

2. Athabasca Sub-basin



Introduction

Geography

The Athabasca River and Lake Athabasca together drain an area of about 269,000 square kilometres in Alberta, Saskatchewan and a small portion of the Northwest Territories (Figure 2–1). The Athabasca sub-basin contains several types of ecosystems from the glaciers, alpine meadows and mountain forests in the Rocky Mountains to the boreal forests and muskeg of northeastern Alberta. Forested, Precambrian Shield occurs in the extreme northeastern part of the sub-basin.

The Athabasca River flows 1,375 kilometres from the Columbia Ice-field in the Rocky Mountains, across north central Alberta, and through the Peace-Athabasca Delta to Lake Athabasca. It is joined by several large tributaries along its course including the McLeod, Pembina, Lesser Slave and Clearwater rivers. Straddling the Alberta - Saskatchewan border, Lake Athabasca spans 7,935 square kilometres, making it the third largest lake in the Mackenzie River Basin. Although the flow of water out of Lake Athabasca is

variable and can change direction under certain conditions, water typically flows north through the Rivière des Rochers and joins the Peace River to form the Slave River.

Human Populations

According to the 2001 census, there were over 155,000 people living in the Athabasca sub-basin. The largest community is Fort McMurray, Alberta with a population of more than 41,000. Hinton and Whitecourt, also in Alberta, are the next largest population centres, with approximately 9,000 and 8,000 inhabitants, respectively.

About 13% of the population in the Athabasca sub-basin is Aboriginal. Métis people live in both the Alberta and Saskatchewan portions of the sub-basin.⁹¹ The Athabasca sub-basin includes lands covered by Treaties 6, 8 and 10, and there are fifteen First Nations with over forty reserves.⁹¹

Industry

The Athabasca sub-basin is rich in non-renewable and renewable resources, which are used by various industries. The conventional oil and gas industry is active in many parts of the basin, and significant oil sands development

occurs in the area north of Fort McMurray (Figure 1–4). Coal is mined in the upper reaches of the Athabasca sub-basin near Hinton and Edson (Figure 1–5). Forestry is a major industrial activity in much of the basin. The forests of the

sub-basin support several sawmills and panelboard factories as well as four pulp mills and one newsprint mill. Agriculture is an important land use in the Pembina River watershed and accounts for about 12% of the total area of the sub-

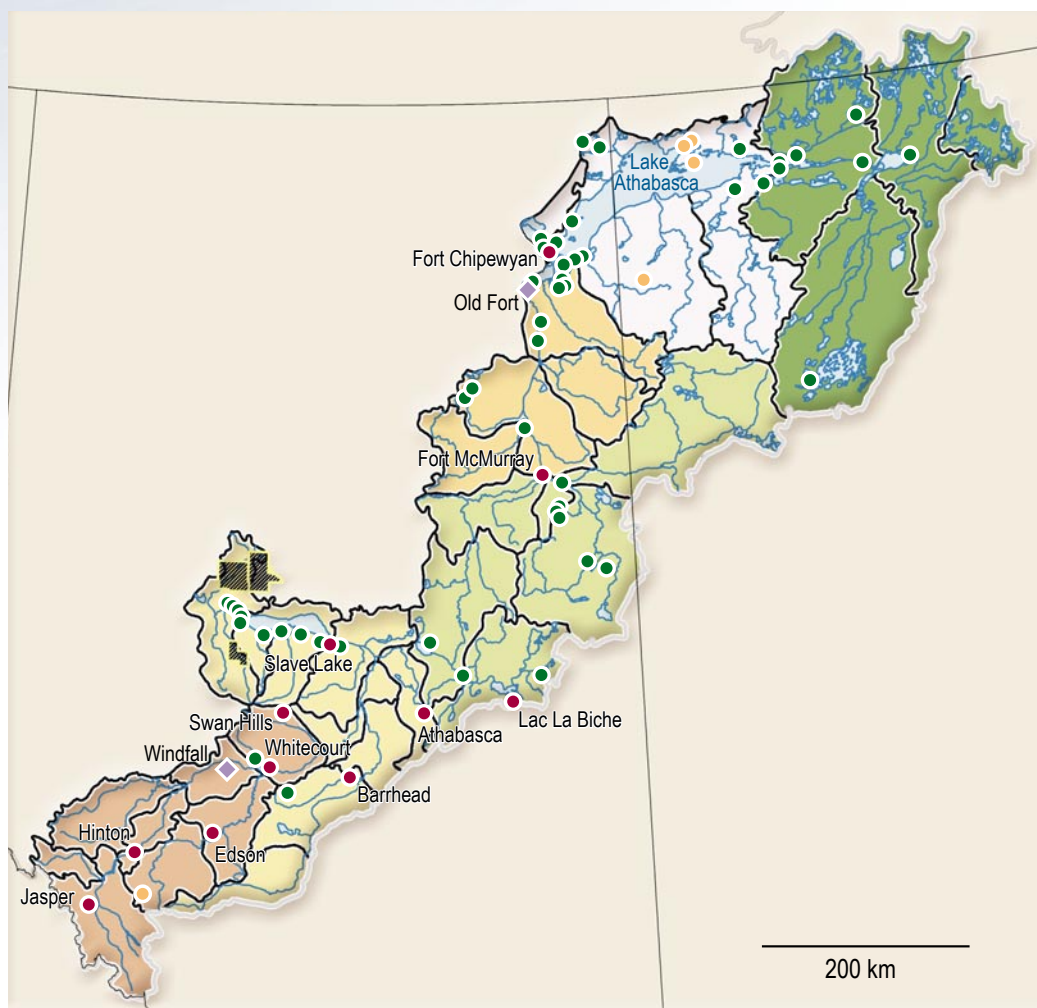


Figure 2–1.

Map of the Athabasca sub-basin.

Legend

□ Mackenzie River Basin

● Community

● Reserve

▨ Metis Settlement

● Past Producing Mine

◆ Other Location of Note

Sub-Basins

□ Upper Athabasca

□ Pembina and Central Athabasca

□ Lower Central Athabasca

□ Lower Athabasca

□ Athabasca Lake

□ Fond du Lac

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basin.³ Commercial fishing and trapping also occur in the Athabasca sub-basin. Until recently, uranium mining was an important industry in the Athabasca sub-basin, at Cluff Lake in northern Saskatchewan, and in earlier times, in the Beaverlodge area north of Lake Athabasca. The Cluff Lake mine closed in 2002 and has now entered the decommissioning phase. Mining in the Beaverlodge area ended in 1982. Old mines in that area are being maintained to prevent further environmental degradation or are being decommissioned to clean up the site. Monitoring is done at these sites to assess the condition of the local environment. Uranium mining continues to be an important industry in northern Saskatchewan near Wollaston and Key lakes, which are situated just outside the Mackenzie River Basin.

Improve Water Quality

Water quality refers collectively to the amounts of suspended solids, nutrients, minerals, micro-organisms, chemicals, pesticides and other substances that enter the water from natural sources and as a result of human activities. It is determined by the geology of the watershed, the addition of suspended solids, nutrients, and other materials from natural sources as well as human activities that provide various point and non-point sources of pollutants. The Athabasca River, which begins as a pristine

mountain stream, passes through communities and industrial sites that alter water quality. In the Athabasca sub-basin, forestry, agriculture, coal mining, and the oil and gas industry all have the potential to affect water quality.

Traditional Knowledge of Water Quality

Based on information obtained prior to 1995, Aboriginal inhabitants of Fort McMurray considered mining and urban development to have the worst impacts on water quality.²⁸ Eighty-six percent of survey respondents noted localized increases in algal growth and 29% noted an increase in turbidity. In general, the Clearwater River was considered to be cleaner than the Athabasca River. First Nations groups would be very supportive of a move to eliminate discharges of wastewater into the aquatic ecosystems of the Athabasca sub-basin.

▼ Overall Assessment – Mixed Signals

First Nations people living within the Athabasca sub-basin have raised concerns about localized increases in turbidity, algal growth, and pollution, which they attribute to effluents from mining operations and urban centres. These concerns were limited to the Athabasca River in the vicinity of Fort McMurray.

Dissolved Phosphorus

Phosphorus is an essential nutrient in aquatic ecosystems. It is required to sustain small plants at the

base of the food chain. However, too much phosphorus can lead to algal blooms. When algae die and decompose, oxygen is used. This may lead to oxygen depletion, a condition that can seriously stress plants and animals living in the water.

What is happening?

Dissolved phosphorus concentrations increased in the Athabasca River at the town of Athabasca from 1978 to 2000 (Figure 2–2). After a substantial drop in 2001, the amount of dissolved phosphorus increased

further in 2002. At Old Fort, near the mouth of the Athabasca River, and at the Snaring River, located in the upstream portion of the river, the amount of dissolved phosphorus has neither increased nor decreased over time.

Why is it happening?

