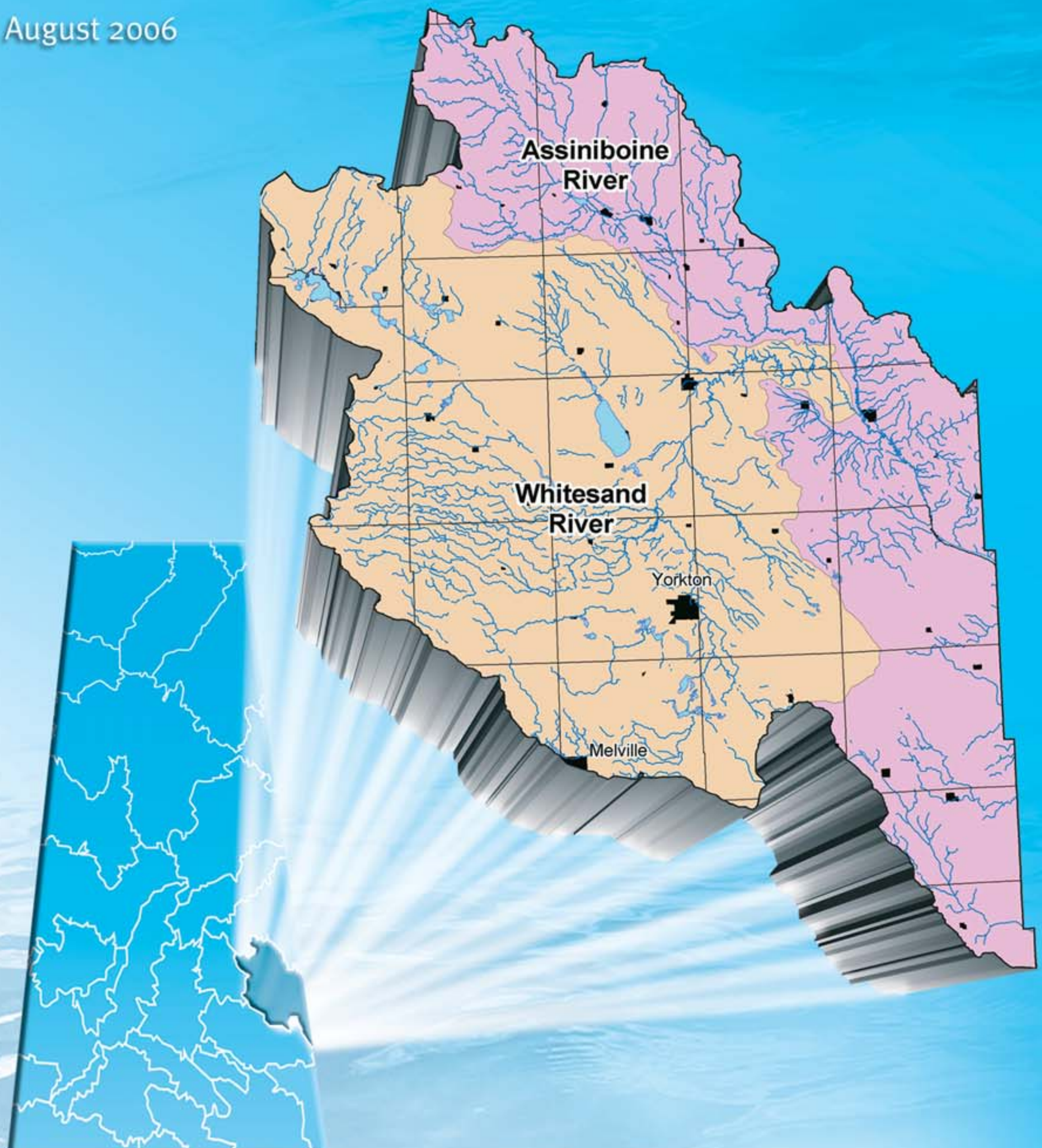
Assiniboine River Watershed

Source Water Protection Plan

August 2006



Saskatchewan Watershed Authority

Assiniboine River Watershed Advisory Committees

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1. Executive Summary

The Assiniboine River and its tributaries are located in eastern Saskatchewan and western Manitoba. Within Saskatchewan, the Assiniboine River Watershed covers an area of 17,300 square kilometres and includes 24 rural municipalities, eight towns, 15 villages and the cities of Melville and Yorkton.

The focus of this plan, consistent with the Saskatchewan's *Safe Drinking Water Strategy*, is to protect source waters in the Assiniboine River Basin within the Province of Saskatchewan. The purpose is to summarize the current status of water resources, identify risks to water quality, and describe an action plan to ensure the sustainability of water in the Assiniboine River Watershed.

The Assiniboine River Watershed Source Water Protection Plan was developed by the Assiniboine River Watershed Advisory Committees, with support from the Assiniboine River Watershed Technical Committee and in consultation with watershed residents. Watershed and Aquifer Planning staff from the Saskatchewan Watershed Authority facilitated the planning process over a two year period.

Source water protection is considered the first barrier in the multi-barrier approach to attaining safe drinking water, and is viewed as the most cost-effective means of ensuring the safety of drinking water.

In October 1996, the governments of Saskatchewan, Manitoba and Canada agreed to conduct The Upper Assiniboine River Basin Study. The study was initiated as a result of the 1995 flood and other issues, including drainage and flood control and the disappearance of valuable wetland habitat. In addition, there was uncertainty regarding sustainable water supplies for municipal, industrial, agricultural and recreational purposes and a lack of knowledge regarding the hydrologic and ecological processes and their effects within the watershed. There was also growing concern that the quality of water was deteriorating, and uncertainty about appropriate measures for aquifer management and protection. The Upper Assiniboine River Basin Study provided information respecting the Basin's water resources, and information and recommendations on which to base decisions affecting future water management.

The Saskatchewan Watershed Authority was established on October 1, 2002 to manage and protect water quantity and quality within the province. As part of this mandate, the Saskatchewan Watershed Authority is responsible for managing watershed and aquifer planning in Saskatchewan. In 2004, two Watershed Advisory Committees were established within the Assiniboine River Watershed to lead the planning and decision-making process. Their work built upon the Upper Assiniboine River Basin Study, with a focus on source water protection.

The development of a management strategy for a watershed normally begins with the assembly of basic watershed information into an overview or background report. The Upper Assiniboine River Basin Study was utilized extensively to develop a background report for the Assiniboine River Watershed.

The Upper Assiniboine River Basin Study was also used to prepare a list of the areas of concern related to source water protection. All of the issues contained in the Upper Assiniboine River Basin Study were reviewed from a source water protection perspective. These concerns and issues were then separated into “water quality”, “watershed health” and “wildlife” issues. This was considered the starting point of the new process. The Assiniboine River Watershed Advisory Committees were then consulted to ensure that the list of concerns and issues was complete, and additional issues were added by the Committees.

As mentioned earlier, the focus of this process was on developing a protection plan for drinking water. Thus, it was decided to first concentrate on community-based drinking water sources, as opposed to individual systems. The latter are to be addressed through such programs as the Environmental Farm Plan program, or within the context of the larger community-based source waters.

It is estimated that nearly 90 percent of residents within the Assiniboine River Watershed use groundwater, as opposed to surface water. In contrast to surface water, the groundwater supply in the watershed is more stable. However, groundwater supplies are typically not sufficient to provide large quantities of water at any given location. Defining the available groundwater supply is more involved and costly than doing the same for surface water.

A risk analysis workshop for the combined Technical Committees of the Assiniboine River Watershed and the Yorkton Area Aquifers planning process was held over a two day period. The committees first screened the issues and sorted them with respect to their relevance to source water protection. This process transformed the list of issues into “risk areas”. Then a scan and scope of each area of risk was conducted by the group.

Some key observations made at the conclusion of the risk analysis process were that:

- agriculture is by far the dominant land use within the watershed, and as such agriculture ranked as a higher risk than the other risk areas;
- there is a split between what urban and rural residents feel has the largest impact on water quality, and that residents in each area feel that the other is not assuming sufficient responsibility;
- the water quality of the Assiniboine River is generally good and that, while there may be reaches that are being negatively impacted, these are few and not widespread;
- currently there are no apparent serious, widespread risks to water quality resulting in source water degradation in the watershed quantity; and
- a major threat or stressor to water quality in the Assiniboine River Watershed is excess nutrient inputs, principally nitrogen (N) and phosphorous (P). This is common to many other watersheds that are dominated by agriculture.

Once the priority risk areas were identified, the next steps of the watershed planning process were to develop objectives to address these risks and then to formulate recommendations and key actions to fulfill those objectives.

Key strategies identified

The following key strategies are not listed in any specific order.

1. Formation of a formal Assiniboine River Watershed Authority (or Conservation District or Source Water Protection Authority). This is a critical component to the successful implementation of the Source Water Protection Plan. It is vital that the implementation of the watershed planning process be carried out under the premise of local ownership. A local manager will provide an exclusive focus to local issues and initiatives.

2. Protect the source drinking water for all communities by developing a well head integrity program for every community that uses groundwater (including community wells owned by Rural Municipalities) and protecting the water quality upstream of surface water intakes.

3. Improve fish passage throughout the Assiniboine River Watershed. An absence of barriers allows for migrations of fish and other species, and results in greater biodiversity and stability throughout the watershed. Fish are a major component of the aquatic system. Taking steps to ensure that desirable fish species are present in the system also encourages people to care for the aquatic system and take the necessary measures to protect water quality.

4. A nutrient reduction plan to reduce nutrient loading associated with human activities that result in the movement of nutrients to water bodies within the watershed is a strategy that affects all residents within the watershed. Every sector should contribute toward the nutrient reduction plan for the watershed. This is viewed as a collaborative initiative and does not assume or place blame on any particular sector.

5. Increasing the education and awareness of residents about their watershed and related watershed issues is seen as a key priority for the Assiniboine River Watershed.

Ensuring the safety of their drinking water is the responsibility of every resident living in a watershed. Everyone has some impact on water quality. Because good water quality is necessary for human life, and because it is vital for sustaining a health economy, it is incumbent on all residents to act in a responsible and sustainable manner.

The Assiniboine River Watershed Technical Committee strongly recommends that the Government of Saskatchewan support, both financially and technically, these evolving Watershed Advisory Boards so that the objectives, recommendations and key actions identified herein will be achieved. This is seen as a vital course of action if the Source Water Protection Plan is to proceed to the implementation phase.

A policy must be developed to address the future interactions with existing “water-related” groups, such as the Yorkton Creek Watershed Association or the Good Lake Conservation and Development Area Authority. These groups have been in place for years and are responsible for the operation and maintenance of many water control works within the watershed.

This plan is not intended to be the complete and comprehensive solution for source water protection in the Assiniboine River Watershed. Instead, the intent is to direct initial strategies for the newly formed watershed organization. These strategies will be based on the issues with the highest potential risk with respect to source water protection.

2. Introduction to Source Water Protection

Abundant, clean, safe drinking water is a basic need for human life. Saskatchewan residents have long taken for granted the safety of their drinking water. However, following the water quality problems experienced in Walkerton and North Battleford that view has changed – not only in Saskatchewan, but also across the rest of Canada. Ensuring the safety of our drinking water is the responsibility of all residents living in a watershed.

Throughout Canada, provinces and municipalities have adopted various strategies to ensure access to safe, abundant drinking water. In Saskatchewan, this included adopting the *Safe Drinking Water Strategy*. A basic premise of this strategy is that it is easier, more effective, and more efficient to prevent contamination of source water than it is to remove contaminants at water treatment facilities. Thus, source water protection is the first barrier in a multi-barrier approach to ensuring safe drinking water. Other barriers include the effective treatment and distribution of water.

When considering source water protection, a fundamental understanding of how water moves through the environment is necessary. Examination of the hydrologic cycle (Figure 1: The Hydrologic Cycle), or water cycle, demonstrates the many routes that water can take as it travels between the atmosphere, the ground, rivers, lakes and the ocean. On the earth, water moves across the surface and through the ground as groundwater. Water may also be stored for long periods in wetlands, lakes, and especially as groundwater. The journey may be complicated and convoluted, but the movement of water through the cycle is never-ending.

