



CHAPTER SIX

THE SOUTHERN TRIBUTARY SUB-BASINS OF THE NORTH SASKATCHEWAN RIVER

Figure 6.1. Southern Tributaries of the North Saskatchewan River



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The southern tributaries of the North Saskatchewan River lie in the prairie ecozone and include the Vermilion River, Battle River, Sounding/Eyehill Creek, and Eagle Creek. They are shown in Figure 6.1. For the most part, the Vermilion and Battle river sub-basins and the Sounding Creek sub-basin lie in the aspen parkland ecoregion, while the Eagle Creek sub-basin is largely in the moist mixed grassland ecoregion.

Sub-basin Summary

Characteristics

- open plains
- extensively cultivated
- gross drainage area 85 213 km²
- effective drainage area 19 120 km²

Hydrology

- low gradient, slow moving streams
- ephemeral flows
- regulated

Water Quality

- fair overall
- impaired by nutrients, pesticides

Biodiversity

- riparian zones unhealthy
- significant wetland loss

Key Issues

- water allocation and use
- land use
- municipal and industrial effluents

These plains regions are underlain by sandstone, mudstone and shale, with occasional bentonite or coal beds. The sub-basins are covered by a thick layer of undulating to kettled glacial till typical of the prairie pothole landscape. There are also areas of level lacustrine deposits and hummocky to ridged deposits laid down by glacial meltwater. In the Sounding Creek sub-basin the land is level to very gently rolling.¹

The dominant tree is the trembling aspen. Balsam poplars ring the small lakes, ponds, and sloughs that provide major habitat for waterfowl. In aspen groves, the deciduous understorey contains berries such as Saskatoon and chokecherry.² As well as providing major breeding habitat for waterfowl, the sub-basins contain habitat for white-tailed deer, coyote, snowshoe hare, cottontail, red fox, northern pocket gopher, Franklin's ground squirrel, and bird species like sharp-tailed grouse and black-billed magpie.



Owing to the climate and fertile black soils, the sub-basins contain productive agricultural lands. For this reason, much of the original aspen parkland has given way to agricultural development. The sub-basins produce a wide diversity of crops, including spring wheat and other cereals, oilseeds, forage, and several specialty crops. In the south, dark brown soils are dominant, but significant areas of salty soils are also found, giving rise to alkaline sloughs and ponds.

Cow-calf operations dominate beef production in the sub-basins. As well as agricultural production, the economy of the sub-basins depends on oil and gas exploration and development and coal mining. The population of the Battle River sub-basin is over 125 000, with most residents located in Alberta. The population of the Vermilion River sub-basin was 25 200 in 2005.

A History of Ducks Unlimited Canada

With a drought gripping the Prairies in the dusty and dirty days of the Great Depression, wetlands dried up and waterfowl numbers dwindled. In 1938, a group of conservation-minded sportsmen set out to raise funds from private sources for habitat restoration and creation projects in Canada, where more than 70 percent of North America's waterfowl originate. They called their effort Ducks Unlimited. The first project in the Saskatchewan River Basin, at Waterhen Marsh, was completed in 1938.

Ducks Unlimited Canada's (DUC) mission and program has since broadened but remains true to its roots, focussing on wetlands and waterfowl, while also conserving the ecological integrity of the larger watershed. Today, DUC is a science-based, non-profit and charitable organization with a mission to conserve, restore and manage wetlands and associated habitats for North American waterfowl, other wildlife and people. DUC collaborates with sister-organizations DU Inc (USA) and DUMAC (Mexico) to ensure a continental approach in conserving the waterfowl resource through habitat conservation. This program is accomplished with the financial support and volunteer efforts from thousands of supporters.

DUC believes that collaborating with a variety of partners including governments, academic institutions, individuals, industries, and other conservation groups is critical to achieving its mission. One important pillar of DUC's program is the North American Waterfowl Management Plan (NAWMP).

Established in 1986, NAWMP is a partnership of government, non-governmental organizations, private companies and many individuals, all working together towards achieving better wetland habitat to sustain continental waterfowl populations at the average level of the 1970s.

The prairies and boreal forest of western Canada are considered the waterfowl factory of North America and, consequently, these regions are the primary target of NAWMP programs. The Saskatchewan River Basin straddles both these ecozones and is home to an estimated eight million waterfowl each spring. DUC has 6153 projects in this basin conserving an estimated 17 000 km² of habitat. These initiatives include:

- Developing conservation easements with landowners to protect parts or all of their property in perpetuity;
- Promoting winter wheat as an economically viable crop that is "duck friendly;"
- Working with ranchers to design grazing systems that conserve habitat;
- Developing and operating water control structures to maintain the ecological integrity of the Saskatchewan River Delta; and
- Working with all partners including government and industries to develop corporate and public policies that sustain wetland habitats for the ecological goods and services they provide to society.

HYDROLOGY

The plains streams discussed in this chapter share an open, rolling landscape that produces relatively little streamflow. Large portions of these sub-basins do not contribute streamflow to the main stream under normal circumstances. Some of this non-contributing area never contributes flow to the North Saskatchewan River, even in very wet years.

