilets per home or unit). The program will operate for four years, ending December 2012. As of February 2011, 30,364 toilets have been replaced with total savings of 1 billion litres of water and reduction in CO_2 emissions of 3,231 tonnes.

Universal metering
Used with a volume-based pricing structure, water metering is a good water conservation practice, as it provides a measure of consumers' actual water use. According to the 2006 Municipal Water Use Survey, of the Saskatchewan municipalities that responded to the survey, 98.2 per cent of residential clients and 98.9 per cent of business clients served by municipal water systems were metered. According to the survey, the Province of Saskatchewan had the highest percentage of metered residential clients in the country (Environment Canada 2010).

Water accounting
Water accounting helps to determine: how much water is in the system (supply); who is using the water (allocation and use); and what the water is being used for (purpose). In 2007, the Saskatchewan Watershed Authority initiated the Battle Creek Conservation Pilot Study in the Milk River Watershed, part of the Missouri River Basin. The study aims to improve the knowledge and understanding of water resources for irrigation projects within the Battle Creek sub-basin. As of February 2011, the Saskatchewan Watershed Authority has reviewed 99 previously issued Water Right Licences for the Battle Creek sub-basin. As a result of this study 18 landowners were contacted and their Water Right Licences were re-issued appurtenant to their land. A number of the previously issued Water Right Licences for the Battle Creek sub-basin were considered to be valid at the time of the review and did not require follow-up.

Other programs for water conservation include:
- establishing water conservation partnerships; water loss control by conducting water audits;
- developing, in conjunction with industry associations, industry recommended practices; and
- promoting sustainable irrigation through research and demonstration projects (Saskatchewan Watershed Authority 2010b).

Snapshots of Local Responses

Educating and Engaging our Future Stewards

The Saskatchewan Prairie Conservation Action Plan (PCAP) delivers the *Cows, Fish, Cattle Dogs & Kids Game Show*, an interactive educational program about prairie riparian areas, to Grades K to 6 students. Since its introduction at Agribition in 1998, over 62,000 elementary students have participated in the Game Show, which educates students about riparian areas and decision-making related to ranch management through the rolling of a dice and answering questions to "moooove" their cow "home to the ranch." Topics include Cows, Water, Fish, Vegetation, Wildlife and Climate Change. The Game Show also illustrates how ranchers, farmers, and urban dwellers need to work cooperatively to maintain these important "green zones".

Wetlands, Waterfowl and Environmental Education

Project Webfoot is Ducks Unlimited Canada's (DUC) curriculum-based education program. It has been designed to help students learn about wetlands, waterfowl, other wildlife, conservation and the environment; both inside and outside the classroom. In Saskatchewan, most Project Webfoot programs are delivered to Grades 4, 5 and 6 students and consist of class presentations and/or wetland field trips with DUC staff or education contractors. There is a sponsorship component of Project Webfoot that provides students and their teachers with a wetland resource kit, mailed to their school. DUC also has the Greenwing Program where school-aged youth may become members of Ducks Unlimited and will receive a certificate of membership, a subscription to either *Puddler* magazine (aged 12 and under) or the *Conservator* magazine (12 to 17 years old), and a copy of the Marsh World wetland guidebook.

Local Watershed Stewardship

Various watershed stewardship groups, made up of local residents, producers, land managers, industry and municipalities, have been established throughout Saskatchewan to lead the implementation and monitoring of watershed and aquifer source water protection plans. These plans are the result of the Saskatchewan Watershed Authority's Watershed and Aquifer Planning program, initiated in 2002, to develop source water protection plans that identify and integrate existing land use interests. The watershed stewardship groups include: the Assiniboine Watershed Stewardship Association, the Lower Souris Watershed Committee Inc., the Moose Jaw River Watershed Stewards, the North Saskatchewan River Basin Council, the South Saskatchewan River Watershed Stewards Inc., the Swift Current Creek Watershed Stewards and the Wascana Upper Qu'Appelle Watersheds Association Taking Responsibility, Inc. The watershed and aquifer planning process has also been initiated in the Carrot River, Lower Qu'Appelle River, and Upper Souris River Watersheds.

Conclusion

Southern Saskatchewan has high demands on its limited water resources, as reflected by the status of the key water indicators selected in this report and those reported on in the *2010 State of the Watershed Report*. With a growing economy and population, these pressures are likely to increase in the future.