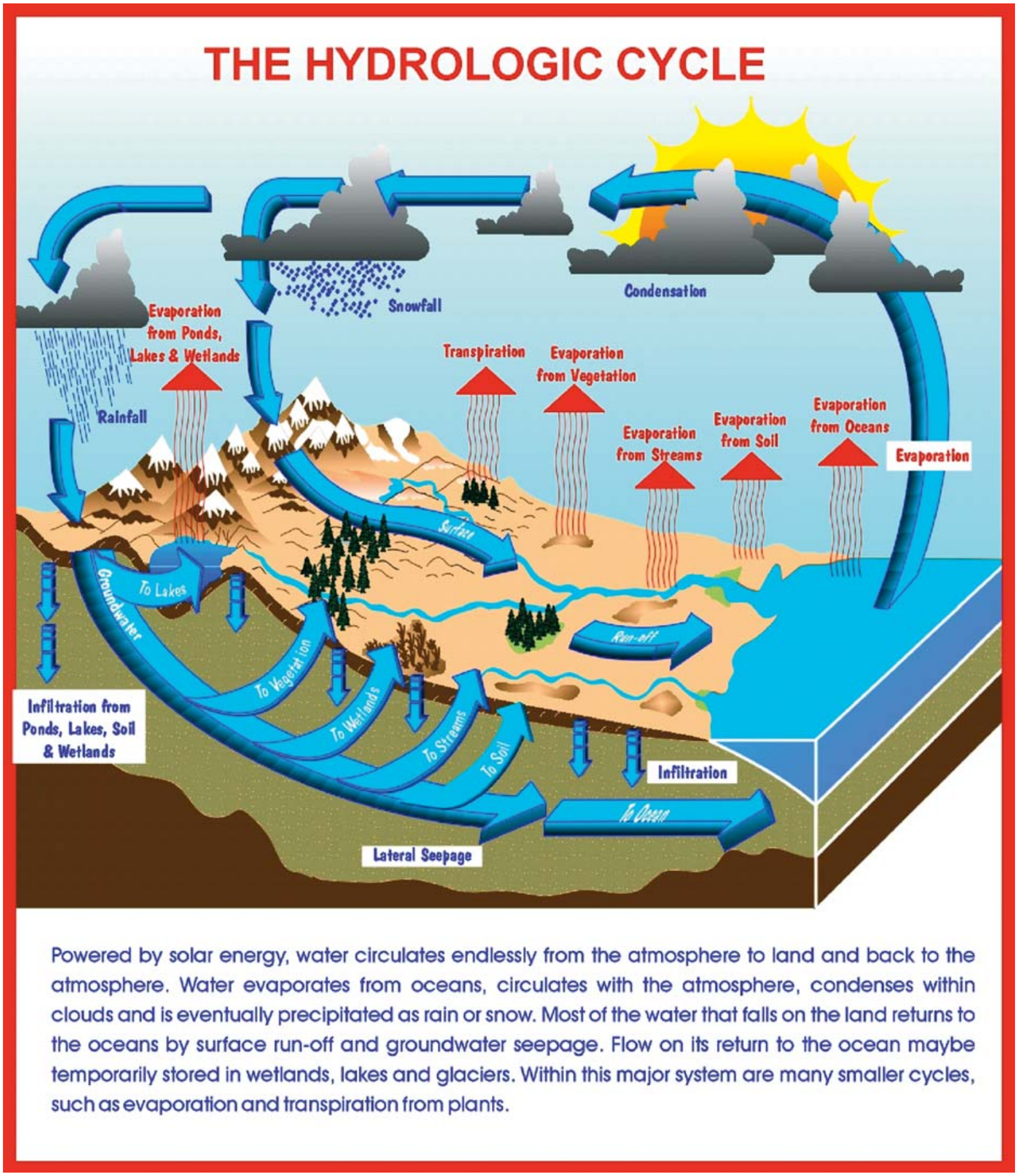

Figure 1: The Hydrologic Cycle

In highly altered landscapes such as the Assiniboine River Watershed, there are many potential contamination threats and many access points of these threats to water quality. These threats have increased as a result of constant ecosystem alterations by humans.

In order to manage water resources in a sustainable manner, the following question must be addressed: What activities and what intensity of activities will negatively impact water quality and water quantity? Also, what is the combined effect of different activities on water quality and quantity? In other words, at what point are we stressing the ecosystem beyond its capacity to assimilate these activities?

The objective of this plan is to summarize the current status of water resources, identify risks to water quality, and describe an action plan to ensure the sustainability of source water in the Assiniboine River Watershed. This process was driven by local residents with support from technical experts in Saskatchewan. Developing a plan that will result in the maintenance of a healthy watershed is an excellent means of attaining the first barrier for the sustainable protection of our source water and move Saskatchewan to the successful implementation of its *Safe Drinking Water Strategy*.

3. Introduction to the Assiniboine River Watershed

The Assiniboine River and its tributaries are located in eastern Saskatchewan and western Manitoba. The Assiniboine River Watershed covers an area of 17,300 square kilometres within Saskatchewan. This area includes 24 rural municipalities, eight towns, 15 villages and the cities of Melville and Yorkton (see Figure 2).

The headwaters of the Assiniboine River are about 50 kilometres (km) northwest of Preeceville in the Porcupine Hills. The Whitesand River originates in the Beaver Hills northwest of Yorkton, then joins the Assiniboine River near Kamsack. Other major tributaries located within Saskatchewan are Lilian River, Smith Creek, Crescent Creek, Willow Brook, Wallace Creek, Kamsack Creek, Stony Creek and Yorkton Creek. Several natural lakes are found within the watershed, the most notable of which are Good Spirit Lake, Fishing Lake, and the series of small, interconnected lakes south of Yorkton which include York, Roussay, Leech, and Crescent Lakes.

From Kamsack the Assiniboine River continues southeast for another 45 km before entering Lake of the Prairies near the Manitoba border. Lake of the Prairies is a reservoir 56 km in length straddling the Saskatchewan-Manitoba border. Shellmouth Dam, which creates Lake of the Prairies, is located 35 km downstream of the provincial boundary.

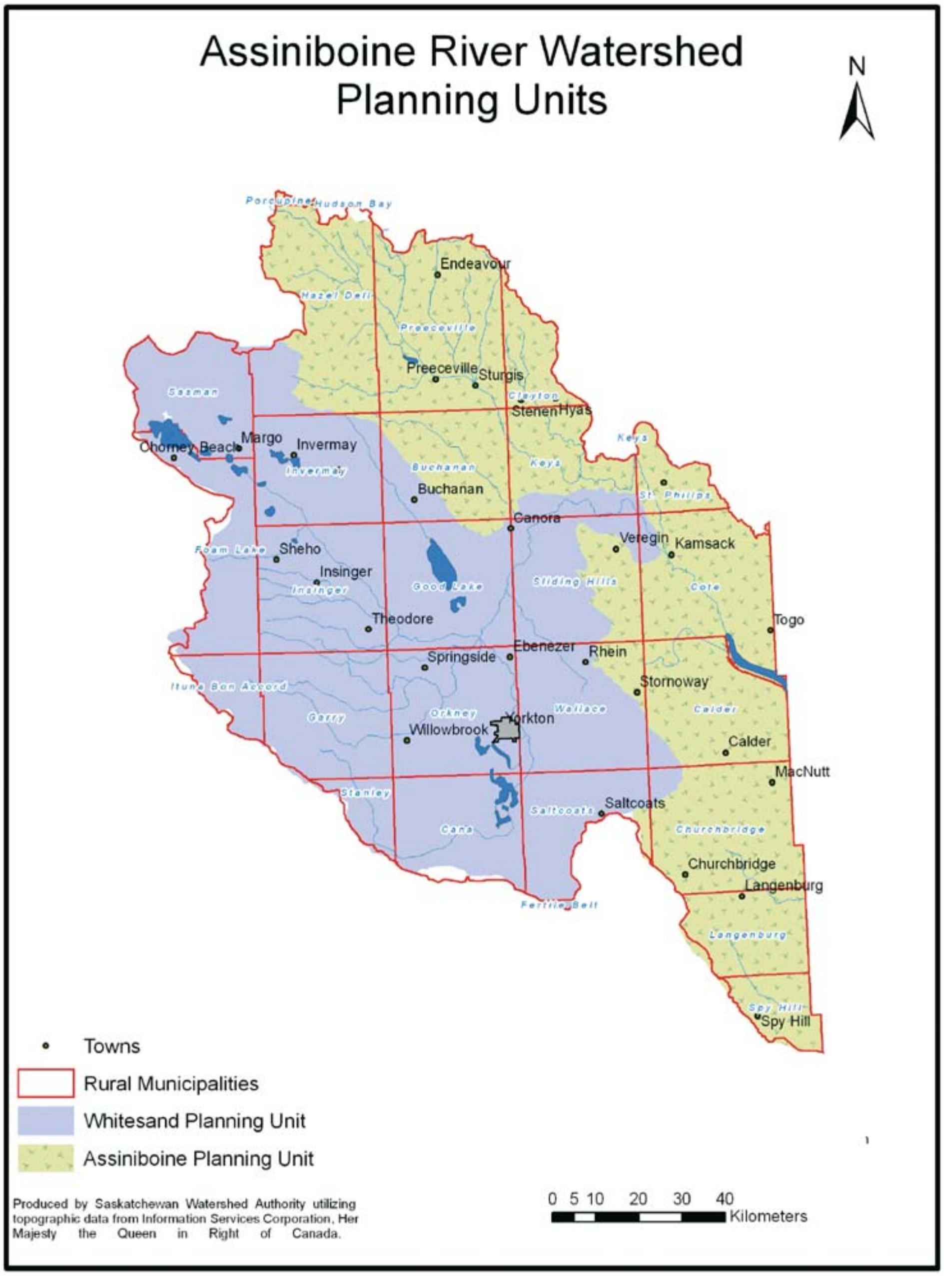

Figure 2: Administrative Boundaries

Upper Assiniboine Basin Wildlife Summary

The Basin supports a diverse wildlife population including approximately 240 bird species, 50 mammal species, three reptile and five amphibian species (see the Upper Assiniboine River Basin Study, Appendix C, Wetlands Committee Report).

- White-tailed deer are the most common ungulate, inhabiting the hills, valleys and aspen bluffs. Elk and moose are also present, but are less common, although their numbers are increasing significantly in some areas.
- The Upper Assiniboine River Basin is an important breeding area for waterfowl in the prairie region of Canada. The diversity in types of wetlands, abundance of permanent wetlands, and increased water stability compared to more arid southerly regions, allow for more consistent waterfowl production.

- The Upper Assiniboine River Basin has a diverse fish community, with established populations of 32 species of fish (See Appendix C: Fish Species of the Assiniboine Basin.) Common species include northern pike, walleye, perch, burbot, and mooneye. A small member of the lamprey family, the chestnut lamprey, has been collected at several locations in the Basin. The chestnut lamprey is listed as "vulnerable" by the Committee on the Status of Endangered Wildlife in Canada. This listing means that the species is not in current danger, but is of special concern due to characteristics that make it sensitive to human activities or natural events.
- Water bodies in the Assiniboine River Basin that are of particular importance to the local sportfishers include many of the larger lakes such as Good Spirit, Stoney and Fishing Lakes. These lakes typically contain a variety of species, including those actively sought by anglers such as northern pike, walleye and perch. Lake of the Prairies, a man-made reservoir, supports the largest sport fishery in the Basin.

Photo courtesy of Nature Saskatchewan
Lakes provide important recreational and economic opportunities.

The dominant land use in the Assiniboine River Watershed is agriculture, with 58% of the total land used for annual crops, as indicated in the following table.

Land Cover	Percent Cover
Cropland	58
Grass	17
Trees	14
Shrubs	5
Wetland	5
Large Lakes	1

Table 1: Land Cover
Data Source: 1990's Western Grains Transition Payment Program

The climate of the area is characterized by long, cold winters and short, warm summers. The mean annual temperature in the watershed is about 1°C. The normal frost-free season is typically from 90 to 110 days. Most of the moisture is provided by air masses originating near the Gulf of Mexico. The annual precipitation in the watershed averages about 450 mm, of which about 74 percent occurs as rainfall with the rest occurring as snowfall. The mean annual potential evaporation from a water body for the Yorkton area is 850 mm. The value for an extreme dry year is 1,090 mm.

The population of the portion of the Assiniboine River Watershed within Saskatchewan is approximately 45,500. The rural population represents about 34 percent of this total, with the urban or community population making up the remaining 66 percent. The City of Yorkton is the largest urban centre in the watershed with 37 percent of the total watershed population. The population of the City of Yorkton and the surrounding four Rural Municipalities (the Rural Municipality of Orkney No. 244, the Rural Municipality of Cana No. 214, the Rural Municipality of Wallace No. 243 and the Rural Municipality of Saltcoats No. 213), including the towns and villages therein, comprises 50 percent of the total watershed population.

Economic activity and land use in the watershed are dominated by mixed grain farms, with pasture and hay lands common. Small livestock operations can be found throughout the study area. The development of feedlots and other intensive livestock operations is becoming more frequent throughout the watershed. Traditionally, the beef cattle industry has dominated the livestock sector; however, there has been a relatively recent increase in intensive hog production.

Courtesy of Saskatchewan Agriculture and Food
Agriculture is the major land use in the watershed.

The average farm size has increased over the last 40 years. The rural population is declining, while urban populations have remained relatively steady.

Industrial activity in the watershed is generally localized in the larger urban centres and is predominantly agricultural-based. Other industrial activities include the potash and petroleum sectors as well as meat packing plants, concrete manufacturing, bakeries, and publishing facilities.

Surface Water Summary

Typical of most prairie streams, the Assiniboine River displays peak flows during the spring as a result of snowmelt. The flow rapidly decreases to a small base flow derived from groundwater. Typically, this base flow persists throughout the summer as shown in Figure 3, although historically the river has occasionally run virtually dry.