The Vermilion River rises near Viking in east-central Alberta, loops north through Vegreville then flows east before joining the North Saskatchewan River near the interprovincial boundary. The river is 464 km long. The drainage area of the sub-basin is 7867 km² and the effective drainage area is 2364 km². The flow of the river is regulated by structures at Watts/Bens lakes, a stop log structure at Morcambe, and a dam at Vermilion. The latter two structures are operated by Alberta to provide a riparian flow, except in the winter. The structures are also operated during summer rains because of concerns about land drainage and agricultural flooding in the sub-basin.

The Battle River basin is situated in east-central Alberta and west-central Saskatchewan. The river itself is 1035 km in length; about 800 km lies in Alberta. The Battle River headwaters originate at Battle and Pigeon lakes in central Alberta. From Battle Lake the river flows in a southeast direction meandering 100 km within a low, well-defined valley. At Ponoka, the river flows east for 48 km into a low, flat area near Samson Lake. Passing through Samson Lake, the river continues north through 64 km of gradually steepening valley as it approaches its confluence with Pipestone Creek. Downstream of Pipestone Creek, the river flows through a larger, more rugged valley carved out by the outflow from glacial Lake Edmonton, which once covered most of Alberta. The Battle's large river valley and *chain lakes*, such as Coal Lake and Driedmeat Lake, are evidence of the glacial spillway carved over 10 000 years ago. The Battle River continues to flow through this larger valley in an easterly direction until it joins the North Saskatchewan

River at Battleford. The drainage area of the sub-basin is 45 654 km², a little over half being in Alberta. The effective drainage area is only 12 498 km².

Water supply for the Battle River is regulated by reservoirs. Water levels on Pigeon Lake are partially controlled by a stop-log weir at the outlet of the lake. Coal Lake, a tributary lake and municipal water supply for Wetaskiwin, is regulated by an earth-fill dam. The dam, which stores 38 000 dam³, is occasionally operated to supplement downstream flows on the Battle River. On the Battle River, riparian flow downstream of Driedmeat Lake, the municipal water supply for Camrose, is regulated by a stop-log weir containing a fishway two metres wide. The impoundment stores 14 200 dam³ and an increase to 24 000 dam³ is under consideration. The ATCO Power dam on the Battle River near Forestburg is used to store cooling water for a 670 MW coal-fired electricity generating station. Forestburg reservoir, which stores 9000 dam³, is also used to maintain a year-round base flow on the Battle River. Water levels of Ribstone Lake near Wainwright are regulated by a stop-log weir for recreation and waterfowl habitat. Ducks Unlimited Canada operates 27 smaller structures in the Ribstone area to create wetlands and back-flood hay meadows for agriculture and habitat improvement. There are no water storage structures on the Battle River in Saskatchewan. Total available storage in the sub-basin is about 30 percent of the naturalized flow at the interprovincial boundary.

Like the Battle River sub-basin, the Sounding/Eyehill Creek sub-basin extends from east-central Alberta into west-central Saskatchewan. The 340-km creek starts some 20 km north of Hanna and meanders about 60 km southeast towards Youngstown, passing through Antelope Lake, before turning east and then north, passing through Grassy Island Lake on its way to Sounding Lake. Sounding Lake, which has been dry since 1971, is essentially a terminal lake that can overflow to Eyehill Creek. Overflow has occurred in only one year. From Sounding Lake the creek then flows northeast for a further 80 km, where it joins Manitou Lake. This lake has a prehistoric spillway to

the Battle River but since European settlement there has been no overflow. The drainage area of Manitou Lake is 15 541 km² and the effective drainage area is only 2126 km². A dam near the town of Macklin, Saskatchewan allows water to be diverted into Macklin Lake during high flows. A control structure on the lake impounds water for stockwatering and maintains water levels. The total storage is 4800 dam³.

The Eagle Creek sub-sub-basin lies in west-central Saskatchewan. The 453-km creek starts near Unity and flows south through Eagle, Tramping and Opuntia lakes then turns east, then north, in a long arc, joining the North Saskatchewan River south of Radisson. The gross drainage area is 16 241 km² and the effective drainage area is only 2132 km². Flows upstream of Tramping and Opuntia lakes are usually contained by those lakes. Opuntia Lake, which stores 19 000 dam³, is regulated by a low dam and weir.

The average annual precipitation in the Vermilion River sub-basin is about 400 mm. The average annual precipitation in the Battle River sub-basin ranges from 480 mm in the headwaters to 373 mm at North Battleford. Average annual precipitation is as little as 320 mm in the Sounding/Eyehill and Eagle Creek sub-basins. Since average annual potential evaporation is 800 mm or greater, the sub-basins have a significant water deficit. Surface water runoff typically is less than ten percent of the annual precipitation, while only a few percentage points of the precipitation recharges groundwater. Most of the annual precipitation returns to the atmosphere through evaporation from water bodies or from the soil surface, or through transpiration from growing plants. Typically, this situation leads to annual runoff from the surface area of the sub-basins being equivalent to 10 mm or less.