Even in a pristine watershed, dissolved phosphorus levels may be expected to increase downstream as weathering of rocks and soils releases additional phosphorus into the aquatic ecosystem. In addition,

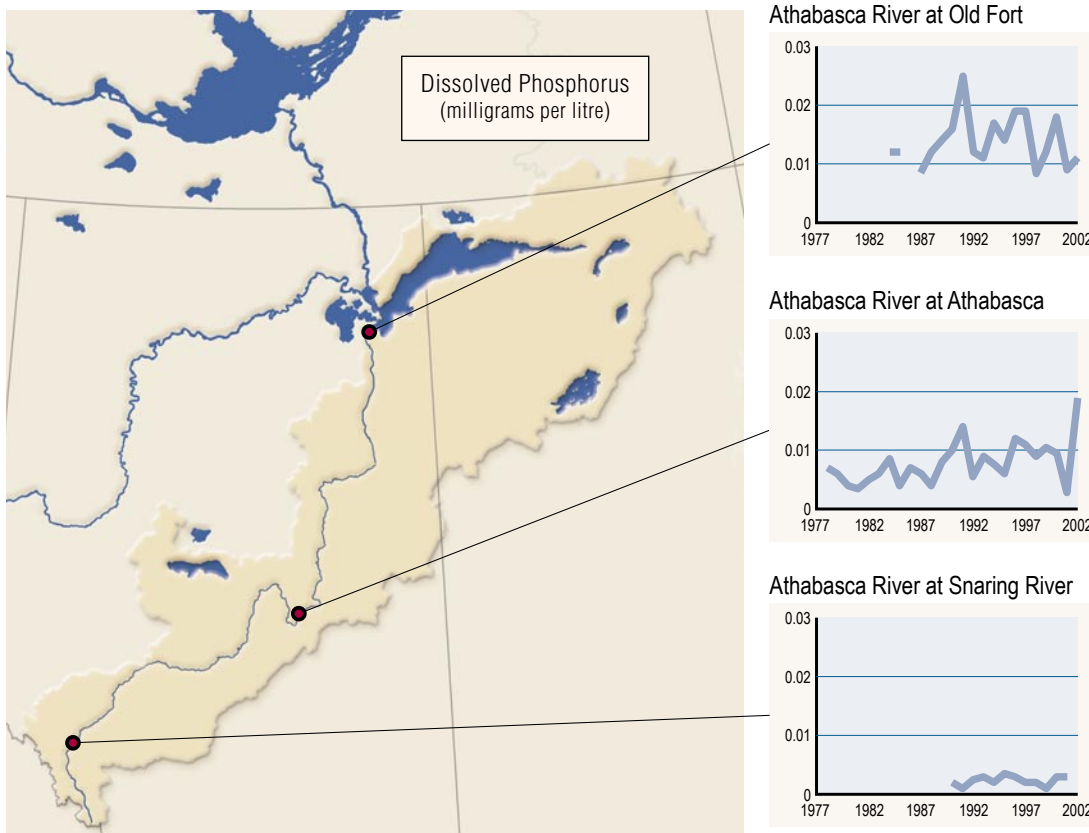


Figure 2–2.

Total dissolved phosphorus concentrations (milligrams per litre) in the Athabasca River tend to increase as one moves downstream. Phosphorus concentrations increased in the Athabasca River at the town of Athabasca between 1978 and 2002.

Data Source: Alberta Environment.

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human activity results in land disturbance and effluent discharges, which may add more phosphorus to the river. For example, the increase in dissolved phosphorus over time at the town of Athabasca may be related to greater loading from pulp mills over the same period.⁹² Runoff from agricultural land and deforested land may also increase phosphorus loading into the Athabasca River.

What does it mean?

Phosphorus is an essential nutrient in aquatic ecosystems. However, large amounts of phosphorus may lead to excessive production of algae and other organic matter. This can have a negative impact on the aquatic ecosystem because decomposition of the organic material may deplete dissolved oxygen in the water. This may be a contributing factor to the low winter oxygen levels sometimes experienced in the Athabasca River (see next section – **Dissolved Oxygen**).

Nitrogen is another important nutrient that affects algal production in Alberta's northern rivers. Many natural sources provide nitrogen to rivers. In addition,

municipal sewage effluent is an important source of nitrogen. The combination of nitrogen in municipal sewage effluent and phosphorus in pulp mill effluent can stress the aquatic ecosystem. Effective management of the impact of nutrients on the Athabasca River will require consideration of the combined effects of nitrogen from sewage effluent and phosphorus from pulp mill effluent.⁹³

What is being done about it?

The Northern Rivers Ecosystem Initiative includes studies of nutrient-algae relationships, which should provide scientific information that will support the development of water quality objectives for phosphorus in the northern rivers. Several nutrient reduction programs will reduce the input of phosphorus. For example, the town of Jasper has implemented nutrient reduction in its sewage effluent, and Fort McMurray is expected to do so in 2006. In addition, Alberta is requiring pulp mills to develop and review their nutrient reduction programs.

▼ Overall Assessment – Mixed Signals

Effluents from industrial and community sources add phosphorus and other nutrients to river ecosystems. Phosphorus levels near the town of Athabasca increased slightly from 1978 to 2000, then declined in 2001 and increased substantially in 2002. There was no clear trend at the Snaring River in the upstream reach of the river or at Old Fort near the mouth of the river.

A study undertaken as part of the Northern Rivers Ecosystem Initiative showed that dissolved phosphorus at a sampling site near the community of Athabasca increased significantly between 1978 and 2000.

Dissolved Oxygen

Dissolved oxygen is critical for the survival of aquatic animals such as fish and aquatic insects. Biochemical processes such as the decomposition of

organic matter consume oxygen in the water. In rivers and lakes, dissolved oxygen is replenished from the atmosphere and from photosynthesis by aquatic plants.

During the winter, ice cover inhibits the re-oxygenation of river water from the atmosphere. Thus the winter oxygen supply is limited, and dissolved oxygen concentrations usually decline over the winter months until spring break-up allows re-oxygenation from the atmosphere. In some water bodies, especially highly productive lakes, winterkill of fish is usually linked to low oxygen levels.

What is happening?

Figure 2–3 shows the minimum winter value of dissolved oxygen on the Athabasca River between the town of Athabasca and Fort McMurray. These minimum values usually occur in February.

During the 1990s, minimum dissolved oxygen levels fluctuated from about 6.6 to 9.6 milligrams per litre, which are all above Alberta's chronic or long-term exposure guideline for the protection of aquatic life. During the winters of 2002 and 2003, minimum dissolved oxygen levels declined to levels that were at or below Alberta's chronic guideline level, although they have stayed above the provincial guideline for short-term exposure of five milligrams per litre.

Why is it happening?

As with most rivers, nutrient levels and organic matter generally increase as one moves downstream from the headwaters of the Athabasca River. This is because tributary streams and runoff along the course of the river continue to deposit additional material into the river. Effluents from community wastewater plants and pulp mills along the Athabasca River add to this drain on oxygen supplies. As well, the flow in

the Athabasca River is lowest in the winter, which means that there is less water and a smaller reserve of dissolved oxygen. Ice cover along the river prevents re-oxygenation above the turbulent rapids located upstream from Fort McMurray.

What does it mean?

Low dissolved oxygen levels can be stressful for sensitive aquatic life, including fish that spawn at this time. Although this is a natural phenomenon, industrial effluents and other sources of organic waste can amplify the problem. When low oxygen levels

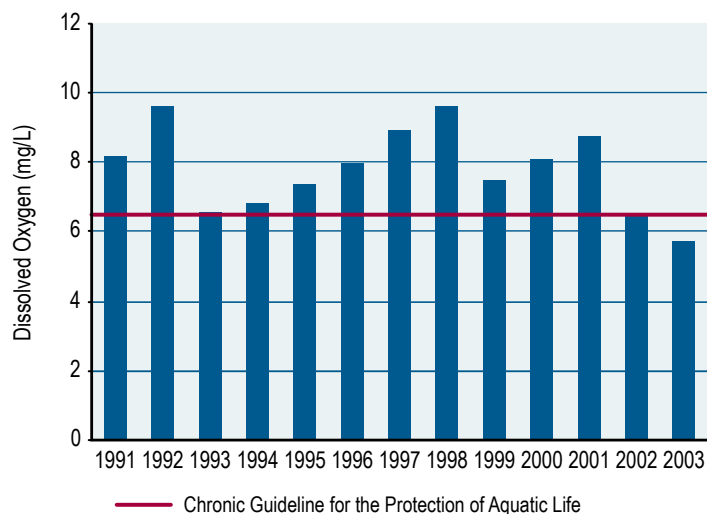


Figure 2–3. At a site in the Athabasca River between the town of Athabasca and Fort McMurray, the minimum wintertime levels of dissolved oxygen (milligrams per litre, averaged over a seven-day period) were lower in 2002 and 2003 than they had been in earlier years. The winter of 2003 marked the first time that the minimum oxygen concentration over a seven-day period slipped below the guideline for the protection of aquatic life.