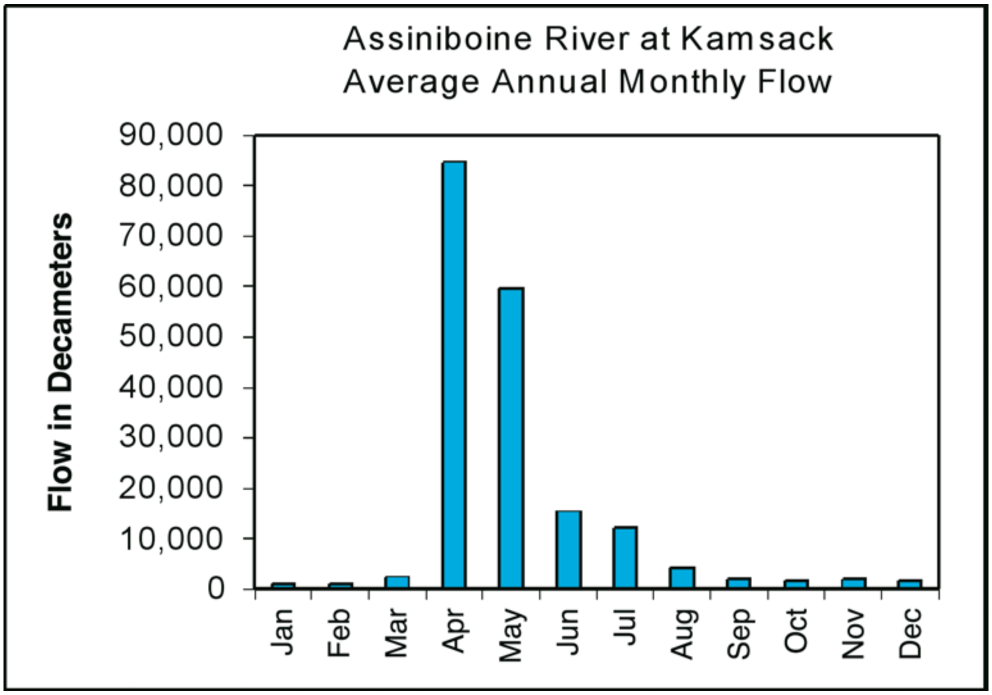

Figure 3: Assiniboine Average Annual Monthly Flow
In an average flow year, 77% of the runoff volume occurs in the months of April and May.

The Prairie Provinces Water Board (PPWB) was established by the governments of Alberta, Saskatchewan, Manitoba and Canada to monitor flow apportionment among the three Prairie Provinces. They have developed what is termed as 'natural flows' (flows that would have occurred under natural conditions prior to the intervention of man) for the Assiniboine River at the provincial boundary.

The surface water supply for the Assiniboine River Watershed is extremely variable during the year, as shown above in Figure 3. It is also highly variable on a year-to-year basis. Between 1912 and 2005, the annual streamflow has ranged from a historical low of 17,000 dam^3 in 1989 to a recorded maximum of 1,471,000 dam^3 in 1922. The last major flood occurred in 1995 and had a flow of nearly 900,000 dam^3. Figure 4 shows the high variability in flows that may occur annually.

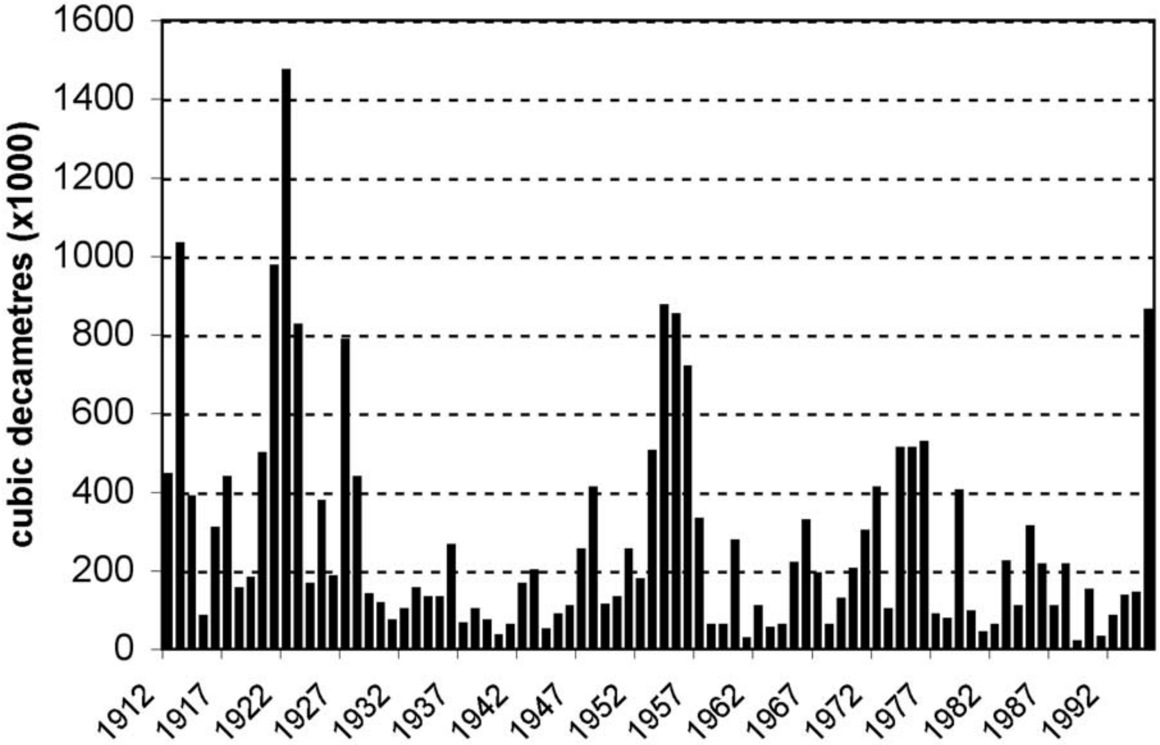

Figure 4: Mean Annual Natural Streamflow at the Provincial Boundary

The mean annual natural flow of the Assiniboine River at the provincial boundary is calculated to be 265,000 dam^3. The apportionment would be 50 percent value (50 percent of the flow must be passed to the Province of Manitoba, as is outlined in the Prairie Provinces Water Board agreements). This translates to a volume of 132,500 dam^3.

The quality of the larger sources of surface water in the Assiniboine River Watershed is generally acceptable for most uses. However, some smaller water bodies may have marginal water quality, a trait common to the prairie region. The water's suitability for specific uses varies with these smaller water bodies. Sometimes the poor water quality has been attributable to human activity, while at other times it is due to natural conditions, such as soil characteristics.

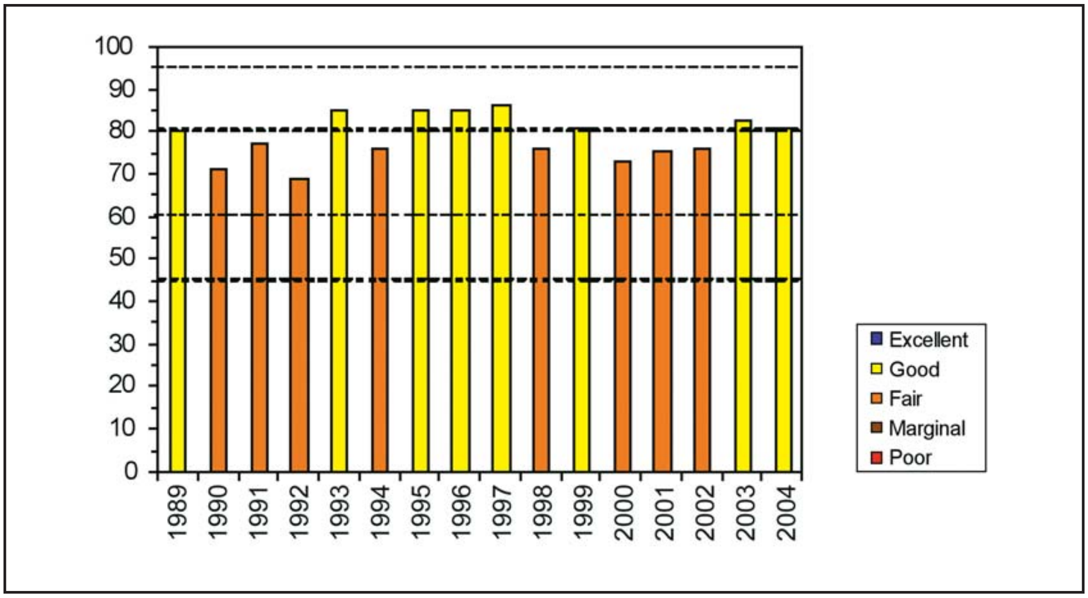

Figure 5: Water Quality Index rating for watershed protection at Kamsack on the Assiniboine River

Dashed lines correspond to WQI ratings 95-100 = 'Excellent', 80-95 = 'good', 60-80 = 'fair', 45-60 = 'marginal', less than 45 = 'poor'

The table below summarizes the parameters and objectives used to calculate the Water Quality Index rating.

Category	**Water Quality Parameter**	**Non-compliance objective**
General	pH Dissolved Oxygen (DO) Chlorophyll *a* (Chl *a*)	< 6.5 or > 8.5 < 5.0 mg/L > 50 µg/L
Dissolved Solids and Major Ions	Total Dissolved Solids (TDS) Dissolved Sodium (Na^+) Dissolved Chloride (Cl^-) Sulphate (SO_4^{2-})	> 700 mg/L > 100 mg/L > 100 mg/L > 500 mg/L
Nutrients	Total Phosphorus (TP) Nitrate/Nitrite (NO_3^-/NO_2^-) Total Ammonia Nitrogen (NH_3)	> 0.1 mg/L > 1.0 mg/L pH and temp. dependent¥
Heavy Metals	Total Arsenic Total Aluminium Total Chromium Total Mercury	> 50 µg/L > 5 mg/L > 20 µg/L > 0.1 µg/L
Pesticides	2, 4-D• MCPA§	> 4 µg/L > 25 µg/L
Microbiological	Fecal Coliforms	> 1,000 cfu*/100 mL

¥ *The objective value for total ammonia nitrogen varies with temperature and pH. When temperature is less than 300C and pH is less than 9, the objective concentration of un-ionized ammonia is less than 33 µg/L.*

• *2,4-Dichlorophenoxyacetic Acid.* § *MCPA, dimethylamine salt.* * *Colony forming unit.*

Table 2: Water Quality Index Parameters and Objectives

Groundwater Summary

In contrast to surface water, groundwater in the watershed is less prone to variability due to short term precipitation extremes, and thus as a supply it is more consistent. However, groundwater supplies are typically less able to provide large quantities of water at any given location. Groundwater can be contained in one of two general geologic deposits: bedrock and glacial. Aquifers in bedrock are deeper and tend to be more extensive in area than those in glacial deposits. For purposes here, glacial aquifers occur as buried valleys, inertial or surficial aquifers. Groundwater supplies not in surficial aquifers are insulated from drought conditions at surface, while even surficial aquifers may offer some measure of drought resistance because of the storage in the aquifer.

Available groundwater supply, unlike surface water supply, cannot be directly measured. Therefore, defining the groundwater supply is more involved, arduous and costly than doing the same for surface water. The complete characterization of groundwater resources, even for a simple system, requires significant amounts of data and skilled data interpretation. For an area as large and hydrogeologically complex as the Assiniboine River Watershed, a complete characterization would require great amounts of data and equal amounts of skilled data interpretation, resulting in a very expensive effort. Thus, this hasn't been accomplished as yet and there are no plans to do so in the foreseeable future. However, considerable mapping has been completed, providing the mapping framework to understand groundwater. This mapping continues to be developed and periodically improved, although in an ad-hoc fashion.

Groundwater resources in the Assiniboine River Watershed are classified as both bedrock and quaternary aquifers. Bedrock aquifers are composed of sands of the Mannville/Swan River Formation and Undifferentiated Tertiary-Quaternary sands. The saturated sands of the Tertiary-Quaternary sediments consist of the Bredenbury, Otthon, and Willowbrook aquifers. These aquifers range in thickness from 20 to 30 meters, overlain by 20 to 130 meters of till. The Bredenbury and Otthon aquifers are hydraulically connected to the Hatfield Valley aquifer system.

Aquifers in the glacial deposits are formed in buried valleys, intertill, and surficial deposits. Buried valley aquifers in the watershed include the Hatfield Valley, Basal, Melville, and Rocanville aquifer systems. The Hatfield Valley aquifer system is the most extensive in the area and extends into Manitoba. It is one of the largest buried preglacial valleys in Saskatchewan. Typical thickness of the Hatfield Valley aquifer is 50 meters, overlain by approximately 50 meters of till. The Melville and Basal aquifers occur above the “shoulder” of the Hatfield Valley, with an estimated thickness of 20 to 30 meters. The Rocanville aquifer ranges in thickness from 10 to 125 meters, overlain by 75 to 150 meters of glacial drift.

Intertill and surficial aquifers are characterized as discontinuous sands and gravels. Intertill aquifers are confined above and below by till deposits. These types of aquifers are referred to as undifferentiated intertill and intratill aquifers. The spatial extent, distribution, and thickness of these aquifers are variable. These aquifers provide an important source of water for both domestic and municipal purposes. For example, the City of Yorkton production wells are mostly completed in the inter- and intratill aquifers. Surficial and alluvial aquifers include sand and gravel lenses and alluvial deposits. The major alluvial deposits are related to the Qu’Appelle and Assiniboine river valleys.

Water Usages

Municipal water use is defined as that occurring in cities, towns, villages and hamlets that are serviced by a distribution system. Commercial and industrial users that are serviced by municipal lines are considered to be municipal water users. There are 27 communities in the watershed that have water systems, serving populations ranging from 21 to over 15,000. There are also a number of park facilities with licensed water allocations that are categorized as being municipal water users for the purposes of this plan. The total current annual use by municipal water users is estimated to be 4,930 dam^3, of which nearly 90 percent is supplied from groundwater sources. The water use by community is shown in Table 3.