The Saskatchewan Watershed Authority has developed an overall rating system that looks at the health of watersheds based on six condition indicators; a stress rating of watersheds based on 22 stressor indicators; and a response rating based on nine indicators (Saskatchewan Watershed Authority 2010b). To summarize, of Saskatchewan's 29 watersheds, 23 (79 per cent) have either Impacted or Stressed Condition ratings, and 18 (62 per cent) have either Moderate or High Stressor ratings. Most of these affected watersheds are found in southern Saskatchewan. Fortunately, 25 (86 per cent) of our watersheds have a High Response rating, indicating that a great deal is being done to improve the health of the province's watersheds and their associated water resources.

MOVING FORWARD

Setting the Stage for Future State of Environment Reporting

The reporting framework, themes and indicators outlined in this report provided the essential building blocks to prepare the Saskatchewan *2011 State of the Environment Report.* State of the Environment reporting will continue to evolve in response to changing environmental priorities and public concerns, and a drive for continuous improvement in reporting. One key consideration for the future of State of the Environment reporting in Saskatchewan is the province's transition towards a new results-based regulatory system.

Results-based Regulations

Saskatchewan is adopting a new, less prescriptive legal framework for managing and protecting the environment as a way to address growing demands and to foster innovative solutions by industry for enhanced environmental protection (Saskatchewan Ministry of Environment 2009, 2011a). Saskatchewan's current regulatory regime was developed in the 1970s, to address industrial point source pollution and non-renewable resource harvesting. The new results-based model represents a significant shift away from highly prescriptive legislation and regulations to a focus on holding proponents accountable for achieving desired environmental outcomes.

To support the new results-based approach, several key pieces of enabling legislation were modernized. Introduced in the fall 2009 legislative session and passed by the legislature in spring 2010, these include *The Environmental Assessment Act*, *The Forest Resources Management Act*, *The Environmental Management and Protection Act* and *The Management and Reduction of Greenhouse Gases Act*. The new or amended versions of these acts have been passed but have not been proclaimed, so they do not yet have the force of law. Once initial sections of the new Saskatchewan Environmental Code are completed, the new legislative framework will be brought into effect. The code, a key feature of the new results-based model, is targeted for completion in the spring of 2012.

The Saskatchewan Environmental Code

One of the key features of the new results-based regulatory system will be the Saskatchewan Environmental Code, a clear, concise statement of objectives, recommended practices and alternatives that will govern the management and protection of Saskatchewan's environment and natural resources while promoting economic growth (Saskatchewan Ministry of Environment 2011b).

The code will provide clear directions and guidelines for developing projects, allowing operators in many situations to proceed without waiting for the ministerial approval process. In essence, the Saskatchewan Environmental Code defines the required environmental outcomes and leaves how to achieve compliance up to the regulated stakeholder. A Code Development Committee (CDC) was established in the summer of 2010 as a formal forum to develop the code by consensus. It provides advice and guidance to the minister on the content of the code and its supporting materials. Made up of 19 stakeholder representatives, including industry, environmental organizations and communities; their function serves to provide the opportunity to contribute directly to the development of the code.

State of the Environment Reporting – where to from here?

Given the move towards a new results-based regulatory system, it makes sense for future state of the environment reporting to not only become more aligned with the new legal framework and its focus on outcomes, but also to achieve greater integration among the various reporting mechanisms in the province. To this end, the Saskatchewan Ministry of Environment will initiate a strategic review of its State of the Environment reporting to guide the content and delivery of future reports. Part of this review will determine how the report and reporting framework is positioned both within the ministry and relative to other environmental management, planning and reporting frameworks in Saskatchewan; such as the State of the Watershed, State of Saskatchewan's Provincial Forests, Saskatchewan Environmental Code, and the ministry's performance measures. The review will also explore the possibilities for web-based reporting and continuous updating as currently adopted by other jurisdications.