Data Source: Alberta Environment.

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persist, winterkill may occur. Large numbers of fish and other sensitive aquatic organisms may die under such conditions.

The appropriateness of current dissolved oxygen guidelines for protecting aquatic life is being evaluated through research conducted as part of the Northern Rivers Ecosystem Initiative.⁹⁴

What is being done about it?

Limits are placed on oxygen-consuming substances in effluents from industrial facilities and wastewater treatment plants in Alberta. In particular, pulp mills on the Athabasca River system can be required to curtail discharge of this material if dissolved oxygen levels on the river become too low. In both 2002 and 2003, the pulp mills were asked to, and implemented, their 'low dissolved oxygen response plans' to minimize the demand on river dissolved oxygen.

Several research projects related to dissolved oxygen requirements for fish and other aquatic biota were conducted as part of the Northern Rivers Ecosystem Initiative. Alberta Environment will consider the findings of these studies and work with the pulp mills to develop a management plan to maintain winter dissolved oxygen levels in this important river.

▼ Overall Assessment – Mixed Signals

Fish and other aquatic biota require oxygen to survive. Dissolved oxygen in the lower Athabasca River between Athabasca and Fort McMurray may become critically low during late winter. No worrisome trends had been evident for oxygen levels in the Athabasca River prior to 2002. During the winters of 2002 and 2003, dissolved oxygen levels in this portion of the Athabasca River equalled or dipped below the chronic guideline level that is considered to be protective of

aquatic life. During winter, natural conditions in the river coupled with wastewater effluent from communities and industries can deplete oxygen levels. Government and industry are working together to limit the amount of oxygen-consuming wastewater released into the Athabasca River during critical periods of the winter. Research is also being done to better understand the oxygen requirements of aquatic biota, including spawning fish.

Water Quality Index

The Alberta Water Quality Index is based on measurements of metals, nutrients, bacteria and pesticides in water samples. These measurements are compared to water quality guidelines and objectives that have been established by government agencies. The guidelines and objectives are concentrations of different substances that are deemed to be safe for freshwater life or for different uses, such as swimming. From the comparisons between measured values of water quality and guideline values, an index is calculated for a given site. Alberta's Water Quality Index rates water quality as excellent, good, fair, marginal, or poor depending on how often and by how much measured values of water quality exceed the guidelines and objectives. Within the Athabasca sub-basin, the Alberta Water Quality Index is calculated for stations in the Athabasca River near the town of Athabasca and Old Fort. Athabasca is located approximately midway between the source and mouth of the Athabasca River while Old Fort is near the mouth of the river.

The Regional Sustainable Development Strategy (RSDS) for the Athabasca Oil Sands Area, and the Cumulative Environmental Management Association (CEMA) have identified surface water quality as a potential environmental concern related to development of the oil sands near Fort McMurray. The RSDS contains a blueprint for action to address this issue, and CEMA is developing environmental objectives and management recommendations for surface water quality.

Elevated concentrations of selenium have been found since the late 1990s in rivers and streams immediately downstream from three open-pit coal mines in the Alberta foothill region of the Athabasca and Peace sub-basins. Selenium concentrations exceeded water quality guidelines for protecting aquatic life. Selenium is a trace element that occurs naturally in soils and rocks. The elevated selenium levels are related to various mining activities that disturb the land surface. Mining activities expose selenium-bearing rocks and soil that are normally far below the surface to surface weathering and leaching. Although selenium is an essential nutrient for human beings and animals, it can be harmful at concentrations only slightly higher than nutritional needs. The provincial and federal governments and the coal industry have been involved in monitoring and research studies since 1999 to assess the risk that selenium poses to the environment around the affected mines. Studies are identifying selenium sources and fate and effects in aquatic food webs, and are developing ways to better manage selenium at the mines.

What is happening?

Water quality at the two stations in the Athabasca sub-basin has consistently been rated as “good” or “excellent” (Figure 2–4). There is a discrepancy between the Alberta Water Quality Index and Traditional Knowledge of Water Quality in the Athabasca River (see **Traditional Knowledge of Water Quality**). The former is based on data collected since 1996 while the latter is based on information compiled prior to 1995. Traditional knowledge of water quality needs to be updated to determine whether this discrepancy still exists.

Why is it happening?

Although various point and non-point sources of pollution have the potential to affect water quality in the Athabasca River and its tributaries, their effects, at

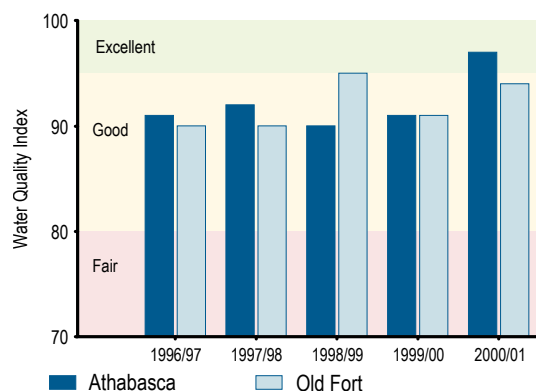


Figure 2–4.

Water quality indices for the Athabasca River at the town of Athabasca and at Old Fort have consistently indicated that the water is of good to excellent quality.

Data Source: Alberta Environment.

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present, are not large enough to harm general water quality. Numerous industrial sites, communities, and non-point sources of pollution can affect water quality of the Athabasca River and its tributaries. Pulp mills are the most significant industrial source of pollution because they release large amounts of organic waste and other pollutants. The eight largest community wastewater (sewage) treatment plants together discharge about 32,000 cubic meters of treated wastewater per day. They include Fort McMurray, Whitecourt, Jasper, Edson, Slave Lake, Barrhead, Lac La Biche and Athabasca. In addition, the town of Hinton combines its wastewater with effluent from the pulp mill in that community. There are dozens of smaller community wastewater systems within the Athabasca sub-basin that discharge treated sewage from lagoons a few times each year. Agricultural practices, logging and the deposition of atmospherically transported contaminants also have the potential to affect water quality.

What does it mean?

According to the Alberta Water Quality Index, water quality in the Athabasca River is generally good to excellent, meaning that nutrients, bacteria, pesticides and metals are not present in excessive amounts that could harm the aquatic ecosystem. This does not mean that water in the Athabasca River is safe for drinking without treatment. Even water that is pristine in appearance needs to be properly treated before drinking it, if its safety has not been proven.

What is being done about it?

The governments of Alberta and Canada will continue to work with many industries to reduce or eventually eliminate contaminants in effluent that is discharged to the aquatic ecosystems of the Athabasca

sub-basin. Recent efforts have focused on pulp mills, the oil sands industry and the agricultural sector.

To improve reporting on water quality, experts across Canada are evaluating and refining water quality indices to produce a better indicator of general water quality. The Alberta index will continue to be used to determine trends in general water quality. A wide range of specific water quality parameters will continue to be evaluated to determine whether specific concerns exist.

✓ Overall Assessment – Favourable

Alberta's water quality index serves as an indicator of general water quality by incorporating information on metals, nutrients, bacteria and pesticides. The two sites in the Athabasca sub-basin for which water quality indices are calculated have consistently shown that the water is of good to excellent quality. This contrasts with the evaluation of water quality based on traditional knowledge. Reasons for this discrepancy need to be determined.

Ensure Sufficient Water Quantity

Average Annual Flow in the Athabasca River

What is happening?

Figure 2–5 shows the average annual flow at three locations on the Athabasca River over the past four decades. Average annual flows have been relatively stable over the past four decades. Flows were somewhat elevated during the 1970s at Athabasca and