Community	Source	Water Use (dam^3/yr)	
		1998	5 Yr Avg (1994-1998)
Badgerville (Cote)	SW	31*	31*
Bredenbury	GW	46.3	47.3
Buchanan	GW/SW	61.2*	61.2*
Calder	GW	13.3	9.8
Canora	GW	280	278
Churchbridge	GW	107*	107.1
Ebenezer	GW/SW	16.7	17.5
Endeavour	GW	66.7	63.0*
Fenwood	GW/SW	3.4	3.7
Gerald	GW	16.8	17.2
Hyas	GW	24.7	21.2
Insinger	GW	0.7	0.8
Invermay	GW	43.2	39.4
Jedburgh	GW	1.9	1.7
Kamsack	SW	315	279
Ketchen	SW	1.6*	1.6*
Kuroki	SW	8.9	9.8
Langenburg	GW	153	155
Lintlaw	GW	45.8	43.7
MacNutt	GW	12.2	12.7
Margo	GW	26	27.6
Melville	GW/SW	643	633
Mikado	GW	5.8	5.3
Preeceville	GW	206	222
Rama	GW	9	8.7
Rhein	GW	18	22.5
Saltcoats	GW	102	92.5
Sheho	GW/SW	26.8	30.3
Springside	GW	63	69.4
Spy Hill	GW	39.9	37.5
Stenen	GW	16.6	15.9
Sturgis	GW	134	145
Tadmore	GW	2.2	2.8
Theodore	GW	123	97.3
Togo	GW	24.9	23.1
Veregin	GW	9.9	8.2
White Spruce	GW	12	12
Willowbrook	GW	6	6*
Wroxton	GW	7.5	6.3
Yorkton	GW	2114	2160
Hamlets[1]	GW	55*	55*
Parks Facilities[2]	GW	41*	41*
Saskatchewan Totals		**4935**	**4922**

Table 3: Municipal Water Use in the Assiniboine River Watershed

*Notes: *,1 & 2 are estimates*
City of Melville is using 75% groundwater

The following table summarizes the annual uses by sector.

Type of Use (% of Total Use)		Saskatchewan (dam³/year)		
		SW	GW	Total
Municipal (15%)	Recreation	0	40	40
	Urban Distribution	540	4,360	4,900
	Total Municipal	540	4,400	4,940
Agriculture (26%)	Irrigation	2,120	30	2,150
	Livestock			2,540
	Domestic			1,400
	Spraying			240
	Evaporation	2,140		2,140
	Total Agriculture			8,470
Industrial (10%)	Food Processing	0	30	30
	Cavern Washing	0	1,940	1,940
	Mining	0	1,380	1,380
	Total Industry	0	3,350	3,350
Wildlife Conservation (50%)		16,640	0	16,640
Reservoir Evaporation (negative 1%)		-360	0	-360
Total				33,040

Table 4: Summary of Present Licensed Withdrawal Uses (dam³/year)

SW is Surface Water, GW is Groundwater
Values have included some estimated values

Note: the negative value for Reservoir Evaporation is due to the lowering of the spill elevation at Good Spirit Lake when SaskWater and the Good Spirit Lake Watershed Association constructed an outlet structure on the lake in the late 1980's.

Wildlife Conservation is an allocation based on 57 'constructed' wildlife projects in the watershed. The allocation was calculated by determining the evaporative loss for each project. This 'use' was to ensure that the allocated water is not available for alternate uses because of the licensing.

The total usage for surface water sources, excluding wildlife and reservoir evaporation, is estimated to be 4,800 dam³/year. This value is only 1.8 percent of the total 265,000 dam³ estimated for the mean surface flow at the provincial boundary and 3.6 percent of the apportionment volume of 132,500 dam³ for a mean annual year as determined by Prairie Provinces Water Board, as outlined above. The surface water usage value increases when wildlife conservation allocation is considered. While this is a non-consumptive use of water, it is necessary to account for the water needed by wildlife so that over-allocation of consumptive uses does not remove too much water from the system.

The total licensed allocation for both surface and groundwater is calculated to be 33,040 dam^3/year. When this value is compared to average surface water supplies it seems apparent that there is an adequate supply of water in the watershed.

In extreme low-flow years, such as 1961 or 1989, the natural flow was calculated to be approximately 17,000 dam^3. During these years there is adequate surface water overall, excluding wildlife and reservoir evaporation. However, when wildlife use is considered the estimated total use is 21,080 dam^3, which is above the extreme low flow value. It is likely there were shortages experienced in the aquatic ecosystems and hardships for some residents in the watershed as well.

In the Upper Assiniboine River Basin Study, a mathematical water management model was used to examine the state of the surface water and the major water uses in the Basin on a monthly basis. The analysis revealed that:

- at both the current and future level of water use, surface water supply is generally sufficient, although it is less reliable in the headwaters of the Basin. As with all prairie areas, the Basin is subject to droughts.

- a preliminary analysis of instream flow requirements suggests that water is generally available for aquatic ecosystems and offstream uses. However, during periods of low flows there may be conflict with other water uses.

- apportionment between Saskatchewan and Manitoba is not an issue in the Basin at the present time or in the foreseeable future.

4. Watershed Planning Methodology

Interests and Issues Identification

The Upper Assiniboine River Basin Study reports were used extensively to prepare a list of concerns related to source water protection.

All of the Upper Assiniboine River Basin Study issues were reviewed from a source water protection perspective. This focus lead to initial concerns among some Assiniboine River Watershed Technical Committee members, who stated that source water is not the only requirement in need of consideration. One particular concern was the perceived need to further explore the relationship between watershed health and wildlife health.

For the purpose of this watershed planning process, it was concluded that *the focus must be on source water protection* and those aspects of the ecosystem that are strongly linked to this aspect. If a protection strategy also has a benefit to wildlife it may be considered an additional advantage; however, it was not the focus of this planning process. It should be stressed that wildlife and habitat can be ideal indicators of ecosystem health and the ability of a watershed to provide quality water for human use.

It was also decided to organize the "water quality" issues and concerns identified in the Upper Assiniboine River Basin Study separately from the "watershed health" and "wildlife" issues. Additional considerations or issues raised by the Watershed Advisory Committees were then added.

The following section summarizes the specific watershed considerations or issues pertaining to source water quality and quantity that were identified in the Upper Assiniboine River Basin Study or added by the Watershed Advisory Committees.

Water Quality

1. Watershed residents perceive that groundwater and surface water quality is deteriorating and that it must be better protected, which includes enhancing our understanding of the systems by increasing the intensity of monitoring.
2. Rural residents are concerned about access to good quality domestic and drinking water supplies and the availability of low cost testing services.
3. Domestic and municipal groundwater supplies need to be protected from contamination.
4. Chemical container disposal areas and landfill operations are point sources of pollution that can affect surface and groundwater quality. These operations must be properly managed, and regulations must be enforced.
5. Agricultural drainage from farm land, sloughs and wetlands can be a non-point source of pollution of surface water. Agricultural runoff may contain increased sediment, nutrients and pesticides.
6. Algal blooms on Lake of the Prairies are a concern.
7. Livestock operations and improper range management practices deteriorate water quality and impact downstream users.
8. Municipal lagoon operations, sewage treatment and effluent releases can impact water quality and must be strictly managed.
9. Urban stormwater runoff may affect the water quality of rivers and streams downstream of communities.
10. Flooding.

Watershed Health

11. The economic and social considerations associated with wetlands and agriculture should be better understood.
12. Wetlands and uplands in the watershed are important and should be protected. The continued degradation and removal of wetlands and riparian areas in upland regions may lower overall watershed health and may also place wildlife at risk.
13. Land and water management practices affect fish habitat.
14. Increased bank erosion of streams and rivers diminishes water quality. Increased erosion and sedimentation reduces fish spawning areas and habitat.
15. Conflicts between land use for agriculture and wildlife habitat should be resolved to give better direction for water management.

16. The oil and gas industry is perceived as a threat to surface and groundwater in the watershed.
17. The development of future regional waste management sites may be of local concern to water quality.

Water Quantity

18. Surface water supplies may not be adequate to meet future water demand.
19. Groundwater demand could exceed the sustainable groundwater supply.
20. The current and future ability to make use of available water may be limited by the state or scale of the required infrastructure.

Analysis of Current Watershed Management Issues/Considerations

The Assiniboine River Watershed Technical Committee was charged with analysing the issues from the Upper Assiniboine River Basin Study. Technical Committee members first reviewed the information and data contained within the Upper Assiniboine River Basin Study to determine its relevance to the current planning process and provide advice on whether new information was available or required.

The Technical Committee also sought to:

- determine whether or not regulations apply to each issue, and under what circumstances they apply;
- identify the agency(s) responsible for administering these regulations;
- provide a copy of current regulations;
- determine what, if any, policies are also being used in the management of these issues and whether the policies have any impact on how the applicable regulations are enforced;
- evaluate whether available research and/or data can demonstrate the relevance of these issues to source water protection; and
- compile an inventory related to the issue (for example, the number of Intensive Livestock Operations within the watershed), with the ultimate goal of having this data accessible in a Geographic Information Systems (GIS)-friendly format.

Expert guest speakers were invited to provide detailed information within their discipline to better inform the Technical Committee on specific issues and how they relate to source water protection.

Details of the issue analysis prepared by the Technical Committee is included in Appendix E: Assiniboine River Watershed Issues Analysis on the CD attached to this document.

During the initial phases of the planning process, it quickly became apparent that a process to review and evaluate these issues was needed. It was felt that the issues should be prioritized according to the level of risk each presented to the watershed's source water.

Risk Assessment Analysis

Dr. Terry Hanley, Director of Watershed Monitoring & Assessment with the Saskatchewan Watershed Authority, was contacted to advise on methods of scientifically assessing the relative risk each issue posed to source water. Dr. Hanley suggested using a method of "Risk Assessment - Evaluation of Issues" that he developed as part of his doctoral research in risk assessment. This procedure has previously been used by the United States Environmental Protection Agency and other agencies around the world. It was presented to the combined Technical Committees of the Assiniboine River Watershed and the Yorkton Area Aquifers planning processes at a two-day risk analysis workshop led by Dr. Hanley.

The risk assessment analysis used the following process:

The Technical Committee first screened the issues and sorted them with respect to their relevance to source water protection. It was also decided that issues related to each other should be combined. This process transformed the list of issues into "risk areas".

The following were determined to be the principal risk areas for the Assiniboine River Watershed:

- Agriculture (non-point pollution)
- Livestock (all aspects)
- Roadways
- Urban stormwater
- Municipal wastewater
- City of Yorkton wastewater
- Oil and gas industry
- Road salt
- Landfill sites
- Chemical container sites

The next step was to determine the scope of each risk area. This involved evaluating each risk area by:

- describing the stress, exposure, and response relationships;
- determining its extent within the watershed (i.e. whether the risk area is localized at one site, or whether it is pervasive throughout the watershed);
- establishing whether there is an increasing, decreasing or stable trend of risks;
- identifying the primary stressors; and
- pinpointing the exposure pathways for each risk.

Table 5 highlights the risk areas identified during the discussions.

Agriculture
• Nutrients [nitrogen (N) and phosphorus (P)], pathogens (manure applications), erosion/sediments, pesticides
Livestock
• Nutrients (N and P), pathogens, erosion/sediments, pharmaceuticals
Roadways
• Erosion/sediments, agricultural runoff, hydrocarbons
Urban Stormwater
• Nutrients, pathogens, hydrocarbons, suspended solids, pesticides, heavy metals . . . we do not have a feel for the relative concentration of these constituents (infomation gap to be filled later this year)
Municipal Wastewater (Lagoons)
• Nutrients (N and P), pathogens, suspended solids, acute total ammonia concentration • Discharges are biannual (for Melville), annually, every second year, as needed or rarely if ever
City of Yorkton Wastewater
• Nutrients (N and P), pathogens, pharmaceuticals, chronic and acute total ammonia concentration • Daily discharge, 24 hours per day

Table 5: Risk Area Constituents

The group then assigned a severity score of Minor, Adverse, Serious or Critical, for three different categories: Health Criteria, Ecological Criteria, and Socio-Economic Criteria.

Based on the above, risk factor scores were calculated and a final score was assigned for each risk area. Table 6 summarizes the scoring.

Risk Area	Category
Agriculture (non-point contamination)	Moderate
Livestock (all aspects)	Moderate
Roadways	Low
Urban Stormwater	Low
Municipal Wastewater	Low
City of Yorkton Wastewater	Low
Oil and Gas	Very Low
Road Salt	Very Low
Landfill Sites	Very Low
Chemical Container Sites	Very Low

Table 6: Analysis of Potential Risk for the Assiniboine Basin

Notes:

- *The analysis focussed more on surface water than on groundwater.*
- *Each item was discussed and debated thoroughly to reach a consensus throughout the evaluation.*
- *Scientific knowledge was used whenever possible, and equally important, the collective knowledge of the group (there were 17 Technical Committee members involved) was used to conduct the risk assessment process.*
- *At the end of the two-day process the group felt that, although the process was not necessarily an exact scientific procedure, there was consensus on its validity and ultimately the conclusions that were reached.*
- *Several issues from the interests and issues identification exercise were excluded from this risk assessment analysis, but would still be analyzed in the issues analysis report prepared by both the Watershed Advisory and Technical Committees.*

Figure 6 compares the relative significance of the risk areas based on the scores determined during the evaluation. Risk scores for all of the risk areas are expressed as a percentage of the overall total score. Although these risks are not necessarily additive, the intent of the figure is to convey a measure of the relative potential of each risk area.