The hydrograph of streams originating on the plains shows most of the annual flow occurring with spring snowmelt runoff in April and May, with very little winter flow. Intense rainfall events may lead to occasional short-duration summer flows, while flows later in the year are sustained by groundwater inflows.³ In general, streamflow in these prairie sub-basins is small compared to the surface area of the

sub-basin. The flow varies considerably from year to year. Available water supplies are much less reliable than those originating in mountain streams.

Figure 6.2 shows the hydrograph of median monthly flows for the Vermilion River.

The median naturalized monthly flows of the Battle River are shown in Figure 6.3. Annual flows in Sounding/Eyehill and Eagle creeks are even less reliable. While the streams exhibit the same general flow pattern as the Battle River, months with little or no flow are common.

The Water Survey of Canada, Saskatchewan Watershed Authority, and Alberta Environment operate 28 gauging stations in these sub-basins. Distribution of stations is shown in Table 6.1.

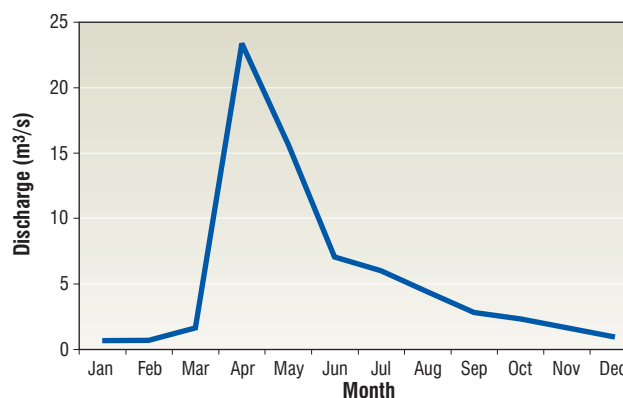


Figure 6.2. Median Monthly Discharge for Vermilion River near Marwayne.

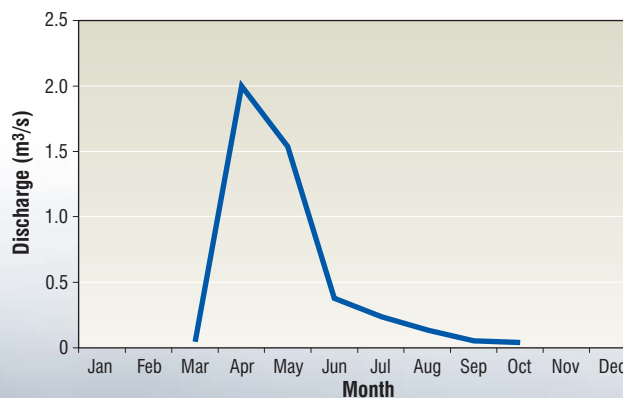


Figure 6.3. Median Monthly Naturalized Discharge for Battle River.

Table 6.1. Gauging Stations in the Southern Tributaries Sub-basins.

Sub-basin	Discharge	Water Level
Vermilion	5	2
Battle	9	3
Sounding/Eyehill	5	1
Eagle	2	1

WATER USE

Water use in these sub-basins represents a significant proportion of available supplies. The licensed overall allocation from surface water is 818 524 dam³ and from ground water is 35 414 dam³. Almost 90 percent of that allocation is for cooling water for a thermal power station in the Battle River sub-basin. Water used for cooling is withdrawn from a reservoir and returned so consumption is small. Figure 6.4 shows the distribution of licences and consumption from surface water. More than half the surface water consumption in the sub-basin is in the ‘other’ sector, largely environmental services such as lake stabilization for wildlife and habitat enhancement and for flood control. The next largest surface water

uses are for irrigation and stockwatering. Petroleum-related activities account for almost one-half of the groundwater consumption in the sub-basin. Stockwatering and municipal use are the next largest consumers. The distribution of licences and water consumption varies considerably from sub-basin to sub-basin.

Vermilion River Sub-basin

The licensed water allocation from the Vermilion River sub-basin is 5383 dam³ from surface water and almost 90 percent of that is consumed. Groundwater allocation is significant, compared to surface water. The allocation is 5009 dam³ with about 60 percent of that being consumed. Figure 6.5 shows the licensed allocation from surface water and groundwater.