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List of Acronyms

AAC	Annual Allowable Cut
AQI	Air Quality Index
AQMS	Air Quality Management System
ASFP	Association of Saskatchewan Forestry Professionals
BEMLOSS	Baseline Environmental Monitoring of Lower Order Streams in Saskatchewan
CAAQS	Canadian Ambient Air Quality Standards
CACs	criteria air contaminants
CCME	Canadian Council of Ministers of the Environment
CCPCCP	CropLife Canada's Pesticide Container Collection Program
CDC	Code Development Committee
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canada-wide Standard
DUC	Ducks Unlimited Canada
e3	Environmental Excellence in Exploration
ECRF	Emissions Control Research Facility
FMA	Forest Management Agreement
FMPs	forest management plans
FSC	Forest Stewardship Council
GDP	gross domestic product
GHG	greenhouse gas
HLA	Hydraulic Launch Assist
HVS	Harvest Volume Schedule
IPPC	Intergovernmental Panel on Climate Change
NPRI	National Pollutant Release Inventory
NSR	not sufficiently regenerated
OSB	oriented strandboard
PARC	Prairie Adaptation Research Collaborative
PCAP	Prairie Conservation Action Plan
PM	particulate matter
RAN	Representative Areas Network
SAML	Saskatchewan Air Monitoring Laboratory
SARRC	Saskatchewan Association for Resource Recovery Corporation
SCDC	Saskatchewan Conservation Data Centre
SESAA	Southeast Saskatchewan Airshed Association
SOS	Stewards of Saskatchewan
SR	sufficiently regenerated
SSCA	Saskatchewan Soil Conservation Association
SSTC	Saskatchewan Scrap Tire Corporation
SWA	Saskatchewan Watershed Authority
SWEEP	Saskatchewan Waste Electronic Equipment Program
TSL	Term Supply Licence
VOCs	volatile organic compounds
WQI	Water Quality Index

Glossary

acid deposition - the process by which acids are deposited, either by wet deposition in the form of rain, snow, sleet, hail or fog or as dry deposition in the form of particulates such as fly ash, sulphates, nitrates, or as gases like sulphur dioxide (SO_2) and nitrogen oxides (NO_x).

Agro-ecosystem - species and ecosystems under agricultural management; an open, dynamic system connected to other ecosystems through the flow of energy and the transfer of material such as crops, pastures, livestock, other flora and fauna, air, soil and water ( ).

Air Quality Index - is an indicator of air quality, based on air pollutants that have adverse effects on human health and the environment. The pollutants are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), and fine particulate matter (PM).

air zone - is a geographic region that shares the same air quality characteristics. The air zone boundaries may be established considering topographic features, meteorology, economic activities, pollution sources, political boundaries, and common air quality issues.

ambient - surrounding, or on all sides.

biodiversity (biological diversity) - refers to the wealth of life forms on earth, including plants, animals, micro-organisms, the genes they possess and their habitats.

boreal forest - consists of a vegetation type dominated by coniferous trees, especially black and white spruce, balsam fir or larch, interspersed with deciduous trees such as birch and aspen.

carbon sequestration - the provision of long-term storage of carbon in terrestrial or aquatic ecosystems, or underground, so that the buildup of carbon dioxide (a major greenhouse gas) concentration in the atmosphere will be reduced.

carbon sink - an area where the rate of carbon uptake by living organisms exceeds the rate of carbon release.

climate change - an alteration in measured quantities (e.g. precipitation, temperature, radiation, wind, cloudiness) within the climate system, that is significantly different from previous average conditions and is seen to endure - bringing about corresponding changes in ecosystems and socio-economic activity.

condition indicators - represent the health or status of both the structure and services of the environment, and how the structure and services function together.

coniferous - evergreen shrubs and trees characterized by needle-shaped leaves, cones and a resinous wood.

criteria air contaminants (CACs) - emissions of criteria air contaminants contribute to smog, poor air quality and acid rain. CACs include total particulate matter (TPM), particulate matter with a diameter less than 10 microns (PM_{10}), particulate matter with a diameter less than 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur oxides (SO_x), volatile organic compounds (VOC), and ammonia (NH_3).

deciduous - plants which shed their leaves or needles at a particular season, usually autumn.

ecoregion - broad integrated land area characterized by a unique combination of landscape, physiography and ecoclimate within the Ecological Land Classification (ELC) System.

ecosystem - the interaction of plants, animals, other organisms and non-living components, which function together to circulate nutrients and create a flow of energy.

emissions - polluted gases, particles, or liquids released into the atmosphere.

emission sources -

- open sources: emission sources that emit air contaminants over large geographical areas, primarily in a stationary but non-point source manner, and are diffuse in nature. Examples include dust from farms, construction, and paved and unpaved roads.
- natural sources: emission sources such as biogenic emissions from vegetation, biological and geological sources, and wildfires.
- industrial sources: emissions sources such as mining, upstream oil and gas, petroleum refining, steel production, chemicals, asphalt plants, pulp and paper and grain industries.
- non-industrial sources: emission sources such as power generation utilities, commercial and residential fuel combustion, and residential fuel wood combustion.
- mobile sources: transportation emission sources such as wheeled vehicles, ships, aircraft and railroad locomotives.

evapo-transpiration - the movement of water from the soil and plant communities to the atmosphere by evaporation of water from the soil and transpiration of water by plants.