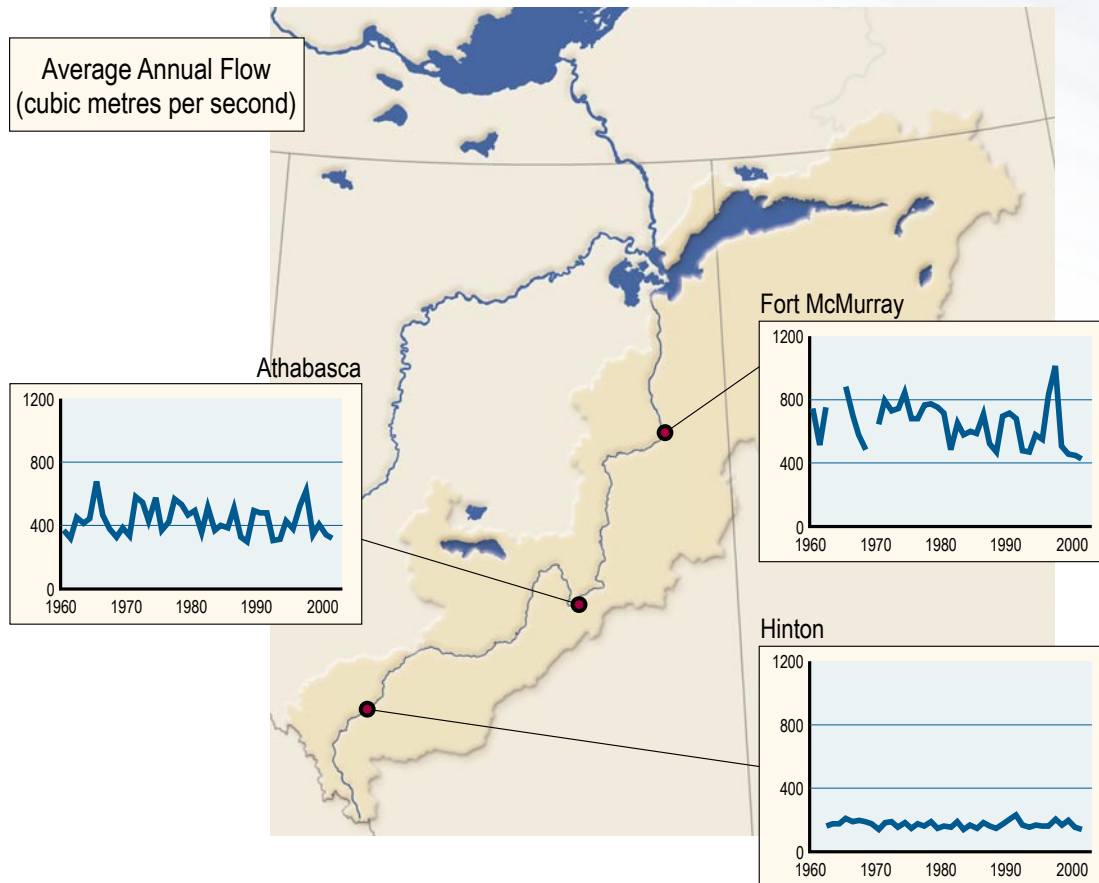


Figure 2-5.

Average annual flow in the Athabasca River has not shown a significant increasing or decreasing trend over the last four decades.

Data Source: Alberta Environment; Environment Canada.

Fort McMurray, while flows at these two sites and Hinton were low during the 1980s. The lowest average annual flows at Fort McMurray during the past forty years occurred in 1999, 2000 and 2001.

Why is it happening?

Flows in the Athabasca River are not significantly regulated by any dams or other structures. They tend to reflect the prevailing climatic conditions and are particularly affected by precipitation and evaporation. There were some very wet years during the 1970s which resulted in high flows, whereas drought during the 1980s and from 1999 to 2001 resulted in lower flows.

Aboriginal residents of Fort McMurray reported that the Athabasca River had low water levels from the mid-1970s to the mid-1990s. They also noted that the water level in this river does not rise in June as it used to.

What does it mean?

The volume of stream flow shapes the aquatic ecosystems of rivers and can have important effects on communities and industries that depend on rivers as a source of water. Very high stream flow usually increases the turbidity of the water. This can present a challenge to water treatment plants whose goal is to provide clean, pure water to the communities they serve. In the extreme, high stream flows can produce floods. In contrast, a reduction in stream flow may limit the amount of water that can be allocated to different users while still meeting the needs of the aquatic ecosystem. Although the flow of water in the Athabasca River has not changed dramatically over the past four decades, it may be affected if future climate change results in less precipitation or more evaporation.

The Athabasca River is very large and stream flow conditions in the river are determined by several factors operating at a large geographic scale. While there has been no long-term change in stream flow at this large geographic scale, it remains uncertain whether such changes have occurred in small watersheds located within the Athabasca sub-basin. Determining this would necessitate the analysis of long-term monitoring stream flow data that is available for many of the small watersheds in the sub-basin.

The melting of glaciers is an important source of water in the Athabasca River during late summer and early fall, especially in dry years. If glaciers in the Rocky Mountains continue to recede as is now occurring, or if they disappear altogether, river flows would likely be reduced during dry years.⁹⁵

What is being done about it?

Flow continues to be monitored in the Athabasca River and its tributaries, and the resulting data are considered during watershed planning and in decisions about allocations for different uses. The Alberta government is developing a strategy to ensure the conservation of the province's water resources. Entitled *Water for Life*, the strategy recognizes the need to manage water resources within the capacity of individual watersheds.⁹⁶

✔ Overall Assessment – Favourable

Flow in the Athabasca River has neither increased nor decreased in a consistent fashion over the past four decades. Differences among decades reflect differences in climatic conditions, and climate change may alter flow in the Athabasca River in the future. Alberta's new *Water for Life* strategy will recognize the need to manage water resources within the capacity of individual watersheds, a development that should improve water conservation in the province.

Water Level of Lake Athabasca

What is happening?

The water level of Lake Athabasca fluctuates from season to season and changes from year to year. Since 1930, there have been years with particularly low water levels and years with particularly high levels, but no long-term trends have emerged (Figure 2–6). However, since the installation of weirs on two of the major channels that drain the lake, average and minimum annual water levels have been slightly higher than they would have been under natural

conditions. Water levels in the lake are more stable now than they would have been if the weirs had not been built.⁹⁷

Why is it happening?

Lake Athabasca is connected to the Peace and Athabasca rivers. About 80% of the water in the lake comes from the Athabasca River, while much of the water in the lake drains into the Peace River. When flow in the Peace River is low, water drains rapidly out of Lake Athabasca. However, high flows in the Peace River can reverse the flow of water back into Lake Athabasca, thus producing high water levels in the lake. Low water levels from 1968 to 1971 were due primarily to low flows on the Peace River that resulted from the filling of Williston Lake behind the Bennett Dam. In 1975 and 1976, permanent weirs were built on the Rivière des Rochers and the Revillon Coupé, the two major channels that connect Lake Athabasca to the Peace River. They were built to offset relatively low, summertime water levels that resulted from the operation of the Bennett Dam on the Peace River. Those weirs have nearly restored peak summer water levels in the lake and in low-lying portions of the Peace-Athabasca Delta. The weirs have also raised annual average and minimum water levels, so that water levels in Lake Athabasca are now more stable than they would have been if the weirs had not been built.⁹⁷ The higher water levels in 1996 and 1997 reflect the relatively high precipitation in those years.

What does it mean?

The water level in Lake Athabasca affects water levels in the low-lying portion of the Peace-Athabasca Delta that is closest to the lake and connected to it by channels. However, its impact diminishes with distance into the delta and away from the lake.

Furthermore, elevated perched basins in the delta are relatively unaffected by Lake Athabasca water levels. These perched basins are typically recharged from ice jam floods, which tend to produce higher water levels than the seasonal open water floods. Water level regulation in Lake Athabasca has stabilized water levels compared to natural conditions and has probably mitigated some of the long-term impacts attributed to the Bennett Dam. However, more information is needed to assess the consequences of lake level stability on the dynamic and productive wetland habitats of the low-lying portion of the Peace-Athabasca Delta.⁹⁷

What is being done about it?

The *Northern River Basins Study* and the *Peace-Athabasca Delta Technical Studies* evaluated the effects of the weirs on the hydrology of the lake and delta.⁹⁷ Water levels continue to be monitored on Lake Athabasca.

Overall Assessment – Favourable

Although the water level of Lake Athabasca changes from season to season and year to year, it has not shown an increasing or decreasing trend. Two weirs were built to offset the effects of the Bennett Dam on

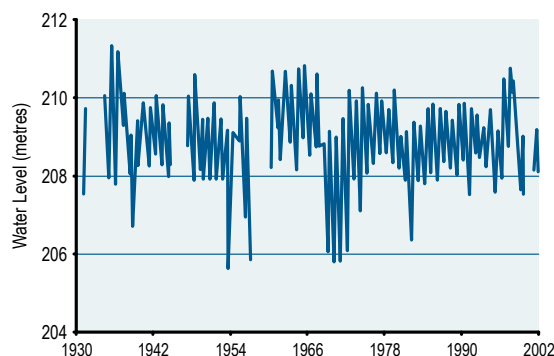


Figure 2-6.

The water level of Lake Athabasca (1930 – 2001) changes from season to season and from year to year but has not shown an increasing or decreasing trend over time.

Data Source: Alberta Environment; Environment Canada

water levels in Lake Athabasca and the Peace-Athabasca Delta. They have nearly restored peak summer water levels to what they would have been in the absence of the Bennett Dam and stabilized lake levels compared to what they would have been under natural conditions. The effects of stabilized lake levels on the Peace-Athabasca Delta ecosystem need to be evaluated.

Sustain In-Stream Water Uses

Traditional Knowledge of In-Stream Water Uses

Based on information obtained prior to 1995, about one-third of survey respondents from Fort McMurray reported using the water for travel while all of them reported using water for recreation. Although fishing was a traditional activity for the people from Fort Chipewyan, some people indicated that they had decreased their consumption of fish because of concerns about fish health. Fish organs, such as liver and intestines, were still eaten but only after being carefully inspected. Elders indicated that fish did not taste as good as in the past, and that people were having difficulty drying fish because the flesh was often soft and watery.²⁸

Overall Assessment – Mixed Signals

Aboriginal inhabitants of the Athabasca sub-basin rely on the water for travel, recreation and fishing. Some people are eating less fish than they used to because of concerns about the quality and health of this resource.