About two-thirds of surface water consumption in the sub-basin is for maintaining wetland habitat and for lake stabilization – included in the ‘other’ sector. Almost all of the water diverted for this purpose is consumed. Stockwatering accounts for almost all the remaining consumption from surface water and is the principal consumer of groundwater, accounting for about 80 percent of consumption. Almost all of the remaining consumption from groundwater is for

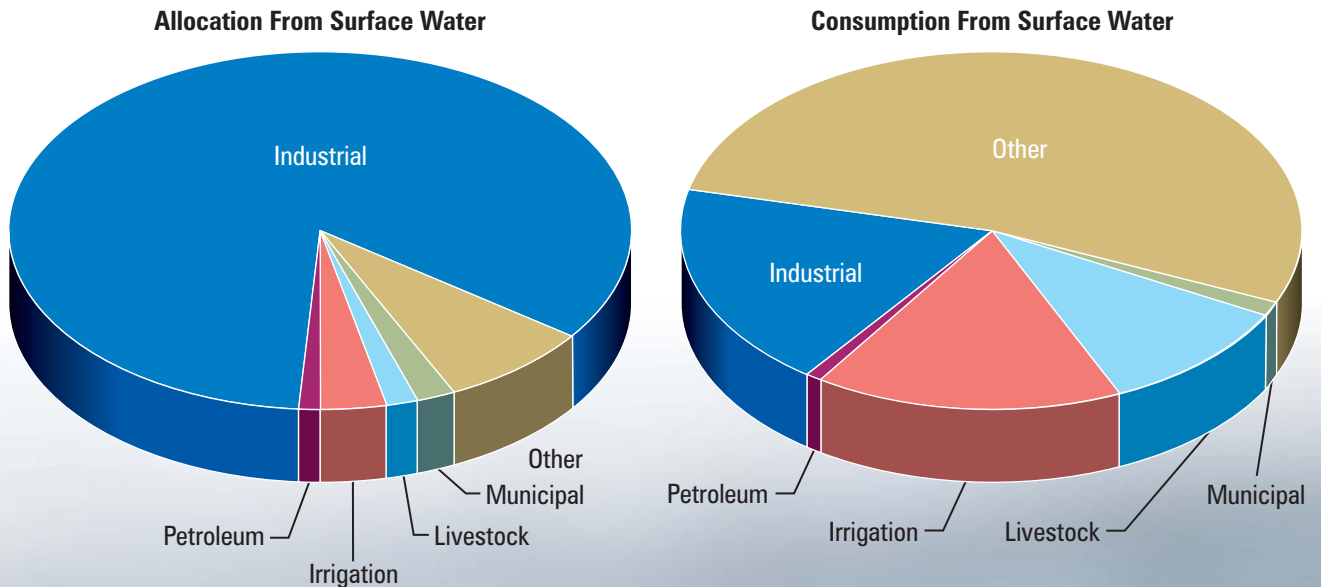


Figure 6.4. Overall Licensed Allocation and Consumption from Surface Water.

domestic use. Much of the water used for that purpose, while lost to the groundwater system, returns to surface water.⁴

Battle River Sub-basin

The licensed water allocation from the Battle River sub-basin includes 770 632 dam³ from surface water and 18 996 dam³ from groundwater.⁵ The surface water quantity appears extremely large taking into account

the long-term median flow of the Battle River, but 691 737 dam³ of that allocation is cooling water from Forestburg Reservoir for ATCO Power. Water consumption for this project is only two percent of the withdrawal. Figure 6.6 shows licensed surface water allocations and average annual consumption.

Surface water consumption in the Battle River sub-basin is about one-third of the median natural flow. About 90 percent of this consumption is in Alberta.

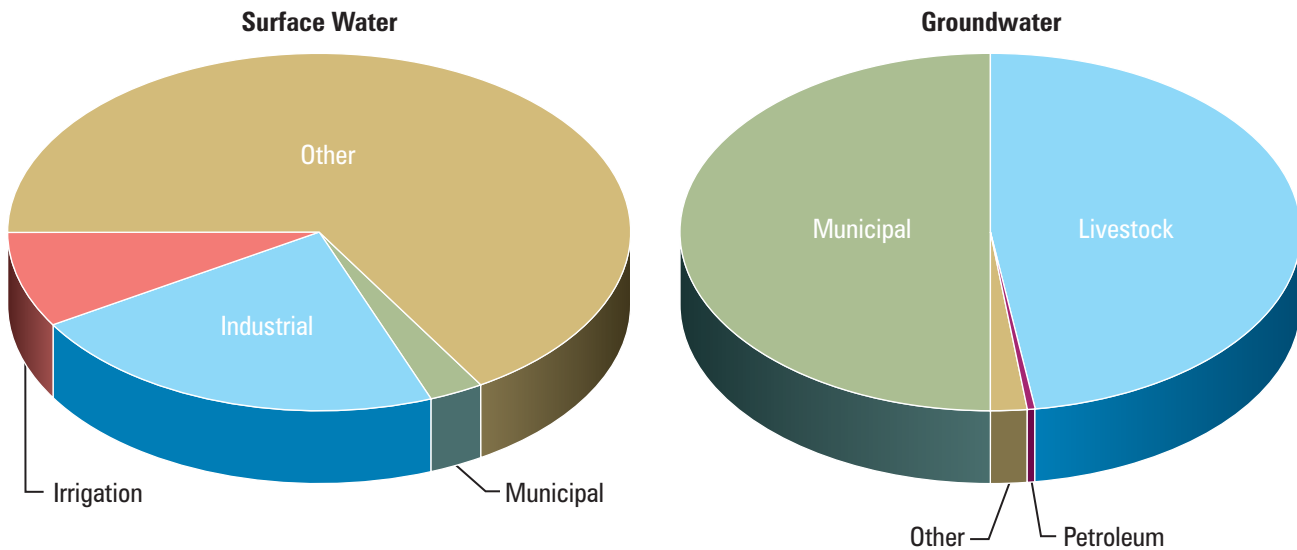


Figure 6.5. Licensed Water Allocation in the Vermilion River Sub-basin.