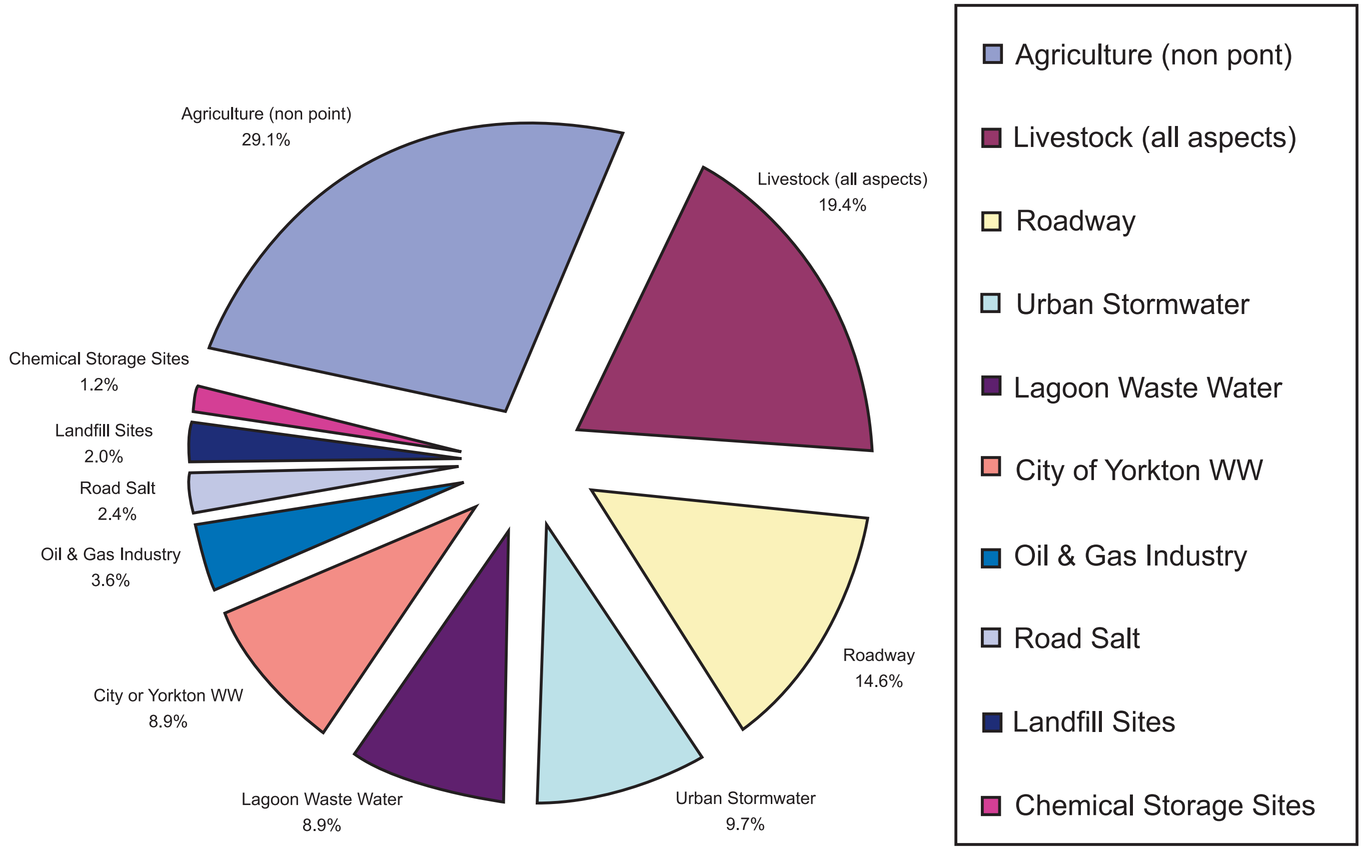

Figure 6: Comparison of Potential Risk for the Assiniboine River Watershed

Some observations made at the conclusion of the risk assessment analysis process were that:

- agriculture is by far the dominant land use within the watershed, and as such agriculture ranked as a higher risk than the other risk areas;
- there is a split between what urban and rural residents feel has the largest impact on water quality, and that residents in each area feel that the other is not assuming sufficient responsibility;
- the water quality of the Assiniboine River is generally good and that, while there may be reaches that are being negatively impacted, these are few and not widespread;
- currently, there are no apparent serious, widespread risks to water quality resulting in source water degradation in the watershed quantity;
- most people in this watershed use groundwater as a drinking source;
- a major threat/stressor to water quality in the Assiniboine River Watershed is excess nutrient inputs, principally nitrogen (N) and phosphorous (P). The addition of nitrogen and phospherous to surface water results in increased algal growth and decreased water quality. This is common to many other watersheds that are dominated by agriculture. Developing and executing a nutrient plan for the Assiniboine River Watershed is an obvious strategy to address this issue.

The Technical Committee recognized that analyzing every aspect of every issue would be prohibitively time consuming. Once implementation of the source water protection plan is initiated and the major topics identified through our risk analysis approach are addressed, it is assumed other issues that generated lower risk scores will be reassessed.

Thus, only the highest scoring risk areas (of low to moderate risk) are considered further in the Assiniboine River Watershed Source Water Protection Plan at this time. Objectives, recommendations, and key actions were only developed for these highest scoring risk areas.

The result of the risk assessment analysis was reported to the Watershed Advisory Committee members for their review and comments. After consensus was achieved between the Watershed Advisory and Technical Committees, the results were used to develop source water protection objectives, recommendations and key actions.

Assiniboine River Watershed Objectives, Recommendations, and Key Actions

Once the priority risk areas were identified, the next step in the process was to develop objectives to address these risks.

Objectives in this planning process were defined as being general statements of desired outcomes to be achieved over a similar but unspecified period of time. Normally in a planning process there are two to four objectives with a time frame of three to five years.

Finalizing the objectives required several iterations between the Technical and Watershed Advisory Committees before reaching consensus. The following table summarizes the five objectives of the Assiniboine River Watershed Source Water Protection Plan. The objectives are not in any order of significance or relevance.

Objective 1:	Empower the local watershed citizens to promote and implement a healthy watershed strategy.
Objective 2:	Protect source drinking water for all communities.
Objective 3:	Improve the health of aquatic ecosystems in the watershed.
Objective 4:	Improve the overall water quality throughout the Assiniboine River Watershed.
Objective 5:	Develop education strategies and increase awareness of source waters and their associated issues within the Assiniboine River Watershed.

Table 7: Assiniboine River Watershed Planning Objectives

Once agreement was reached among the Committees, the planning process focused on developing recommendations and key actions for each objective.

Recommendations are measurable, time-defined goals that are specifically subordinate to an objective. Usually there are seven to ten recommendations per objective. The time frame for the achievement of each recommendation is up to three years.

Key actions identify the specifics of what must be done to achieve each recommendation. These actions represent the means needed to achieve the goal stated in the recommendation. They tend to be fairly immediate steps and are more likely to be adapted to meet the goals of the process than are objectives or recommendations.

Once the Watershed Advisory Committee approved the objectives, they asked the Technical Committee to develop a list of recommendations and key actions that would address them. The Watershed Advisory Committee made this request because they felt the Technical Committee had the expertise to better prepare a comprehensive list of recommendations and key actions.

The Technical Committee met on several occasions to develop, review and discuss potential recommendations and key actions. After a list was developed, a joint meeting between the Technical and Watershed Advisory Committees was held to review and discuss the recommendations and key actions in order to reach consensus between these two committees.

The following is the list of the objectives, recommendations and key actions agreed to by both committees.

5. Watershed Planning Objectives, Recommendations, and Key Actions

Objective 1:

Empower the local watershed citizens to promote and implement a healthy watershed strategy.

Introduction

This objective is a critical component essential to the successful implementation of the Source Water Protection Plan. Having an Advisory Board and a Local Watershed Manager is an effective means for meeting watershed implementation strategies. It will promote a strong sense of direction, purpose and ownership, and ultimately provide the impetus to meet the identified planning goals.

It is vital that the implementation of the watershed planning process operates under the premise of local ownership. A local manager provides exclusive focus to local issues and initiatives and serves as the “go-to” contact for stakeholders.

The creation of an Advisory Board and the establishment of a Local Watershed Manager will serve to bridge and unify the efforts of various government and non-government agencies that individually address issues related to soil, air, water and wildlife. This concept provides a mechanism for these organizations to deliver their respective programs, while at the same time meeting the overall watershed planning objectives. The Local Watershed Manager will function as a broker to improve the health of our watersheds.

A Technical Committee, with a similar membership to which participated in the watershed planning process would be available to the Local Watershed Manager and to the Advisory Board.

The existing *Watershed Associations Act* will be used as the framework to form the new administration. New legislation may be needed in years ahead if administrative problems arise.

The Province of Manitoba has used a very similar model to this approach for the last 30-plus years and has been extremely successful, especially from the local support aspect.

Recommendation

1.1 Formation of a formal Assiniboine River Watershed Authority (or Conservation District or Source Water Protection Authority).

Key Action: Seek support from Watershed Advisory Committee members in forming the Assiniboine Advisory Board, and explore funding sources.

Time Frame	Responsibility
During 2006	Assiniboine Advisory Board* Saskatchewan Watershed Authority* Assiniboine River Watershed Technical Committee

Key Action: Hire a full-time Local Watershed Manager who would report to the Assiniboine Advisory Board.

Time Frame	Responsibility
By the end of 2006	Assiniboine Advisory Board* Saskatchewan Watershed Authority*

It is imperative that the implementation of the source water protection plan is guided by the local Assiniboine Advisory Board. The Local Watershed Manager, who reports to this Board, will be responsible for the implementation, but the Advisory Board will determine the direction of the implementation. The Technical Committee is to provide technical assistance as required. Securing long-term funding for the coordinator position is seen as critical to the success of the implementation process.

Objective 2:
Protect the source drinking water for all communities.

Introduction

The principal basis of this objective is to address community water systems, not necessarily individual sources of drinking water. These individual sources will be, at least in some scenarios, protected by actions intended to address community systems. In addition, there are other programs which address individual systems, including the Environmental Farm Plan program, the Saskatchewan Watershed Authority's Rural Water Quality Advisory program, and the water testing services available from Saskatchewan Health.

* Indicates the organization(s) responsible for leading the key action

Any expectation that raw source water, whether surface or groundwater, will be potable without treatment is unrealistic. Although improved and enhanced source water reduces risks to human health and often results in lowering treatment costs, source water needs to be treated prior to human consumption.

Source water protection is the first level of a multi-barrier approach to protecting drinking water. To minimize the risk to source water in the Assiniboine River Watershed, a risk analysis was performed for the entire watershed and specific strategies were formulated to address those risks. This analysis provided the basis for the following recommendations.

Recommendation

2.1 Develop a well head integrity program for every community using groundwater including Rural Municipality community wells.

Key Action: Compile and collect existing well data.

Time Frame	Responsibility
2006	Saskatchewan Watershed Authority*

Key Action: Categorize the risk situation (i.e. low, medium, high) for all community wells. The aquifer will be categorized for its vulnerability at the well location.

Time Frame	Responsibility
2006	Saskatchewan Watershed Authority*

Key Action: Determine how Saskatchewan Environment's well head protection program could be used to enhance the well head integrity program.

Time Frame	Responsibility
2006	Saskatchewan Watershed Authority Saskatchewan Environment

Key Action: Increase site inspections and collect data from additional sites, specifically targeting community wells and aquifers.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Watershed Authority* Individual communities and Rural Municipalities

* Indicates the organization(s) responsible for leading the key action

Key Action: Develop programs to address the issues that arise from carrying out the above mentioned key actions.

Time Frame	Responsibility
2007 & forward	Assiniboine Advisory Board* Saskatchewan Watershed Authority* Assiniboine River Watershed Technical Committee

Recommendation

2.2 Protect water quality upstream of surface water intakes.

Key Action: Identify the surface water sources that are being used for community drinking water.

Time Frame	Responsibility
2006	Saskatchewan Watershed Authority* Assiniboine Advisory Board

Key Action: Develop site-specific or subwatershed plans for those communities using surface water as the source of their drinking water.

Time Frame	Responsibility
2007	Saskatchewan Watershed Authority* Communities Assiniboine Advisory Board

The following are examples of possible goals:

- Ensure the maintenance of healthy riparian zones/buffers along water courses to a specified distance upstream of the community's water intake.
- Ensure sufficient vegetative buffers exist around any waterbodies being used as community drinking water supplies.

Objective 3:
Improve the health of aquatic ecosystems in the watershed.

Introduction

Healthy aquatic ecosystems are those that can sustain human use and accommodate natural and human-caused disturbances, while still maintaining their structure and function. The term structure refers to the living and non-living components of the ecosystem – specifically, the species of animals, fish, insects, bacteria, plants and so on that are present, along with the water and substrate that form the habitat for these species. Ecosystem function refers to the processes that link these components together: for example, the flow of energy and matter through the food web, the migrations of various species, and how various species use the aquatic habitat to complete their life cycles.

* Indicates the organization(s) responsible for leading the key action

Wildlife and wildlife habitat can be ideal indicators of ecosystem health, and the ability of a watershed to provide a sustainable source of quality water for human use. In addition, wetlands are instrumental to a healthy watershed.

It is not sufficient that the necessary components of the ecosystem are simply present at some place in the system; they must be accessible and available to the appropriate species when they are needed. Fish, as an example, require different types of habitat for spawning, rearing, feeding, and surviving through the winter. These different types of habitat are not usually present in close proximity but may be many miles apart. For a fish population to survive, grow, successfully reproduce, and be healthy, it must be able to reach different types of habitat at the appropriate times of year. However, there are often migration barriers that prevent fish from reaching critical habitat. Common barriers to migration are dams, weirs and low level crossings that are not designed to provide flow conditions for fish to swim through or over. One of the greatest concerns is barriers that stop fish from moving upstream during the spring spawning migration.

In general, the greater the number and variety of plant and animal species that are present, the more stable and healthy the ecosystem. An absence of barriers allows for migrations of fish and other species, and results in greater biodiversity and stability throughout the watershed.