Water Allocations

What is happening?

A water allocation grants the withdrawal or use of a certain amount of water from a specific water source. Over 540 million cubic meters of water per year are allocated for various uses within the Athabasca sub-basin. This volume of water corresponds to approximately 2.4% of the estimated flow in the Athabasca River at Old Fort, near its mouth.

Why is it happening?

The oil and gas industry and the forestry industry are the two largest users of water in the Athabasca sub-basin (Figure 2–7). The oil and gas industry, which accounts for 58% of the allocated water, uses water for a variety of purposes including deep-well injection, processing tar sands and oil, and cooling. The forestry industry, which includes pulp mills, a paper mill, saw mills and wood-processing plants, accounts for 25% of the allocated water. In addition, smaller volumes of water are allocated for communities, water management, industrial processing and other uses.

What does it mean?

A large portion of the water allocated for use remains in the river system. This occurs because the

volume of water actually used may be less than the volume allocated. In many cases, much of the water used is returned to the rivers as treated wastewater.

What is being done about it?

Provincial and federal laws and regulations govern the use of water in the Athabasca River sub-basin. Major water users must obtain licences from the provincial government. Their licences stipulate conditions under which they must operate, such as the amount of water that can be withdrawn and the quality of water returned to the river system.

Overall Assessment – Favourable

The oil and gas industry and the forestry industry are the two largest users of water in the Athabasca sub-basin. The total amount of water allocated for these and other uses is a small portion (<3%) of the total flow in the Athabasca River, but a large amount of this allocated water is either not used or is returned to the river system.

Commercial Fishing

What is happening?

Commercial fishing took place on about fifty lakes in the Athabasca sub-basin during the 1990s, but not all lakes were fished each year. The total commercial catch fluctuated between 907 and 1,262 tonnes per year, with whitefish accounting for about 75% of the total commercial harvest (Figure 2–8). Despite yearly fluctuations, it does not appear that the commercial fish harvest in the Athabasca sub-basin has significantly increased or decreased during the past decade.

Why is it happening?

The year-to-year fluctuation in harvest depends on several environmental, social, and economic factors such as weather, fishing effort and market conditions. Another important factor that affects the harvest is the

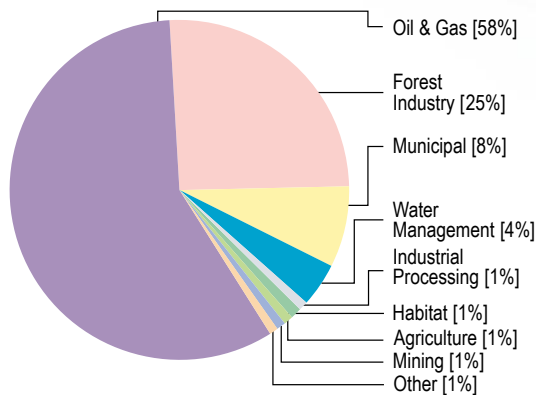


Figure 2–7.

In the Athabasca sub-basin, over 540 million cubic metres of water each year are allocated for the oil and gas industry, the forestry industry, and various other uses.

Data Sources: Alberta Environment; Saskatchewan Watershed Authority.

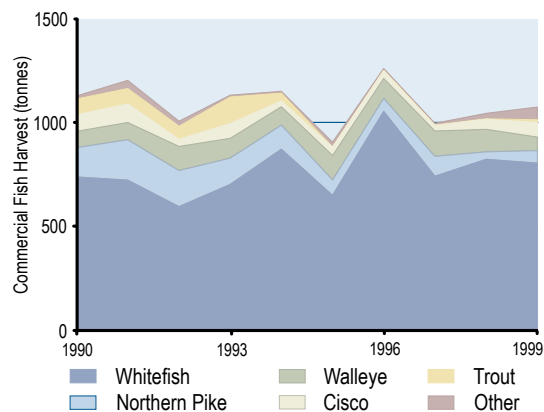


Figure 2–8.

Size of the commercial harvest of fish in lakes of the Athabasca sub-basin.

Data Sources: Alberta Sustainable Resource Development; Saskatchewan Environment & Resource Management.

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quota. In each lake, quotas are set annually for each species. Once the quota is reached, the fishery is shut down.

What does it mean?

Commercial fishing is an important industry in the Athabasca sub-basin, but commercial harvesting on certain lakes can reduce the numbers of many species that are highly valued by anglers and subsistence fishers. Regulation and monitoring of the fishing industry is necessary to ensure that fish stocks are harvested in a sustainable manner that benefits commercial, sport and subsistence fishers. In light of concerns about declining fish populations identified by traditional knowledge (see section entitled **Traditional Knowledge of Aquatic Species and Habitat**), it is equally important to assess population attributes and trends for key fish stocks. The Alberta government is presently making such assessments for key fish stocks such as Lake Athabasca walleye.

What is being done about it?

In recent years, there have been about 800 commercial fishing operators in Alberta, using a total of 37,000 nets. The Alberta government has determined that this level of fishing activity needs to be reduced if commercial fishing is to remain economically viable. Through licensing adjustments and compensation, the provincial government hopes to reduce the number of operators to approximately 200 and the number of nets to about 18,000. In Saskatchewan, Saskatchewan Environment and

Resource Management manages commercial fisheries with the purpose of ensuring that fish stocks are sustained. The department manages fisheries in a flexible manner by taking into consideration the needs of commercial fishers, the demands of other users, such as subsistence and sport fishers, and the productivity of the fisheries.

✔ Overall Assessment – Favourable

Commercial fishing occurs in several lakes in the Saskatchewan and Alberta portions of the Athabasca sub-basin. The industry is managed to ensure a sustainable harvest of fish. The Alberta government is working to reduce the number of commercial operators and the number of nets, and is assessing populations of key fish stocks. In Saskatchewan, management is geared towards ensuring the sustainability of fish stocks, while at the same time meeting the demands of all users, including commercial, subsistence and sport fishers.

Harvest of Semi-Aquatic Furbearers

What is happening?

Many residents of the Athabasca sub-basin trap furbearers to supplement their incomes. Several fur-bearing species, such as beaver, muskrat, mink and otter, are dependent on aquatic ecosystems. Several thousand pelts, primarily beaver, were taken each year from 1992 to 2001 (Figure 2–9). The number of muskrat pelts was very high in 1998 but has decreased since then.

Why is it happening?

The annual harvest of semi-aquatic fur-bearers depends to some extent on social and economic factors such as trapping effort and market conditions. To a lesser extent, harvest can be affected by the abundance of fur-bearing species, which is in turn dependent on disease, predators and numerous environmental factors. The high number of muskrats harvested in 1998, for example, was likely due to an increase in the muskrat population following the 1996 flooding of the Peace-Athabasca Delta.

What does it mean?

While trapping is an important activity for some residents of the Athabasca sub-basin, its relative importance has declined substantially over the past several decades, owing mainly to lower fur prices. Over the years, trapping has changed from a moneymaking activity to one that is now engaged in primarily for cultural and recreational purposes. The present harvest of furbearers is below a level that would exert pressure on their populations. Furbearer populations are presently considered to be healthy and thriving.⁹⁸

What is being done about it?

Trapping is regulated through provincial licensing systems and trappers determine their own trapping effort. River otters, which naturally have low population densities, are trapped in Alberta under a quota system that restricts the number of animals taken by each trapper.

Overall Assessment – Favourable

The harvest of semi-aquatic fur-bearers is a source of income for some residents of the Athabasca sub-basin. The most significant change during the last decade was an increase in the numbers of muskrat harvested following the 1996 flood of the Peace-Athabasca Delta. Overall, trapping has declined markedly in the past few decades, because it is not as profitable now as it used to be. The present level of trapping is not a significant pressure on semi-aquatic furbearer populations.

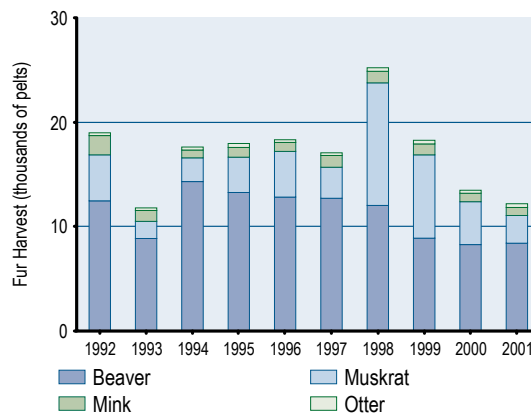


Figure 2–9.

Harvest of semi-aquatic fur-bearers in the Athabasca sub-basin (1992–2001).