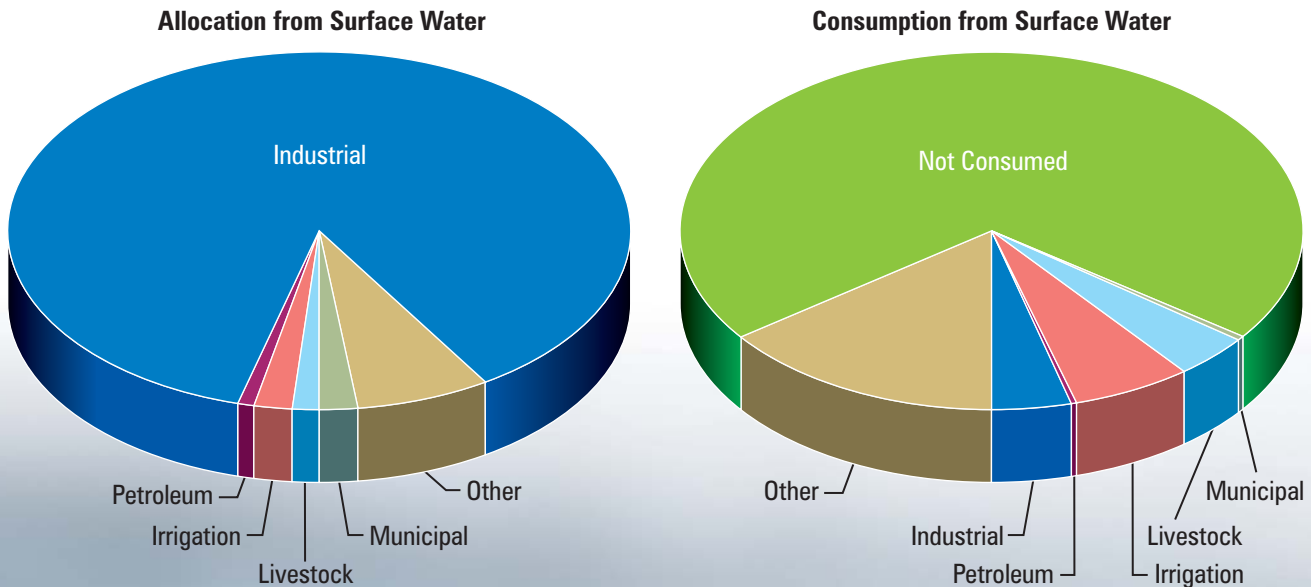


Figure 6.6. Licensed Water Allocation and Consumption from Surface Water for the Battle River Sub-basin.

The largest water consumption in the sub-basin is, by far, for environmental purposes, shown as 'other' in Figure 6.6. Uses of the water include lake stabilization, primarily for waterfowl, and fish, wildlife, and habitat enhancement. Many of the projects are Ducks Unlimited Canada projects. Almost all of the water withdrawn to support this use is consumed and does not return to the river, accounting for more than one-half of the water consumption in this sub-basin. The next largest water consumer in the basin is irrigated agriculture, followed by industrial consumption and stockwatering. Livestock operators tend to fill dugouts and small storage reservoirs in the spring, when river flows are high. Most of the water retained is consumed by livestock directly, by evaporation, and by other losses. Most of the irrigation water used in the sub-basin is by private irrigators producing forage for livestock. Almost all the water diverted is consumed or lost.

Industrial users in the sub-basin consume surface water for fertilizer plants, manufacturing and mining. The most significant use is cooling water for the ATCO thermal electric generating station but, as indicated earlier, very little of this water is consumed.

Domestic water consumption from surface water is inconsequential for the Battle River. There are two reasons for this. First, the towns of Stettler and Millet obtain their water from the Red Deer River and the North Saskatchewan River respectively, but effluent flows from these towns enter the Battle River. Secondly, five communities and many rural municipal users draw their water from groundwater. Much of the water withdrawn returns to the Battle River as effluent, making a positive contribution to surface water. Water use by the petroleum sector, primarily for well injection, is also very small.

Groundwater consumption in the sub-basin is about one-quarter of surface water consumption. More than one-half of this consumption is for stockwatering. Irrigated agriculture and petroleum-related industries constitute most of the remaining consumption.

The flow in the Battle River at the interprovincial boundary is subject to the PPWB *Master Agreement on Apportionment*. Although Alberta's water consumption has increased by some 88 percent from 1979 to 2004, there is no time from 1980 to present when the province retained more than its share of the river. In 2002, a drought year, Alberta passed 51 percent of the naturalized flow to Saskatchewan – close to the required minimum. Projections for increased water use in Alberta show modest increases, well within the terms of the existing licenses. Under this scenario, Alberta will be able to meet the requirements of the Master Agreement when streamflow conditions are normal; however, a series of very dry years with low runoff could present a challenge.