Fish are a major and visible component of the aquatic system. Taking steps to ensure that desirable fish species are present in the system has the beneficial side effect of encouraging people to care for the aquatic system and take the necessary measures to protect water quality.

Recommendation

3.1 Improve the connectivity of aquatic habitat, and in particular, improve fish passage throughout the Assiniboine River Watershed.

Key Action: Collect hydrological and fish passage data during the spring spawning season at selected obstructions.

Time Frame	Responsibility
Ongoing – 2007	Saskatchewan Watershed Authority* Fisheries and Oceans Canada Saskatchewan Wildlife Federation

* Indicates the organization(s) responsible for leading the key action

Key Action: Conduct biological and engineering evaluations of potential fish barrier structures at the selected sites.

Time Frame	Responsibility
Ongoing – 2007	Saskatchewan Watershed Authority Fisheries and Oceans Canada

Key Action: Determine the best solutions to mitigate these barriers.

Time Frame	Responsibility
Ongoing – 2007	Saskatchewan Watershed Authority Fisheries and Oceans Canada Local governments Local landowners

Key Action: Prioritize, consult, and develop strategies for upgrading these sites.

Time Frame	Responsibility
Ongoing – 2007	Saskatchewan Watershed Authority Fisheries and Oceans Canada

Key Action: Seek funding, including from the original funding partners of the constructed works, to carry out the recommended mitigation works.

Time Frame	Responsibility
Ongoing – 2007	Saskatchewan Watershed Authority* Fisheries and Oceans Canada Saskatchewan Wildlife Federation Local governments

Key Action: Implement the recommended works.

Time Frame	Responsibility
2006 – 2008	Saskatchewan Watershed Authority Fisheries and Oceans Canada Saskatchewan Environment Local Landowners Assiniboine Advisory Board

Recommendation

3.2 Protect and improve riparian buffers along selected streams and stream reaches in order to protect aquatic ecosystems and water quality. An example key action:

- Identify locations where riparian buffers require enhancement or development.

* Indicates the organization(s) responsible for leading the key action

Recommendation

3.3 In-stream work such as excavation and channelization should be avoided. Instream works to maintain existing drainage systems should be conducted in a manner that will minimize any impacts to aquatic systems and downstream water quality. Example key actions include:

- Drainage works should incorporate their existing natural elements to the greatest extent possible, such as wetlands and existing riparian vegetation.
- Mitigation of lost aquatic habitat may be an option. Mitigation may involve retaining, improving or restoring habitat to compensate for habitat that may be lost in developing a project that involves land drainage and/or clearing. This concept is applicable at both the small scale (individual farm level) and to a larger scale proposal (watershed level).

Objective 4:
Improve the overall water quality throughout the Assiniboine River Watershed.

Introduction

Overall, the water quality of the Assiniboine River is considered to be relatively good for a prairie river. There have been no significant trends observed in the overall water quality for the past 20 years at the Prairie Provinces Water Board monitoring site near Kamsack. There are no known environmental disasters occurring in the watershed.

It is probable that water in the Assiniboine River has been relatively nutrient rich for centuries, as is the case for many other water bodies and water courses in the Canadian prairies. Thus, it is unrealistic of this watershed planning process to set unattainable nutrient goals based on water quality objectives from other regions with different geology and lower nutrient loads, such as the Canadian Shield. It is also unreasonable to expect raw source water from the Assiniboine River to be potable.

One of the principal water quality concerns is the input of nutrients, sediment, chemicals and pathogens resulting from human activity. These inputs can either be from a single point (point source), or can occur over a wide range (non-point source). Both point source and non-point source contributions of pollutants within the Assiniboine River Watershed need to be assessed.

It is easier to assess the contribution and impact from point sources of pollution, such as sewage effluent, than it is from non-point sources. However, non-point source pollution can be important because of the area of land involved. This is especially true for activities like agriculture that use large areas of land. Because of the pervasiveness of agriculture in the Assiniboine River Watershed and the potential effects the industry can have on water quality, it is necessary to identify specific agricultural practices that can help reduce these risks, especially with respect to nutrient movement.

Other watershed activities can also contribute significant amounts of nutrients, sediment, and pathogens to surface waters. In order to ensure that all activities are identified and all reasonable key actions are taken, it is critical to consider all of the activities that contribute these pollutants within the watershed.

Concern about nutrient movement into water and the subsequent degradation of water quality continues to be a primary concern for lake managers. This is apparent in various studies that have been conducted on Lake of the Prairies, and also from concerns that have been expressed about the eutrophication of Lake Winnipeg. Special attention will therefore be paid in this plan to recommendations and key actions that address human activities which result in the movement of nutrients to water bodies.

Recommendations

4.1 Prepare a nutrient reduction plan to reduce nutrient loading within the watershed, with the following targets:

   a. a total phosphorus value of less than 0.24 mg/L for the Assiniboine River at the Prairie Provinces Water Board monitoring site near Kamsack.

   b. a total nitrogen value of less than 1.85 mg/L for the Assiniboine River at the Prairie Provinces Water Board monitoring site near Kamsack.

To calculate the above parameters, water quality data for the Assiniboine River near Kamsack from 1977 to 2003 was reviewed. The 90th percentile for both total phosphorous and total nitrogen was then determined, and these values were selected as the nutrient targets. The 90th percentile is a standard method reviewed in the protocols for determining site specific guidelines, as outlined by the Canadian Council of Ministers of the Environment.

It should be noted that these target values should be considered as notional targets or transitional values. The values will be reviewed and compared at a later date by the Prairie Provinces Water Board and/or Saskatchewan Environment and the Saskatchewan Watershed Authority as part of another process to establish provincial boundary surface water quality objectives at Prairie Provinces Water Board monitoring sites.

The Prairie Provinces Water Board monitoring site is a very comprehensive monitoring station. However, it is located at the bottom of the Assiniboine River Watershed and thus, although representative of the watershed, there is no information on the various subwatersheds or streams within the watershed. It would be of value to have an understanding of how the water quality (for this watershed, nutrients would be the major focus) differs across the watershed, from the upstream reaches to the lower end, as well as to determine if there are differences between the more major subwatersheds.

Balancing the need for sufficient data to understand the variability in water quality across the watershed with the costs of monitoring requires careful consideration. This balance must maximize the usefulness of additional monitoring stations while minimizing the costs. Additional monitoring in the watershed should be conducted in conjunction with a hydrometric station.

There are many benefits from reducing summer fallow (fallowed by tillage) and increasing direct seeding of cropped land. However, under these management practices weeds are primarily controlled by herbicides. Therefore it is critical to ensure the proper handling of herbicides (and all pesticides) and monitor their transport and fate to ensure that they do not impact negatively on water quality.

Key Actions

Every sector should contribute toward the nutrient reduction plan for the watershed. This is viewed as a collaborative initiative and does not assume or place blame on any particular sector.

For each sector the Committees developed key actions that they felt would have the greatest impact on nutrient reduction. It was recognized that the list of key actions would not necessarily be exhaustive, but would instead initially direct the implementation strategy toward key actions that would furthest reduce nutrient loading.

Within Objective 4, key actions were developed for each sector or risk area. The categorization of these actions by sector follows the process of not focussing on any particular sector, but rather expecting that each sector will contribute toward the nutrient reduction plan for the watershed.

4.1.1 Agriculture (non-point source)

There are two principal strategies for reducing phosphorous movement in the Assiniboine River Watershed. The first is to minimize soil erosion (wind or water). This is particularly important as the soil types present in the Assiniboine River Watershed readily bind phosphorus. The second strategy to manage water runoff is by encouraging "water harvesting" and maintaining water retention on upland locations.

Some forms of nitrogen are highly soluble, and thus very mobile. The key to reducing nitrogen loading is to adopt the practice of efficient water harvesting.

Water harvesting refers to the practice of using as much of the available water in the rooting zone as possible each year. Since water is the most important yield limiting factor in Saskatchewan dryland crop and forage production, this practice makes sound economic and environmental sense. A realistic yield potential should be based on available soil water and average growing season precipitation, and then applying nutrients near the time of crop use. Using as much of the available water from the rooting zone as possible to grow crops and forage greatly decreases the potential of water movement (both surface runoff and downward leaching) and associated nutrient movements.

Key Action: Encourage and work with producers to decrease the number of cultivated acres that are under summer fallow management (fallowed by tillage) in the Assiniboine River Watershed by 50 percent over the years 2006 to 2011.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Soil Conservation Association* Saskatchewan Agriculture and Food Assiniboine Advisory Board

This key action is based on matching provincial trends. Agriculture and Agri-Food Canada census data will be collected in both 2006 and 2011 and will be used for the evaluation.

* Indicates the organization(s) responsible for leading the key action

Key Action: Encourage and work with producers to increase the number of cultivated acres that are direct seeded in the Assiniboine River Watershed (with the appropriate nutrient management) by 100 percent over the years 2006 to 2011.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Soil Conservation Association* Saskatchewan Agriculture and Food Assiniboine Advisory Board

This key action is also based on the provincial trend. Increasing direct seeded acres not only reduces erosion but also increases infiltration rates, thus reducing surface runoff.

Key Action: Encourage and work with producers to increase the number of kilometres of functional riparian buffers along cultivated fields and pasture lands that are adjacent to water courses.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Watershed Authority* Assiniboine Advisory Board* Saskatchewan Agriculture and Food Ducks Unlimited Canada Fisheries and Oceans Canada

Buffers not only trap sediments, they can also remove dissolved nitrogen before it reaches a watercourse.

Key Action: Encourage and work with producers to reduce the number of cultivated acres that are sensitive to wind and/or water erosion (because of the soil type and/or topography) by converting this land to permanent cover.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Agriculture and Food* Saskatchewan Watershed Authority Ducks Unlimited Canada Prairie Farm Rehabilitation Administration Assiniboine Advisory Board

Key Action: Promote the retention and restoration of wetlands on the uplands through education and programming.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Agriculture and Food Ducks Unlimited Canada Saskatchewan Watershed Authority Assiniboine Advisory Board

Wetlands and uplands in the watershed are important and should be protected. The continual removal and degradation of the uplands associated with wetlands and riparian areas will place the watershed health at risk.

* Indicates the organization(s) responsible for leading the key action

Key Action: Collect water quality nutrient data at strategic points in the watershed to determine the variability of nutrients within the watershed.

Time Frame	Responsibility
2007 – 2008	Saskatchewan Watershed Authority Assiniboine Advisory Board

4.1.2 Livestock (all aspects)

Manure should be handled as a fertilizer, and not as a waste product. Manure should be applied to land at appropriate rates so that it is not a centralized risk and doesn't act as a point source for nutrients, pathogens or sediment. Another concern to source water protection may include ensuring that potential pathogens are prevented from entering ground or surface water sources. The Manure Application Rate Calculator (MARC) 2005 is a manure management planning software for Manitoba and Saskatchewan.

As cattle manure has a high phosphorous to nitrogen ratio, it is a potential risk for phosphorus accumulation in soils and increased transfer of phosphorus to surface water. Care must be exercised to base inputs on the amount of phosphorous required and not nitrogen in order to avoid applying excess phosphorous. Hog manure is more similar to commercial fertilizers (i.e. a better phosphorous to nitrogen ratio for crop uptake) and thus, depending on its application rate, poses less of a phosphorous accumulation risk. However, excess application and or repeated applications of any manure increases the potential for nutrient movement.

Key Action: Encourage all producers to develop and adopt manure management plans.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Agriculture and Food Assiniboine Advisory Board

Key Action: Encourage and work with producers to eliminate the use of cattle concentration sites near waterways.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Agriculture and Food* Saskatchewan Watershed Authority Environment Canada Assiniboine Advisory Board

* Indicates the organization(s) responsible for leading the key action

Key Action: Encourage and work with producers to eliminate the prolonged occurrences of bank destabilization from livestock activities. The loss of vegetation removes the buffer barrier.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Agriculture and Food* Saskatchewan Watershed Authority Environment Canada Assiniboine Advisory Board

Key Action: Develop a strategy to manage leased Crown lands so that livestock pastured on them have minimal impact on source water in the Assiniboine River Watershed.

Time Frame	Responsibility
2006 – 2011	Saskatchewan Agriculture and Food* Saskatchewan Watershed Authority Saskatchewan Environment

Water management issues arising on Crown lands that affect adjacent land owners need to be addressed.

4.1.3 Roadways

Roadways and ditches are prevalent throughout the Assiniboine River Watershed, frequently intersecting creeks, streams, and rivers.

Roadway drainage ditches may function as watercourses. They can act as a source of contaminants, and can act as a conduit for nutrients and contaminants from the adjoining uplands to join connecting waterways.

Beaver activities (more specifically, the water associated with their activities) on Crown lands may create problems with roadways. Rural municipalities have expressed the need for the Government of Saskatchewan to maintain programs similar to the channel clearing assistance program in order to control beavers and their activities.

Key Action: Enhance roadway construction practices by developing best practices to reduce the impact on adjacent water courses. For example, road ditches should be seeded as soon as possible after construction to minimize erosion.

Time Frame	Responsibility
2006 – 2007	Saskatchewan Highways and Transportation* Saskatchewan Association of Rural Municipalities Saskatchewan Urban Municipalities Association Fisheries and Oceans Canada

* Indicates the organization(s) responsible for leading the key action

Key Action: Funding approval for road construction should be contingent on the fulfillment of conditions and specifications related to these best practices. Natural drainage patterns are to be maintained.

Time Frame	Responsibility
2008	Saskatchewan Highways and Transportation Saskatchewan Association of Rural Municipalities Saskatchewan Urban Municipalities Association Prairie Farm Rehabilitation Administration Federal Infrastructure

4.1.4 Urban Stormwater

There is little water quality information available on the stormwater from smaller cities and towns in the Canadian prairies. This information gap needs to be addressed.