Data Sources: Alberta Sustainable Resource Development; Saskatchewan Environment & Resource Management.

Ensure Healthy, Abundant and Diverse Aquatic Species and Habitat

Traditional Knowledge of Aquatic Species and Habitat

Based on information collected before 1995, people from Fort McMurray noticed that muskrats were less numerous and beavers were more numerous than in the past in some locations in the Athabasca sub-basin. Elders in the Fort Chipewyan region indicated that fish were less abundant than in the past. They believe that commercial fishing significantly reduced fish populations in Lake Athabasca. Goldeye were nearly eliminated from the lake, but populations recovered somewhat after controls were put in place to limit the catch. Walleye (pickerel) once spawned extensively in Richardson Lake but over the years spawning activity declined because of accumulation of silt at the channel entrances to the lake. At some locations, various anatomical and physiological changes were also noted in some of the fish: external warts, unusually blue veins, abnormally yellow livers, internal white markings, and soft watery flesh.²⁸

The observed reduction in fish populations in Lake Athabasca is inconsistent with a recent assessment of walleye and goldeye fisheries in that lake. That assessment reported that commercial catch targets for walleye and goldeye in Lake Athabasca were met throughout most of the 1990s.⁹⁹ Contradictions in the results of traditional knowledge and governmental

science-based assessments lead to uncertainty. More thorough investigations using both approaches may be required to overcome this uncertainty.

▼ Overall Assessment – Mixed Signals

Based on information collected prior to 1995, some First Nations people along the lower reaches of the Athabasca River and near Lake Athabasca noticed changes in populations of muskrats, beaver, and some fish. A general deterioration in fish quality was noted. It was also observed that the population of goldeye in Lake Athabasca declined due to over-fishing. It was further noted that this population of fish has partially recovered since limits on the catch were instituted. Information on traditional knowledge of fish in Lake Athabasca needs to be updated to determine if fish populations are still considered to be low.

Aquatic and Riparian-Dependent Wildlife Species at Risk

The Alberta Species at Risk Program evaluates the status of wild species and identifies those that are at risk or that may be at risk of extinction or extirpation.¹⁰⁰ After a more detailed assessment of species status, species may be legally designated as threatened or endangered. In Saskatchewan, a similar process allows designation of wild species as vulnerable, threatened, or endangered.¹⁰¹

What is happening?

Based on the provincial classification systems of Alberta and Saskatchewan, four species of aquatic and riparian-dependent wildlife that live in the Athabasca sub-basin are considered to be at risk, endangered or threatened. In addition, four other species may be at

risk. These eight species include three fish, two amphibians and three bird species (Figure 2–10).

Why is it happening?

Habitat loss from human activities that modify or fragment the land is a key reason why many wildlife species are designated as threatened or endangered. Other possible threats include environmental contamination, excessive harvest, disease, climate change and introduction of alien species. Within the Saskatchewan portion of the Athabasca sub-basin, habitat degradation due to climate change together with pollution from acid precipitation have been identified as threats to aquatic biodiversity.¹⁰²

Some species at risk in the Athabasca sub-basin are migratory and the pressures exerted on their populations likely arise in other parts of their ranges. Examples include the whooping crane and trumpeter swan, both of which may migrate through the Athabasca sub-basin, but are not common residents



Courtesy of: D. Forsyth

The northern leopard frog (*Rana pipiens*) is considered to be common in Saskatchewan, but has been designated as “at risk” and “threatened” in Alberta. The Committee on the Status of Endangered Wildlife in Canada considers the western boreal and prairie populations of this species to be of special concern. The range of this species has been reduced in size in western Canada, and some populations have disappeared. Threats to this species include wetland drainage, habitat fragmentation, eutrophication, pesticide contamination, introduction of game fish, and collection.

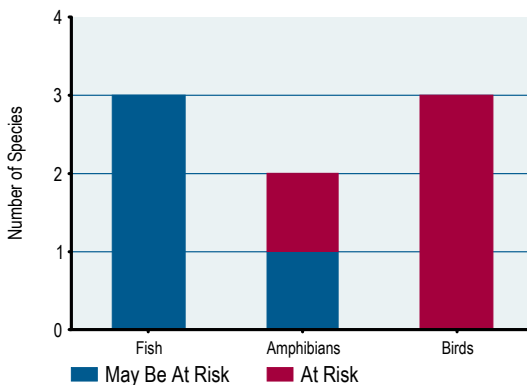


Figure 2–10. Based on the provincial classifications systems of Alberta and Saskatchewan, there are eight species of aquatic and riparian-dependent wildlife in the Athabasca sub-basin that are considered to be “at risk” or “may be at risk” of extinction or extirpation.

Data Source: Alberta Sustainable Resource Development; Saskatchewan Environment & Resource Management.

there. Some resident species of fish, including the short-jawed cisco and the pygmy whitefish, although extremely rare, are not under imminent threat from human activities.^{103, 104}

What does it mean?

The number of species at risk is an indicator of the ability of an ecosystem to support a diversity of wildlife. Although it is natural for some species to become extinct, the current global extinction rate is higher than what is expected naturally, and thus concern about biodiversity has increased in recent decades. There are relatively few species at risk in the Athabasca sub-basin compared to more populated and more heavily industrialized parts of Canada. The Athabasca sub-basin continues to support a diversity of aquatic and riparian-dependent species of wildlife.

What is being done about it?

Both Alberta and Saskatchewan have legislation to protect species at risk, and recovery plans have been developed for some species. In addition to the provincial designations, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the status of wildlife species and determines appropriate designations at a national level. The federal *Species at Risk Act* (SARA) was recently passed, giving legal protection to Canadian species at risk and their habitats. SARA is one component of a three-part strategy for protecting species at risk that also includes the Habitat Stewardship Program and the *Accord for the Protection of Species at Risk*, a Canada-wide agreement on federal-provincial-territorial cooperation.

✔ Overall Assessment – Favourable

There are eight aquatic and riparian-dependent wildlife species considered to be at risk or that may be

at risk in the Athabasca sub-basin. Some of these species are naturally rare and are not under imminent threat from human activities. Some others are migratory and pressures on their populations likely arise in parts of their range outside of the Athabasca sub-basin. In comparison to other regions of Canada, the number of species at risk or that may be at risk in the Athabasca sub-basin is low. Legislation at the provincial and national levels will improve protection for these and other species.

Population Trends for Key Waterfowl Species

The United States Fish and Wildlife Service has done annual surveys of waterfowl breeding populations and their habitats across North America for several decades. Four survey strata within northern Alberta generally overlap with the Alberta portions of the Peace and Athabasca sub-basins, and survey data from these strata were used to examine trends in waterfowl populations.

What is happening?

The total duck population in northern Alberta can change dramatically from one year to the next. Populations of diving ducks have neither increased nor decreased in a consistent fashion over the past four decades (Figure 2–11). Populations of dabbling ducks, such as mallard and pintail, were very high in the 1950s and early 1960s but dropped to a lower level in the mid-1960s and have not changed in a consistent fashion since then (Figure 2–11). Although the total duck population has not changed significantly over the long-term, some individual species show different trends. In 2001, gadwall,

northern shoveler and canvasback populations were well above their long-term averages. On the other hand, populations of northern pintail and scaup were down by approximately 53% and 34%, respectively. The northern boreal forest is the most important part of the breeding range for scaup, and their population in northern Alberta has declined dramatically since the early 1980s (Figure 2–12).

Why is it happening?

Waterfowl numbers in a given area can fluctuate from year to year due to differences in reproductive success and distribution patterns. These fluctuations are normal and can be attributed to annual changes in weather, habitat conditions, predator populations and several other factors. The large-scale conversion of prairie parkland to agricultural land that has occurred during the past century has resulted in the loss and degradation of habitat favoured by ducks.

The decline in scaup and pintail numbers is a continent-wide phenomenon that is not well understood. It is currently thought that contaminants, lower female survival, and reduced breeding success due to changes in food resources or breeding-ground habitat may be contributing to this population decline.¹⁰⁵

What does it mean?

Changes in duck populations in northern Alberta are indicative of climate trends as well as land use patterns that have affected the number and quality of wetlands. Wetlands provide valuable habitat for many species of wildlife, so changes in duck populations may be indicative of trends in the overall capacity of a region to support a diversity of wetland-dependent wildlife.

Ducks have been part of the traditional diet of First Nations people in several communities in northern

Alberta.²⁸ As migration routes of ducks have shifted away from the Peace-Athabasca Delta, where they were especially numerous at one time, the opportunities for harvesting ducks has decreased in this area. As a result, the traditional use of ducks has likely decreased over time in the Peace-Athabasca Delta.

When long-term changes in population size are detected, the 'bag limit' or allowable kill by sport hunters in Canada and the United States may be changed. Such changes are intended to either reduce hunting pressure on species whose populations are declining or to provide further opportunity for harvesting species whose populations are increasing.