Sounding/Eyehill Creek Sub-basin

The licensed water allocation in the Sounding/Eyehill Creek sub-basin is 29 404 dam³ from surface water and 6885 dam³ from groundwater. About 90 percent of each of the allocations is consumed. About 70 percent of surface water use is for environmental purposes, shown as 'other' in Figure 6.7. Uses of the water include lake stabilization, primarily for waterfowl, and fish, wildlife, and habitat enhancement.

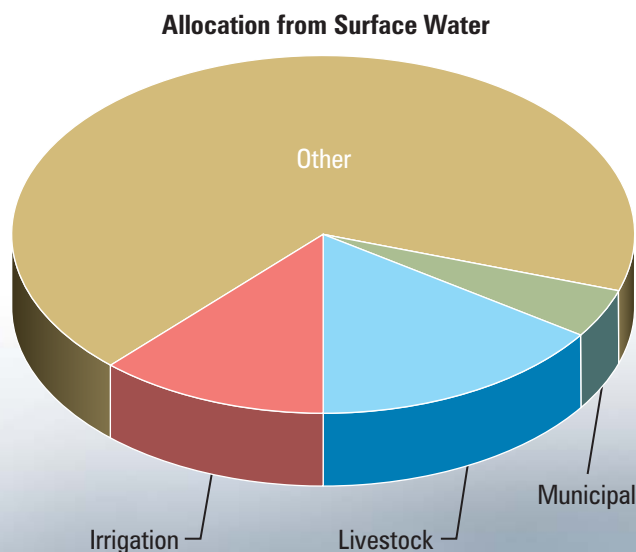


Figure 6.7. Licensed Allocation from Surface Water for Sounding/Eyehill Sub-basin.

Stockwatering and irrigated agriculture make up most of the remaining surface water consumption. Since Sounding Lake rarely overflows, the entire Sounding Creek watershed, where most of the surface water consumption occurs, lies in non-contributing drainage.

The petroleum industry accounts for 60 percent of the groundwater consumption in this sub-basin. The remaining consumption is by stockwatering and municipal use. As stated earlier in this chapter, groundwater consumption for domestic purposes results in discharges to surface water.

The flow in the Sounding/Eyehill Creek at the interprovincial boundary is subject to the PPWB *Master Agreement on Apportionment*. A study many years ago indicated that water consumption in the Eyehill sub-basin constituted no more than 18 percent of the median naturalized annual flow, but identified a potential problem with water apportionment in extremely low flow years.⁶ Recent examinations of water use by Alberta do not indicate significant increases in water use over the years.

There are local concerns regarding the effect of water use on levels of Manitou Lake. The lake has dropped about five metres in the last twenty-five years (Figure 6.8), most likely attributable to changes in precipitation and land use. The problem is influenced

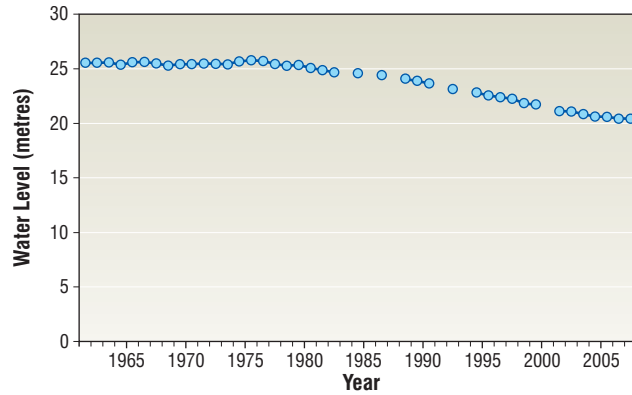


Figure 6.8. Water Levels on Manitou Lake.

by the effects of Sounding Lake. In extremely wet years, Sounding Lake may overflow and spill excess water downstream. In normal and dry years, Sounding Lake will intercept all runoff from the upper sub-basin, thereby reducing the surface area contributing to flow in the lower sub-basin.⁷

Eagle Creek Sub-basin

The licensed water allocation for the Eagle Creek sub-basin is 16 358 dam³ from surface water and 10 296 dam³ from groundwater. About 60 percent of each of the licensed allocations is used. Figure 6.9 shows the distribution of allocations.