Forest Management Agreement (FMA) - an agreement entered into by the minister pursuant to The Forest Resources Management Act, where the term of the agreement is not exceed 20 years, with provisions setting out the rights of the licensee for the harvesting of forest products and the responsibilities of the licensee for the renewal of specified forest products.

fugitive emissions - air pollution derived from human activities that do not emanate from a particular point, such as an exhaust pipe or stack. Roadway dust and volatile organic compounds (VOCs) from refinery valves are examples of fugitive emissions.

greenhouse gases - gases such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxide and water vapor that trap heat in the Earth's atmosphere and contribute to global warming.

hectare - one hectare is the equivalent of 10,000 m2 (0.01 km2) or 2.471 acres. A hectare could also be considered the area of slightly less than three Canadian football fields.

indicator - physical, chemical, biological or socio-economic measures used to simplify, describe, monitor and interpret environmental functions.

legislation - the act or process of making laws.

micron - 39.37 millionths of an inch, or 0.001 millimetre.

NSR (Not Sufficiently Regenerated) - is defined as area not meeting regeneration standards.

non-point source - a source of atmospheric, aquatic or terrestrial pollution in which naturally occurring or human-created pollutants are discharged over a widespread area or from a number of small inputs, rather than from one distinct, identifiable source (point source).

particulates - fine liquid or solid particles that remain suspended in the air for any length of time such as dust, smoke, mist, fumes or smog found in the air of emissions. Particulate matter can be broken down into the following categories:

- total particulate matter (TPM): any particulate matter with a diameter less than 100 microns.
- particulate matter less than or equal to 2.5 microns ($PM_{2.5}$): any particulate matter with a diameter less than or equal to 2.5 microns.
- particulate matter less than or equal to 10 microns (PM_{10}): any particulate matter with a diameter less than or equal to 10 microns.

pH – An expression of the intensity of the basic or acidic condition of a liquid or of soil generally expressed on a scale ranging from 0 to 14 where values below 7 are acidic, 7 is neutral and values above 7 are considered alkaline.

point sources - any stationary source that usually releases emissions through stacks or other emissions sources, for which individual source records are maintained in the inventory and for which annual emissions exceed a specified cut-off level.

policy - a defined course of action adopted by an organization or government.

Provincial Forest - any Crown resource land designated by the Minister pursuant to section 12 of *The Forest Resources Management Act*.

response indicators - represent the management activities implemented to mitigate the stress and improve the health of the environment

riparian - transition zones between land and water environments pertaining to anything connected with, or immediately adjacent to, the banks of a lake, river or other body of water.

seral stages - A broad range of forest stand ages across landscapes. Seral-stage communities consist of vegetation types that are adapted to the site's particular set of physical and biotic conditions. In the unmanaged forested landscape, various natural disturbance agents (such as fire, windthrow, landslides, and insects) are responsible for creating forests containing a full range of stand ages.

species - a group of individuals that share certain physical characteristics and are capable of producing fertile offspring.

- endangered: species on the verge of immediate extinction or extirpation.
- extinct: species that no longer exist anywhere.
- extirpated: species no longer found in the wild in Canada, although they may exist elsewhere.
- threatened: species likely to become endangered if the pressures from human or natural causes threatening them are not reversed.
- vulnerable: species at risk because of low numbers or restricted range; although not in immediate danger, they could be at any time.

stakeholders - the people or groups with a direct or indirect interest, or "stake," in an issue.

stewardship - judicious use and care of the Earth's resources.

strategy - an action plan designed to achieve a specific goal.

stressor indicators - represent human activities that have the potential to impact the health or condition of the environment.

summerfallow - land that has no crop for one year and is either tilled or chemically treated to control weeds.

tillage - mechanical preparation of the soil for seeding, fallow or weed control.

Timber Supply Licence (TSL) - a licence granted by the minister pursuant to The Forest Resources Management Act conferring the right to harvest specified forest products for a set number of years.

Water Quality Index (WQI) - an index used to measure and summarize how well individual water bodies meet surface water quality objectives.

watershed - a geographic area defined by topographic elevation divides that has a common outlet for its surface runoff.

zero-tillage - a one-pass operation that places seed and fertilizer into an undisturbed seedbed, packs the furrow and retains adequate surface residues to prevent soil erosion.

FSC certified
55% recycled fibres
30% post consumer waste
Chlorine free - acid free