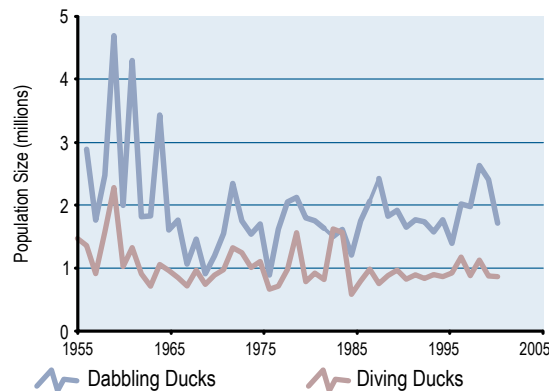


Figure 2–11.

The total number of dabbling ducks and diving ducks in northern Alberta fluctuates from year to year, but has not shown a clear increasing or decreasing trend since the mid-1960s.

Data Source: Canadian Wildlife Service; US Fish and Wildlife Service.

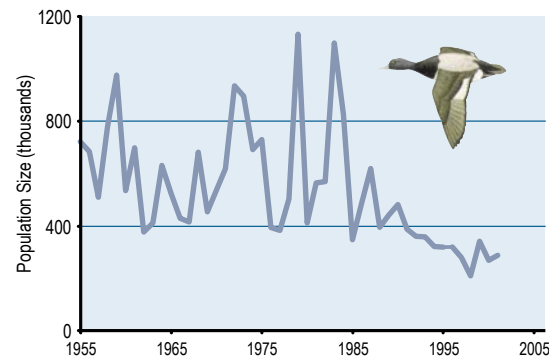


Figure 2–12.

The scaup population in northern Alberta has declined dramatically since the early 1980s.

Data Source: Canadian Wildlife Service; US Fish and Wildlife Service.

What is being done about it?

The Canadian Wildlife Service and the United States Fish and Wildlife Service continue to co-operate in monitoring waterfowl populations in North America. These agencies, together with provincial, territorial and state wildlife departments, also set bag limits on individual populations. Government agencies, Ducks Unlimited and other partners work together through the North American Waterfowl Management Plan to develop programs intended to promote the conservation of waterfowl and their habitat. These agencies are co-operating in continent-wide efforts to determine why pintail and scaup numbers have declined so much in recent years, so that corrective measures can be put in place to reverse this trend. Ducks Unlimited and its partners have developed the Western Boreal Forest Initiative to address water bird conservation concerns in the vast boreal forest region of western Canada, including much of the Athabasca, Peace, Great Slave and Mackenzie-Great Bear sub-basins.

▼ Overall Assessment – Mixed Signals

Waterfowl populations in northern Alberta change dramatically from year to year. Populations of some species are currently larger than their long-term average while others are smaller. The decline in pintail and scaup numbers over the past two decades is of particular concern. The commitment to additional research and monitoring of waterfowl populations by government and non-government agencies will improve our understanding of factors that affect waterfowl populations. Such knowledge

will be essential in order to improve waterfowl conservation programs.

Ensure Human Health and Safety

Traditional Knowledge of Human Health and Safety

Based on information prior to 1995, over half of the Aboriginal respondents from Fort McMurray said that their water use had changed because of the risk of disease, and 14% said that their water use had changed because of health warnings. In Fort Chipewyan, about two-thirds of people reported that risk of disease and health warnings had altered their use of water.²⁸

◆ Overall Assessment – Unfavourable

Aboriginal residents of Fort McMurray and Fort Chipewyan have changed their use of water because of health warnings and the risk of disease.

Fish Consumption Advisories

What is happening?

The Athabasca River and several lakes within its watershed have fish consumption advisories based on elevated concentrations of mercury, dioxins and furans in fish tissues (Figure 2–13). Saskatchewan guidelines recommend that children and pregnant

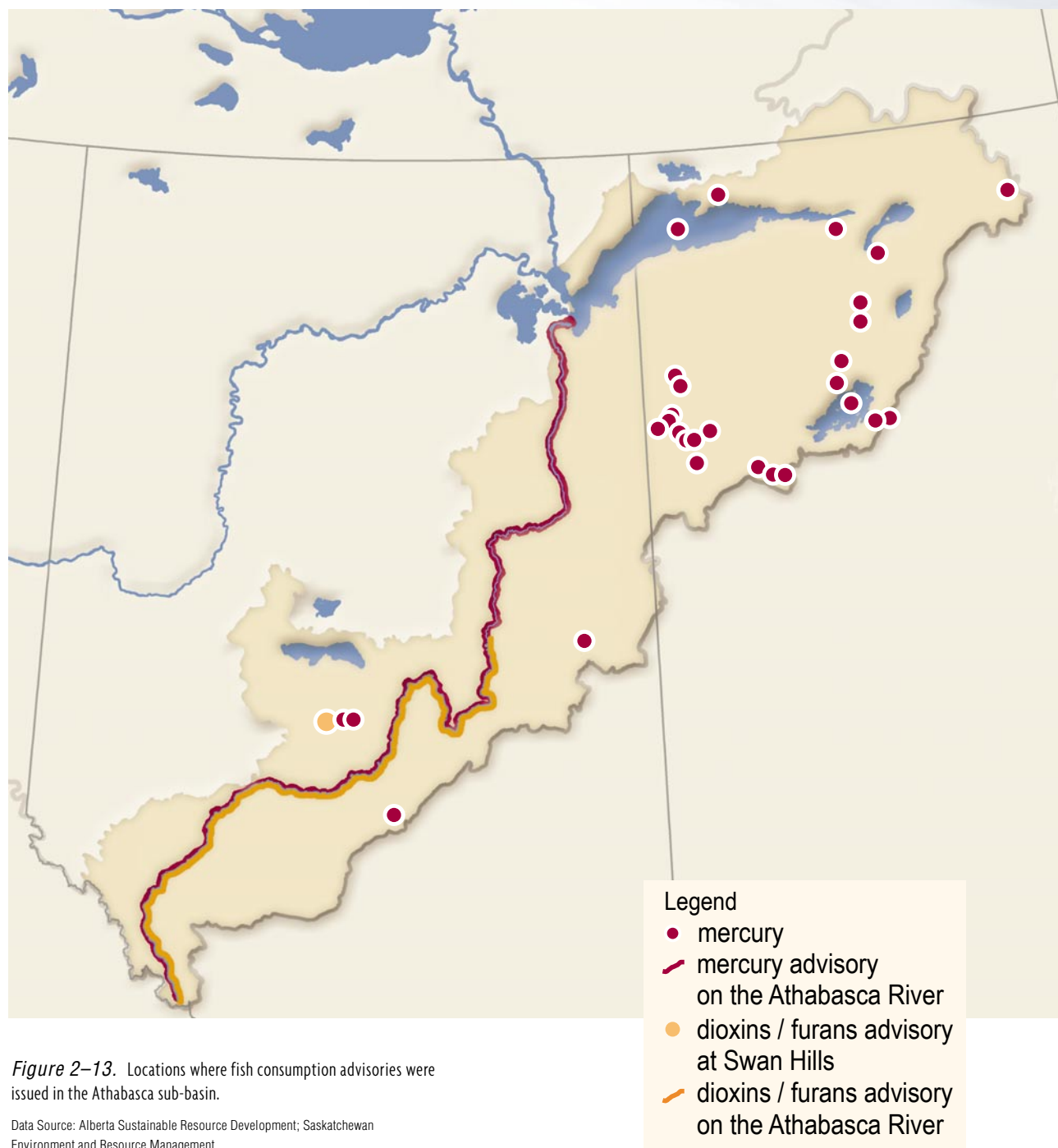


Figure 2-13. Locations where fish consumption advisories were issued in the Athabasca sub-basin.

Data Source: Alberta Sustainable Resource Development; Saskatchewan Environment and Resource Management.

2. Athabasca Sub-basin - Mackenzie River Basin

Environmental monitoring occurs in the area around the Swan Hills Treatment Centre to measure environmental levels of contaminants and evaluate whether traditional use of the local environment can be done safely. A human health impact assessment based on two independent studies conducted in 1997 by Health Canada and Alberta Health and Wellness found no evidence of elevated levels of PCBs, dioxins or furans in local residents, but discovered elevated levels of these contaminants in some wild game.

women should not eat fish with more than 0.5 parts per million mercury, and state the maximum number of meals of fish that can be safely consumed by others. These guidelines are dependent not only on the species of fish, but also on fish length and the number of weeks per year that the lake is fished. There are twenty-five water bodies in the Saskatchewan portion of the Athabasca sub-basin with fish consumption advisories for mercury.

In Alberta, there are fish consumption advisories based on mercury for certain fish species caught in the Athabasca River and four lakes in the Athabasca sub-basin. These advisories recommend that women of childbearing age and children younger than fifteen should not eat these fish, while other people should not consume more than one meal per week. Also in Alberta, elevated levels of dioxins and furans prompted the recommendation that consumption be limited to one meal per week for all fish species caught from all waters within a twenty-kilometre radius of the Swan Hills Special Waste Treatment Centre. In addition, it is advised that for burbot caught in the Athabasca River upstream of Iron Point, the organs should be discarded and only the fillet portions should be eaten.