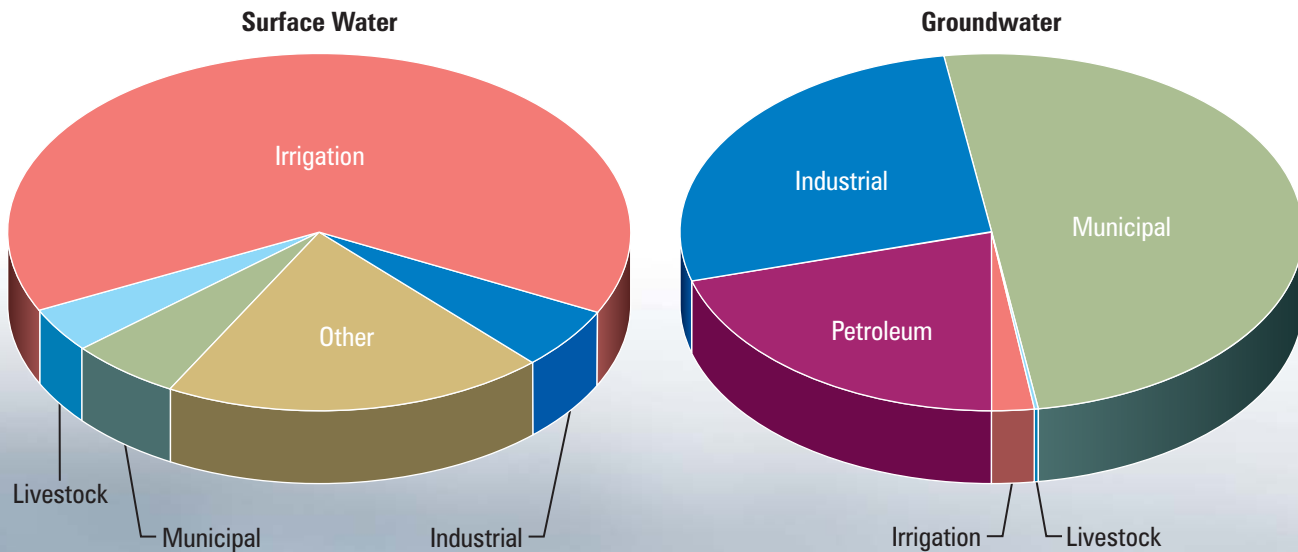


Figure 6.9. Licensed Surface Water and Groundwater Allocations for the Eagle Creek Sub-basin.

About 60 percent of surface water consumption in the Eagle Creek sub-basin is for irrigated agriculture. The next largest consumer of water is the 'other' sector, primarily water management and habitat enhancement. Industrial, stockwatering and domestic uses make up the rest of the consumption. Groundwater consumption relates primarily to industrial uses, including consumption by the petroleum industry.

More than 40 percent of the median annual flow of Eagle Creek has been licensed.⁸ It is likely that water use must be curtailed during years when surface water supplies are low.

WATER QUALITY

Water quality is influenced by the landscape and geology through which the stream flows, by the seasonal and highly variable flows in these sub-basins, and by human factors. Prairie streams, like the ones discussed in this chapter, are naturally high in nutrients because of nutrients in the soil. These low-gradient streams drain predominantly agricultural landscapes and meander slowly from their source to the North Saskatchewan River or, in the case of Sounding/Eyehill Creek, to Manitou Lake. Small lakes and sloughs impede their flow. Even in the spring it takes about a month for Battle River water to travel from the source to the mouth; during low flows this travel time is much greater.⁹ Point sources of pollutants include municipal effluents and industrial sources. Municipalities in the sub-basins operate sewage lagoons that are emptied in the spring or fall, or both. Although this effluent is reasonably good quality, the quantity released is significant in comparison to the flow of the river, particularly for fall releases. Releases from industrial sources tend to be continuous, but much smaller. Water quality is also influenced by the reductions in flow caused by the significant water use in these sub-basins. Water quality monitoring and assessments in the southern tributaries sub-basins relate mainly to the Battle River.

Water quality of the Battle River is influenced by runoff from agricultural lands, coal-mining operations, and urban areas. These sources are particularly important during spring runoff. Forestburg Reservoir has an unusual influence on water quality. The reservoir is heated due to operations of the ATCO generating station, and the warmer water released from the reservoir can raise the temperature of the river for some 200 km downstream. The open water downstream of the reservoir in the winter helps oxygenate the water. The reservoir also provides a year-round baseflow. A further influence on water quality is the groundwater inflow that contributes to baseflow.

Alberta has long-term monitoring network stations on the Battle River in the headwaters upstream of Ponoka and at the upstream end of Driedmeat Lake. Water quality is considered fair to good in the headwaters and fair at Driedmeat Lake. The river is either mesotrophic or eutrophic because of high nutrient levels. The reach between Ponoka and Driedmeat Lake, in particular, is affected by municipal point sources. Dissolved oxygen levels are depleted during the winter. Pesticide levels can be elevated.¹⁰ Alberta has recently begun to calculate a water quality index for the Battle River at the two monitoring locations.

The Prairie Provinces Water Board has monitored water quality of the Battle River near the Alberta-Saskatchewan boundary for many years. Parameters frequently exceeding established water-quality guidelines include sodium, total dissolved solids, total phosphorous, fecal coliforms, dissolved oxygen and pH. Phosphorous from municipal effluents accounts for 60 percent of the phosphorous measured at the interprovincial boundary.¹¹ Trend analysis of data from 1986 to 2002 indicates no trend for total phosphorous, nitrate/nitrite, fecal coliforms, and dissolved oxygen. There appeared to be an increasing trend in total dissolved solids, sulphate, chloride and pH.¹² The water quality of the Battle River is considered poor to fair.