Key Action: Proceed with the proposed City of Yorkton stormwater study by the Saskatchewan Watershed Authority and the City of Yorkton as soon as possible.

Time Frame	Responsibility
2006 – 2007	Saskatchewan Watershed Authority City of Yorkton

Key Action: Develop a guideline document detailing best practices for managing stormwater, emphasizing source water protection for the Province of Saskatchewan.

Time Frame	Responsibility
Completed	Saskatchewan Environment*

Key Action: Inform communities about these guidelines and encourage them to begin adopting the recommended best practices.

Time Frame	Responsibility
2006 and forward	Saskatchewan Environment Saskatchewan Urban Municipalities Association Assiniboine Advisory Board

4.1.5 Municipal Wastewater

Every community in the Assiniboine River Watershed (except the City of Yorkton) utilizes wastewater lagoons to treat their effluents. They are an economical standard practice for treating wastewater.

A review of the literature supports the effectiveness of treating domestic sewage by using two-cell lagoons. In fact, two-cell lagoons, if they are managed and operated as designed, can be as effective as highly technical tertiary wastewater treatment plants.

* Indicates the organization(s) responsible for leading the key action

Even though communities are following the lagoon operation guidelines as determined by Saskatchewan Environment, landowners located downstream of the lagoons have expressed concerns about the effect of lagoon releases on water quality.

According to the document *Optimization of Lagoon Operation: A Best Practice* (prepared by the National Research Council - National Guide to Sustainable Municipal Infrastructure) there are several opportunities to improve the water quality of effluent releases. Residents in the watershed want the Government of Saskatchewan to consider this document as part of the Province's review of lagoons in the Assiniboine River Watershed.

Key Action: Provide a risk rating of all municipal wastewater lagoons within the watershed.

Time Frame	Responsibility
2006	Saskatchewan Environment*

Key Action: Determine the total lagoon nutrient releases within the watershed and estimate the significance of this from a nutrient balance perspective.

Time Frame	Responsibility
2006 – 2007	Saskatchewan Environment Saskatchewan Watershed Authority

Key Action: Evaluate the current lagoon release regulations to determine if they are appropriate based on the estimated significance of the total nutrient load of the lagoons, and then determine if changes in lagoon practices are warranted.

Time Frame	Responsibility
2008	Saskatchewan Environment Saskatchewan Watershed Authority

Key Action: Inform landowners and communities downstream of lagoons of pending releases in order to synchronize surface water withdrawals and usages with the releases.

Time Frame	Responsibility
2007 – 2008	Saskatchewan Environment Saskatchewan Urban Municipalities Association Saskatchewan Association of Rural Municipalities Assiniboine Advisory Board

* Indicates the organization(s) responsible for leading the key action

4.1.6 City of Yorkton Wastewater

The City of Yorkton's wastewater treatment plant is a major point source of nutrients in the Assiniboine River Watershed. It is the only mechanical treatment facility in the Assiniboine River Watershed. The treated effluent is continually discharged to Yorkton Creek throughout the year. The City is regulated by the Government of Saskatchewan and operates the plant according to provincial guidelines.

Key Action: Determine the information gap regarding the 'environmental fate' of the wastewater plant nutrient releases to Yorkton Creek and the Whitesand River.

Time Frame	Responsibility
2007 – 2010	Saskatchewan Watershed Authority* Saskatchewan Environment City of Yorkton

Key Action: Evaluate the plant to determine if there are relatively simple and inexpensive modifications that can be made to the plant and/or to its operations that would reduce the amount of nutrients in the plant effluent. This optimization review may qualify for funding.

Time Frame	Responsibility
2007 – 2008	Saskatchewan Environment City of Yorkton Saskatchewan Watershed Authority

Key Action: Conduct a basic nutrient source analysis for the City of Yorkton to determine if there are opportunities to reduce nutrient loading prior to waste reaching the treatment plant.

Time Frame	Responsibility
2006	Saskatchewan Watershed Authority* City of Yorkton

Key Action: Develop an education strategy for the community to enhance residents' awareness of their impact on the City's wastewater.

Time Frame	Responsibility
2007	Saskatchewan Watershed Authority* City of Yorkton Assiniboine Advisory Board

* Indicates the organization(s) responsible for leading the key action

Objective 5:

Develop education strategies and increase awareness of source waters and their associated issues within the Assiniboine River Watershed.

Introduction

Increasing the education and awareness of residents about their watershed and related watershed issues requires a specific emphasis, which is best served by having a separate objective. However, it should be noted that education and awareness are also important components of every objective, recommendation and key action contained in this plan.

Residents of the watershed should know the importance of, and the issues surrounding, source water protection. The residents of the watershed all share in the use of the watershed's resources, and should appreciate that the quality of source water can be negatively affected by their activities.

Saskatchewan Environment is the principal regulator of municipal waterworks and all privately owned and publicly accessible waterworks that have flow rates of 18,000 litres or more per day. Saskatchewan Environment also regulates certain pipeline systems. The owners of urban potable water systems are required to take regular samples of the water in order to test for basic biological and chemical constituents, use certified operators, and are far more regulated than owners of rural systems.

Ensuring the health and safety of rural populations also requires source water sampling and analysis. A water quality monitoring strategy for rural residents will assist in increasing the awareness of source water protection and will provide water quality data on various aquifers and surface water sources.

Recommendation

5.1 Institute a rural source water protection campaign.

Key Action: Communicate the Saskatchewan Watershed Authority's definition of source water protection to residents within the Assiniboine River Watershed.

Time Frame	Responsibility
2007 and onwards	Saskatchewan Watershed Authority* Assiniboine Advisory Board

* Indicates the organization(s) responsible for leading the key action

Recommendation

5.2 Ensure the rural population conducts regular sampling of their source water.

Key Action: Promote the importance of regular water quality testing.

Time Frame	Responsibility
2007 onwards	Sunrise Health Region Saskatchewan Association of Rural Municipalities Saskatchewan Watershed Authority Assiniboine Advisory Board

Key Action: Deliver regular water quality testing campaigns.

Time Frame	Responsibility
2007 onwards	Sunrise Health Region Saskatchewan Association of Rural Municipalities Saskatchewan Watershed Authority Saskatchewan Research Council Assiniboine Advisory Board

Recommendation

5.3 Promote the importance of participation in the Environmental Farm Plan (EFP) program.

Key Action: Encourage producers to participate in completing the Environmental Farm Plan workbook.

Time Frame	Responsibility
2006 – 2007	Provincial Council of Agriculture Development and Diversification Boards* Saskatchewan Watershed Authority Saskatchewan Agriculture and Food Ducks Unlimited Canada Assiniboine Advisory Board

The Provincial Council of Agriculture Development and Diversification Boards (PCAB) deliver the Environmental Farm Plan program in Saskatchewan. PCAB is a producer-driven, grass-roots organization that is based on the Rural Municipality system within the province. Information provided by the participating producers is voluntary and confidential.

* Indicates the organization(s) responsible for leading the key action

Key Action: Encourage the Provincial Council of Agriculture Development and Diversification Boards and producers to work together to identify common "on-farm" environmental issues.

Time Frame	Responsibility
2006 – 2007	Saskatchewan Watershed Authority Saskatchewan Agriculture and Food Saskatchewan Environment Environment Canada

Key Action: Select programs to address these issues.

Time Frame	Responsibility
2006 – 2007	Saskatchewan Watershed Authority Saskatchewan Agriculture and Food Ducks Unlimited Canada

Recommendation

5.4 Saskatchewan Agriculture and Food needs to be more involved in the education component. There is a benefit to using a stewardship-type model in providing education.

Recommendation

5.5 Promote the importance of a regular soil testing program throughout the watershed. Provincially, less than 20 percent of all fields are soil tested annually.

6. New and Emerging Issues

An aim of the Assiniboine River Watershed Source Water Protection Plan is to identify activities that pose the greatest risk to the quality and quantity of source water in the watershed and work toward mitigating those risks. There are several issues that were not directly addressed in the risk analysis, in part because the issues have not been well studied within the watershed, and/or in part because they are new so it was difficult to assess their relevance and/or importance. However, these issues require further consideration as our understanding of them increases. One of the vital characteristics of a formal Assiniboine Advisory Board, with a Local Watershed Manager, is that it will have the ability to address, as appropriate, these new and emerging issues and thereby maintain the flexibility needed to provide source water protection in the watershed.

Two emerging issues identified at this time which may be important but require further study/consideration are: 1) the effects of pesticides in the environment; and 2) the presence and effects of pharmaceuticals in the environment.

Pesticides

Pesticides have been found throughout the environment, though typically at low concentrations which are below the Saskatchewan Surface Water Quality Objectives and Saskatchewan's Drinking Water Quality Standards and Objectives. Many of the pesticides found in regions of Saskatchewan are not locally applied, demonstrating the importance of aerial drift and the long-range transport of pesticides. However, many of the pesticides applied in Saskatchewan do end up in source waters. For example, a study found that more than 10 percent of the wetlands examined had at least one pesticide present during the year at concentrations greater than the Canadian Water Quality Guidelines. Increased pesticide use within the watershed is an implied consequence as farms move toward the implementation of minimum-till or no-till practices. Previous mention has been made of the benefits of minimum-till practices; however, it is important to pay close attention to any threats to water quality that occur as a consequence of this practice to ensure a healthy balance is maintained.

There is on-going research with respect to best management techniques to minimize the application losses of pesticides (National Agri-Environmental Standards Initiative – NAESI), the cumulative effects of pesticides (Environment Canada) and the fate and transport of pesticides in dugouts and wetlands (Prairie Farm Rehabilitation Administration).

Pharmaceuticals, Personal Care Products, Hormones and Hormone-like Substances

Understanding the distribution, concentration and environmental effect of pharmaceuticals is an emerging issue in environmental science and management. The scale and significance of this issue, as related to source water protection, is currently unknown. While studies have documented the presence of pharmaceuticals in both waste effluent, effluent mixing zones, surface water and drinking water (at the tap), there are fewer studies that have looked at this large range of compounds to assess their effect on aquatic ecosystem and human health. Pharmaceuticals, care products, and hormone-like substances can arise from many sources and can persist in the environment in various forms. However, human and agricultural animal waste is a principal source. Compounds tend to break down more readily during summer months when conditions are warmer, sunlight is more intense (photodegradation) and microbes are more active. Apart from points of discharge (i.e. mixing zones) these compounds will be found at low concentrations when there is sufficient dilution.

Two areas of potential interest within the Assiniboine River Watershed are wastewater treatment plants/lagoons and from livestock operations.

The prairies are somewhat unique in the design and function of sewage lagoons because sewage release is typically only needed once or twice a year. This means that the products entering these lagoons have an increased chance of being removed prior to entering the environment, either through bacterial degradation, photodegradation or sorption onto particles or sediment. The effectiveness of these sewage lagoons compared to mechanized treatment facilities is unknown at this time; however, studies have demonstrated that lagoons can be effective in the removal of certain compounds.

Environment Canada conducted a preliminary study looking for various compounds in the Assiniboine River at the Kamsack Prairie Provinces Water Board station in 2002 and 2003. Several compounds were detected, but at low concentrations. The low concentrations are in part due to the dilution effect, especially during spring.

The following table summarizes the information on the compounds detected in river water at the Prairie Provinces Water Board site near Kamsack. It should be noted that several other compounds analyzed were not detected, including: ibuprofen, acetaminophen, gemfibrozil, fenoprofen, fenofibrate, ketaprofen, and indomethacin.

Compound	Concentration(µg/L)		
	March 2003	June 2002	March 2002
Clofibric acid (Heart medication)	0.00199	0.00177	0.00114
Salicylic acid (Aspirin by-product, also in personal care products)	0.00360	0.00095	0.00159
Naproxen (Anti-inflammatory)	0.00302	0.00085	0.00099
Triclosan (Broad-spectrum antibacterial/ antimicrobial agent)	0.00033	0.00024	0.00061
Diclofenac (Anti-inflammatory)	0.00146	not detected	not detected

Table 8: Compounds detected at Prairie Provinces Water Board site near Kamsack

The extent and potential consequences of the presence of these compounds within the Assiniboine River Watershed are currently unknown, and this is best identified as an information gap. However, because of their importance it is necessary to consider them and be aware of changes in practices that could affect their distribution.

To fill this information gap it is recommended that a study be conducted to examine the efficacy of sewage lagoons in breaking down and removing pharmaceuticals, personal care product derivatives, and hormones and hormone-like compounds. Previous studies have demonstrated that greater breakdown of these compounds occurs during summer. It is therefore anticipated that there may be a build up of compounds during winter, whereas during summer lagoons will be more efficient at breaking down these products. Concentrations in the river will also depend on dilution, which is higher in the spring. Until a study is conducted that specifically examines the ability of prairie lagoons to process these products, the scope of this issue will not be fully understood.

Livestock operations are also a potential environmental source of antimicrobial compounds and hormones. There are currently studies underway on the prairies examining the degradation efficiency, environmental persistence and environmental fate of common antimicrobial compounds added to hog and cattle feed. Preliminary results suggest that antimicrobial compounds from livestock operations can be found in both surface and groundwater at relevant concentrations. The environmental impact of these compounds is still not widely known. The recent initiation of a study examining the impact of antibiotics in prairie wetlands will help to address this question. This emerging issue requires further consideration as more studies are conducted and study results become available. Re-examination of recommendations about the handling of manure will need to be considered in the context of this information.