Why is it happening?

Mercury is naturally present in some soils and weathering of these soils introduces mercury into the aquatic ecosystem. Mercury is also a pollutant that is released by several types of industries. It is transported globally through the atmosphere and may be deposited in water bodies with precipitation or as dry deposition.

Accidental releases of dioxins and furans from the Swan Hills Special Waste Treatment Centre in 1996 resulted in local contamination of the environment and prompted the fish consumption advisory for the area. In addition, dioxins and furans are released in the effluents of bleached kraft pulp mills in the Athabasca sub-basin.

Mercury, dioxins and furans can biomagnify along food chains so predatory species, like walleye, northern pike, burbot and lake trout tend to have higher concentrations of these contaminants. As a result, it is usually these species for which consumption advisories are issued.

What does it mean?

Mercury, dioxins and furans are toxic chemicals that are known to cause many health problems when consumed over recommended levels. Fish consumption advisories are designed to protect humans from consuming harmful levels of these contaminants by limiting their consumption of highly contaminated fish. By following fish consumption advisories, people can safely enjoy the health benefits of eating fish they have caught themselves. Government agencies need to monitor contaminant levels in fish and update advisories on a regular basis so that people will be able to make informed decisions about eating fish that they have caught themselves.

What is being done about it?

As a follow-up to the *Northern River Basins Study*, work is underway with First Nations to develop better protocols for fish consumption advisories. Pulp mills

are required to use the latest technologies to reduce their output of dioxins and furans, and the amount of these chemicals being discharged into the environment has significantly decreased in the last decade. As a result, there is no longer a fish consumption advisory for mountain whitefish and burbot fillets on the Athabasca River. Monitoring for contaminants in the vicinity of the Swan Hills Treatment Centre is done on a regular basis as a condition of the company's operating licence.

▼ Overall Assessment – Mixed Signals

Because of high levels of mercury, dioxins and furans in some fish species, there are fish consumption advisories for several sites in the Athabasca sub-basin. These advisories are meant to protect people from excessive dietary exposure to environmental contaminants. While the mercury advisories are the result of naturally elevated levels of mercury in predatory fish in certain water bodies, the dioxin and furan advisories stem from industrial releases of these contaminants within the Athabasca sub-basin. Pulp mills have dramatically reduced their release of dioxins and furans into the Athabasca River. As a result, the fish consumption advisory on the Athabasca River has been eased in recent years. Government agencies need to monitor contaminant levels in fish and update advisories on a regular basis so that people will be able to make informed decisions about eating fish that they have caught themselves.

Oil Sands Development

Introduction to Oil Sands Development

The oil sands of northern Alberta represent one of the world's largest deposits of bitumen, a thick hydrocarbon that can be processed into a variety of petroleum products.¹⁰⁶ Located in the Peace River, Fort McMurray and Cold Lake regions, Alberta's oil sands cover an area of almost 141,000 square kilometres. The deposits have been estimated to contain a total of 1.6 trillion barrels of bitumen with a potential to recover over 300 billion barrels using modern technology and with the expectation of a reasonable economic return.¹⁰⁷

Oil sands are a mixture of earth and bitumen, a substance from which oil can be extracted.

When the bitumen deposit is close to the surface, open-pit mining is used to remove the oil sands. This method is used for the majority of bitumen produced in the Athabasca oil sands deposit near Fort McMurray. About two tonnes of oil sands must be dug up and processed to produce one barrel of oil.¹⁰⁷

Bitumen is separated from sand by a process that involves the addition of large volumes of warm water.¹⁰⁶ Some of this water can be re-used, but some is disposed of as tailings along with sand, clay and un-recovered bitumen. These tailings are stored in large ponds until they can be used to fill in the mined-out pits.

In situ operations are used when the bitumen deposits are too deep to mine. Since only 19% of the oil sands in the Athabasca region can be mined, *in situ* methods will likely be used in the future to access the majority of these deposits.¹⁰⁸ *In situ* operations require large volumes of water to recover bitumen; for example, the steam assisted gravity drainage (SAGD) method uses 2.5 to 4 units of water for each unit of bitumen recovered.¹⁰⁸ To date, all the SAGD operations in the Athabasca oil sands have used fresh groundwater to make steam, but efforts are being made to use brackish or saline water instead.¹⁰⁸ Water is recycled as much as possible. Nevertheless, for each unit of oil produced, one unit of water is lost from the hydrological cycle since it fills deep cracks in the earth from which the oil was recovered.¹⁰⁸

Oil Sands Development - continued



Suncor Energy's oil sands mining operation located north of Fort McMurray.

Courtesy of Malcolm Conly

Oil Sands Development - continued

Development of the Alberta Oil Sands

Aboriginal inhabitants of the area knew of the black tar pitch that oozed from the sandy banks of the Athabasca River and traditionally used it to construct and repair their canoes.¹⁰⁹ In the 1700s, European explorers in the Fort McMurray area documented the presence of the tar sands.¹⁰⁹ Efforts to commercially develop the oil sands began in the early 1920s.¹⁰⁹ Large-scale commercial developments began in the late 1960s and 1970s when Great Canadian Oil Sands (later Suncor Inc.) and Syncrude opened plants in the Fort McMurray area. In 2001, production from all Alberta oil sands was 645,000 barrels per day,¹⁰⁷ with the majority of that being produced in the Athabasca region. The oil sands currently represent about 40% of Alberta's total oil production and about one third of all the oil produced in Canada.¹⁰⁷ Production is expected to approach two million barrels per day within the next ten to twenty years.¹¹⁰

Oil sands development has brought people and jobs to Fort McMurray. The city has grown quickly in response to the rapid growth in the industry. Concerns have been raised that this rapid pace of change has impinged on the traditional lifestyle of many First

Nations people living in the area. Industry and the federal Department of Indian Affairs and Northern Development negotiated an agreement with the Athabasca Tribal Council to address this concern and to enable First Nations people to derive some of the benefits that come from oil sands development. The agreement focuses on employment, education and training, physical and social infrastructure and building the capacity for environmental consultation in the communities.¹¹⁰

Environmental Concerns

The growth and expansion of the oil sands industry has, and will continue to have, an impact on the regional environment. Large-scale water use, land disturbance and potential water and air pollution are major concerns. The loss of freshwater from the hydrologic cycle by injecting it into deep geological formations is one such concern.¹⁰⁸ Alberta Environment initiated a review of deep well injection to learn more about the volumes being used. Initial results show a decrease in the volume of water being diverted for this purpose and an increase in water recycling. Nevertheless, further steps are being taken to improve water conservation by the industry.¹¹¹ Another concern relates to how water quality may be

Oil Sands Development - continued

affected by tailing pond emissions, which contain various types of pollutants.¹⁰⁹ There are also concerns about the production of various air pollutants, including acidifying emissions, particulate matter, polycyclic aromatic hydrocarbons, sulphur, volatile organic compounds, and greenhouse gases.

Up to 70% of the sulphur dioxide and nitrogen oxides emitted by Alberta oil sands operations are deposited in Saskatchewan.¹¹² The Government of Saskatchewan is concerned that these acidifying emissions could lead to the acidification of lakes in north central Saskatchewan. While acid deposition is currently below levels that would harm lakes in northern Saskatchewan, long-term projections indicate that it could pose a risk to some lakes in the area within the next twenty-five to fifty years.¹¹²

In response to the anticipated effects of the industry on the environment, Alberta Environment initiated the Regional Sustainable Development Strategy (RSDS) for the Athabasca Oil Sands Area.¹¹³ The RSDS identified seventy-two environmental issues that require attention. Issues that are the highest priority include sustainable ecosystems, cumulative impacts on wildlife, soil and plant species diversity, effects of air emissions on human health, wildlife and vegetation, and bioaccumulation of heavy metals.

Other important issues that were identified include access management, cumulative impacts on fish habitat and populations, effects of tailings pond emissions, effects of acid deposition, and impacts on surface water quality. The RSDS has developed blueprints for actions to address these important issues.

The Cumulative Environmental Management Association (CEMA), established in 2000, develops environmental objectives and management recommendations on how best to reduce the long-term environmental impacts of industrial development in northeastern Alberta.¹⁴ CEMA works closely with the Government of Alberta on their RSDS to ensure that the environment in northeastern Alberta is protected from long-term, significant damage. This organization, which includes representatives from industry, government, Aboriginal and environmental groups, has identified twelve priority issues: cultural and historical resources, reclamation, landscape diversity, biodiversity, wildlife habitat, fish habitat, surface water quantity, surface water quality, trace metals, acidification, air contaminants and ground level ozone. Work is ongoing to ensure that each of these issues is addressed during all phases of industrial development in northeastern Alberta.