Alberta and Saskatchewan routinely monitor water quality at other locations on the Battle River and Alberta has conducted periodic assessments of water quality on Sounding/Eyehill Creek. The PPWB does not monitor Eyehill Creek at the boundary.

Saskatchewan calculates a water quality index for Eyehill Creek near Macklin. The water quality is considered fair.¹³ There are insufficient data to calculate a water quality index for Eagle Creek. Low flows in Eagle Creek combined with municipal effluents lead to impaired water quality.

BIODIVERSITY AND ECOSYSTEMS

The Vermilion and Battle rivers, Sounding/Eyehill Creek and Eagle Creek sub-basins have been completely transformed by agricultural production. Loss of the original prairie grassland represents a

major shift in biodiversity. Less than two percent of the land is now treed and water bodies cover four to five percent of the sub-basins. Additional wetlands are few and ephemeral. About three percent of the sub-basins is affected by linear features such as roads, rail lines, pipelines and transmission line rights-of-way, and by other features such as industrial facilities.¹⁴ These linear features, usually roads, tend to fragment terrestrial habitat and, depending on the nature of stream crossings, may fragment aquatic habit. Urban areas take up a further two percent of the sub-basins. There are ten First Nations Reserves in the Battle Creek sub-basin and four in the Eagle Creek sub-basin.

Protected areas in the Vermilion sub-basin include Vermilion Provincial Park and Minburn Provincial Grazing Reserve. Protected areas in the Battle Creek sub-basin include Pigeon Lake and Ma-Me-O



Provincial Parks on Pigeon Lake, and Big Knife Provincial Park, also in the upper sub-basin. Other notable land areas in this sub-basin include the Wainwright Dunes Ecological Reserve, Canadian Forces Base Wainwright, and the Ribstone Creek Heritage Rangeland. Gooseberry Lake Provincial Park, Alberta is the only provincially protected area in the Sounding Creek sub-basin. Other smaller privately held land holdings are also protected.

The Sibbald Plain that straddles the interprovincial boundary in the Sounding/Eyehill Creek sub-basin and extends into the Eagle Creek sub-basin is nationally important habitat for migratory birds. This classification is based primarily on its importance for waterfowl staging. Most of the rest of the southern tributaries sub-basins is considered regionally or locally important.¹⁵

Vermilion River Sub-basin

About half of the Vermilion sub-basin consists of cropland, with almost all of the remaining land cover being grassland. Livestock density is generally moderate although it is high in the north-central part of the sub-basin. The riparian health assessment of the river indicates 16 percent of the sites examined are healthy, 30 percent healthy with problems, and 54 percent unhealthy.¹⁶ No assessments have been made of aquatic plants, benthic invertebrates or fish resources of the Vermilion River.

Battle River Sub-basin

Overall, about 40 percent of the Battle River sub-basin is devoted to cropland and a similar percentage to grassland. Forage crops are grown in a little over ten percent of the sub-basin. These average values vary considerably throughout the sub-basin, however. The headwaters of the Battle River, including tributaries, consist of almost 40 percent forage and 30 percent cropland. This part of the sub-basin also has high livestock density. The remainder of the Alberta portion of the sub-basin tends to have moderate livestock densities, with densities

increasing again in Saskatchewan. Riparian health has been assessed in the upper sub-basin where it is generally good or healthy with problems. Although riparian health has not been assessed on downstream tributaries, it tends to degrade moving downstream. By the interprovincial boundary, about 30 percent of sites are deemed to be unhealthy. There are no assessments of aquatic plants or benthic invertebrates for the Battle River. White sucker and northern pike occur in the sub-basin although fish movements are impeded by low flows and structures such as dams and weirs. Lake whitefish, burbot and yellow perch are found in Battle and Pigeon lakes in the headwaters and walleye have been reintroduced in Pigeon Lake.¹⁷

Sounding/Eyehill Creek Sub-basin

The almost treeless Sounding River sub-basin is predominantly grassland, reflecting the semi-arid climate of the region. About 30 percent of the sub-basin is cropland. Livestock densities are moderate. Riparian health and aquatic resources of this sub-basin have not yet been assessed.¹⁸

Eagle Creek Sub-basin

Most of the Eagle Creek sub-basin is cultivated and wetland loss is high. Little data exist pertaining to aquatic ecosystems of the creek, and it is possible that riparian and aquatic ecosystems are not healthy.

ENDNOTES

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¹² Saskatchewan Watershed Authority 2007a. *supra*.

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¹⁴ North Saskatchewan Watershed Alliance 2005. *supra*.

¹⁵ Poston, B., D.M. Ealey, P.S. Taylor, G.B. McKeating 1990. *Priority Bird Habitats of Canada's Prairie Provinces*. Environment Canada, Edmonton, AB.

¹⁶ North Saskatchewan Watershed Alliance 2005. *supra*.

¹⁷ North Saskatchewan Watershed Alliance 2005. *supra*.

¹⁸ North Saskatchewan Watershed Alliance 2005. *supra*.