7. Glossary

Aerobic – living or taking place only in the presence of oxygen.
Allocation – the amount of water assigned for use, out of the total amount that is available for use in a particular watershed or aquifer.
Anaerobic – living or taking place in the absence of oxygen.
Aquatic – consisting of, relating to or being in water; living or growing in, on or near water.
Aquifer – a permeable body of rock capable of yielding usable quantities of groundwater to wells and springs.

Base of groundwater exploration – a feature shown on the provincial groundwater maps. Defines the depth to which it is generally considered to be uneconomic to explore for groundwater because of the depth of drilling required and/or the water at that depth is considered to be too highly mineralized for the intended use.
Bedrock formations – rock deposited prior to glaciation. These layers are overlain by glacial deposits which consist of glacial till, sand and gravel.
Biodiversity (biological diversity) – the many and varied species of life forms on earth, including plants, animals, micro-organisms, the genes they possess and their habitats.

Climate – meteorological elements (e.g. precipitation, temperature, radiation, wind, cloudiness) that characterize the average and extreme conditions of the atmosphere over long periods of time at a location or region of the earth's surface.
Climate change – an alteration in measured meteorological conditions that significantly differs from previous conditions and is seen to endure, bringing about corresponding changes in ecosystems and socio-economic activities.
Conservation – the preservation and renewal, when possible, of human and natural resources. The use, protection and improvement of natural resources according to principles that ensure their highest economic and social benefits.
Conservation easement – a voluntary legal agreement between a property owner and a government or qualified conservation agency. These agreements are tailored to each individual landowner and conserve the property's natural values and features by restricting the type and amount of development that can occur on the owner's property.

Development – building, engineering, mining or other operations that alter or intensify the use of a resource.
Deleterious substance – any substance that is deleterious to fish, fish habitat, or to the use by man of fish that frequent that water. See *The Fisheries Act* for further details.
Discharge – the flow of surface water in a stream or ditch or the flow of groundwater from a spring or flowing artesian well; the rate of flow.
Diversion – the removal of water from any waterbody, watercourse or aquifer (either for use or storage), including the removal of water for drainage purposes. Construction of any works required for the diversion of water need approval pursuant to Section 50 of *The Saskatchewan Watershed Authority Act*. The total diversion is equal to the allocation plus any losses from evaporation or seepage.
Drainage – movement of water off land, either naturally or man-made.
Drought – generally in reference to periods of less than average or normal precipitation over a set time, sufficiently prolonged to cause serious hydrological imbalance that results in biological or economic losses.

DUC – Ducks Unlimited Canada, an entity that conserves, restores and manages wetlands and associated habitat for North American waterfowl. These habitats also benefit other wildlife and people.

Ecological – pertains to the relationship between living organisms and their environments.
Economic development – the process of using and converting resources into wealth, jobs and an enhanced quality of life.
Ecosystem – a dynamic complex of organisms (biota) including humans, and their physical environment, that interacts as a functional unit in nature.
Effective drainage area – the area which is estimated to contribute runoff in at least half of the years.
Effluent – the treated wastewater discharged into the environment.

Facultative – bacteria that can live in a range of external conditions, including both aerobic and anaerobic conditions.
First Nation – an Indian band or an Indian community functioning as a band but not having official band status, not including Inuit or Métis peoples.

Grazing management – activities that ensure stocking rates are appropriate to sustain long-term health of livestock grazing conditions during wet and dry seasons.
Gross drainage area – the area bounded by the height of land between adjacent watersheds.
Groundwater – water beneath the surface of the earth in the pores and fractures of sand, gravel, and rock formations.

Habitat – natural surroundings or native environment where a plant or animal grows and lives.
Headwater – small streams and lakes that are the sources of a river, located in the upper reaches of a watershed.
Hydro – from the Greek hydor, meaning "water."
Hydrogeology – the science of subsurface waters and related geologic aspects.
Hydrology – the science of the waters of the earth, their occurrences, circulation and distribution on or below the earth's surface.

Intensive Livestock Operation (ILO) – production facilities such as feedlots and buildings where many animals are raised in a confined space that does not have naturally-growing vegetation and where waste accumulates if not removed (as defined by *The Agricultural Operations Act* in Saskatchewan).

Land cover – predominant vegetation on the surface of a parcel of land.
Land use – present use of a given area of land.
Leachate – a liquid that has percolated through or out of another substance such as soil or refuse, and may contain nutrients or contaminants.
Lithology – the characteristics of rock formations.

Median – a value in a sorted range of values by which there is the same number of values above it as there is below it. A statistical term used in non-parametric statistics.

Native prairie – age-old plant communities of the prairie and parkland regions that may contain more than 200 types of grasses, flowers and shrubs (native grassland and parkland aquatic and terrestrial habitats).
Non-point source pollution – single or multiple contaminants of unknown origin that enter waterways, degrading water quality.

Partnership – co-operative, collaborative alliance between/among stakeholders in a non-legal arrangement used to improve and build relationships and achieve common goals.
Permeability – the ability of a material to allow the passage of a liquid, such as water through rocks. Permeable materials, such as gravel and sand, allow water to move quickly through them, whereas impermeable material, such as clay, does not allow water to flow freely.
Point source contamination – a static and easily identifiable source of air, soil or water pollution.

Recharge – replenishment of the groundwater by the addition of water.
Riparian – an area of land adjacent to or connected with a stream, river, lake or wetland that contains vegetation that is distinctly different from vegetation of adjacent upland areas.
Riparian areas – the zone of vegetation alongside waterways and other surface water. Lush and diverse vegetation is the best sign of healthy, well-managed riparian areas and is critical to filtering and slowing runoff.
River basin – an area that contributes to form a watershed.

Sewage – the waste and wastewater from residential or commercial establishments that are normally discharged into sewers.
Sewage lagoon – a shallow pond where sunlight, bacterial action and oxygen work to purify wastewater; also used for storage of wastewater.
Source water protection – the prevention of pollution and the sound management of factors and activities that (may) threaten water quality and quantity of lakes, reservoirs, rivers, streams and groundwater.
Stakeholder – individual or group with direct or indirect interest in issues or situations, usually involved in understanding and helping resolve or improve their situations.
Stewardship – judicious care and responsibility by individuals or institutions for reducing their impacts on the natural environment.

Water quality – the chemical, physical and biological characteristics of water with respect to its suitability for a specific use.
Watershed – an elevated boundary contained by its drainage divide and subject to surface and subsurface drainage under gravity to the ocean or interior lakes.
Watershed health – the desired maintenance over time of biological diversity, biotic integrity and ecological processes of a watershed.
Watershed and aquifer management – a process, within the geographic confines of a watershed or aquifer, that facilitates planning, directing, monitoring and evaluating activities to ensure sustainable, reliable, safe and clean water supplies.
Watershed and aquifer planning – a process, within the geographic confines of a watershed or aquifer and with the participation of stakeholders, to develop plans to manage and protect water resources.
Wetland – an area of low-lying land covered by water often enough to support aquatic plants and wildlife for part of the life cycle. The wetland area includes the wet basin and adjacent upland.

8. Glossary of Units

Length			
1.0 m	= 1.0 metre = 3.28 feet = 39.37 inches	1.0 km	= 1.0 kilometre = 1,000 metre = 0.621 miles
Area			
1.0 m^2	= 1.0 square metre = 10.76 square feet	1.0 km^2	= 1.0 square kilometre = 1.0 X 10^6 square metres = 0.386 square miles = 247 acres = 100 hectares
Volume			
1.0 m^3	= 1.0 cubic metre = 35.31 cubic feet = 220.083 imperial gallons = 1,000 litres	1.0 dam^3	= 1.0 cubic decametre = 1000 cubic metres = 220,083 imperial gallons = 0.810 acre feet
1.0 ig	= 1.0 imperial gallon = 4.54 litres = 0.00454 cubic metres = 0.1605 cubic feet	1.0 l	= 1.0 litre = 0.221 imperial gallons = 0.264 US gallons = 0.001 cubic metres = 0.035 cubic feet
Rate			
1.0 igpm	= 1.0 imperial gallon per minute = 0.833 US gallons per minute = 0.076 litres per second = 6.54 m^3/day = 1.94 acre feet/year = 2.39 dam^3/year	1.0 lps	= 1.0 litres per second = 13.22 imperial gallons per minute = 11.01 US gallons per minute = 8.640 m^3/day = 31.54 dam^3/year
1.0 m^3/day	= 1.0 cubic metres per day = 220 imperial gallons per day = 0.0116 litres per second = 35.32 cubic feet per day	1.0 dam^3/day	= 1.0 cubic decametres per day = 1,000 cubic metres per day = 35,320 cubic feet per day

Table based on Beckie Hydrogeologists (1990) Ltd.

9. Appendices

A. **Watershed Advisory Committee Members**

B. **Technical Committee Members**

C. **Fish Species of the Upper Assiniboine River Basin**

D. **Water Quality and Water Quality Trends for the Assiniboine River at Kamsack (on CD)**

E. **Assiniboine River Watershed Issues Analysis (on CD)**

F. **Assiniboine River Watershed Background Report (on CD)**

A. Watershed Advisory Committee Members

Assiniboine River Watershed Advisory Committee

Member	Representing
Brian Bolouc/ Denis Wishnevetski	Town of Kamsack
Vern Bowes	Rural Municipality of Cote No. 271
Wallace Butterfield	Rural Municipality of Keys No. 303
Gil Comeault	Rural Municipality of St. Philips No. 301
Douglas Ferder	Rural Municipality of Clayton No. 333
Don Fogg	Town of Langenburg
Terry Keewatin	Yorkton Tribal Council/Cote First Nation
Neil Mehrer	Rural Municipality of Churchbridge No. 211
Ken Mitchell	Rural Municipality of Preeceville No. 334
Don Olson (Chair)	Town of Sturgis
Ernie Patrick	Sask Pork
Marlo Schappert	Rural Municipality of Langenburg No. 181
Gerald Schepp	Rural Municipality of Calder No. 241
Beatrice Sekel	Town of Preeceville
Ken Somogyi	Saskatchewan Wildlife Federation

Whitesand River Watershed Advisory Committee

Member	Representing
Russel Baron	Buchanan Conservation & Development Area
Viola Bell	Metis Nation of Saskatchewan
Shirley Biro	Village of Willowbrook
Dale Cherry/ Gary Liebrecht	Rural Municipality of Wallace No. 243
Fay Hanson	Rural Municipality of Foam Lake No. 276
Dale Heshka	City of Melville
Janet Hill	City of Yorkton
Jeff Hunter	Village of Rama
James Hupka	Rural Municipality of Good Lake No. 274/ Burgiss Conservation & Development Area
Ed Keyowski	Rural Municipality of Sliding Hills No. 273
Adam Kosar	Village of Buchanan
Ron Kulyk	Rural Municipality of Sasman No. 336
Garry Kupchinski	Rural Municipality of Buchanan No. 304
Ben Pengilly	Rural Municipality of Cana No. 214
Bob Pratt	Fishing Lake First Nation/ Touchwood Agency Tribal Council
Jack Prychak/ Tom Niecker	Rural Municipality of Invermay No. 305
Ray Reisz	Friends of Good Spirit Lake
Al Schatz	Rural Municipality of Stanley No. 215
Eugene Secondiak	Good Lake Conservation & Development Area
Ken Smuk	Rural Municipality of Garry No. 245
Don Taylor	Rural Municipality of Saltcoats No. 213
Don Walters	Spirit Creek Monitoring Group

B. Technical Committee Members

Member	Representing
Brad Ashdown	Saskatchewan Watershed Authority
Doug Brook	Ducks Unlimited Canada
Mike Buchholzer	City of Yorkton
Brian Campbell	Saskatchewan Agriculture and Food
Tim Cheesman	Saskatchewan Government Relations
John-Mark Davies	Saskatchewan Watershed Authority
John Fahlman	Saskatchewan Watershed Authority
Jon Gaudrey	Sunrise Health District
Ross Herrington	Environment Canada
Rob Kirkness	Saskatchewan Watershed Authority
Neil Lamberty	Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration
Darlene McLeod	Saskatchewan Health
Rick Orr	Fisheries and Oceans Canada
Jason Puckett	Saskatchewan Watershed Authority
Jim Rodgers	Environment Canada
Warren Thomson	Saskatchewan Watershed Authority
Rob Walcer	Saskatchewan Watershed Authority
Joe Zarowny	Saskatchewan Environment

C. Fish Species of the Upper Assiniboine River Basin

Scientific Name	Common Name	Abbreviation
Ambloplites rupestris	rock bass	RCBS
Ameiuris nebulosis	brown bullhead	BRBL
Catostomus commersoni	white sucker	WHSC
Carpiodes cyprinus	quillback	QUIL
Culaea inconstans	brook stickleback	BRST
Cyprinus carpio	common carp	CMCR
Esox lucius	northern pike	NRPK
Etheostoma exile	Iowa darter	IWDR
Etheostoma nigrum	johnny darter	JHDR
Hiodon tergisus	mooneye	MOON
Hybognathus hankinsoni	brassy minnow	BRMN
Ichthyomyzon castaneus	chestnut lamprey	CHLM
Lota lota	burbot	BURB
Luxilus cornutus	common shiner	CMSH
Margariscus margarita	pearl dace	PRDC
Moxostoma anisurum	silver redhorse	SLRD
Moxostoma macrolepidotum	shorthead redhorse	SHRD
Notropis atherinoides	emerald shiner	EMSH
Notropis dorsalis	bigmouth shiner	BGSH
Notropis heterolepis	blacknose shiner	BLSH
Notropis hudsonius	spottail shiner	SPSH
Notropis stramineus	sand shiner	SNSH
Noturus flavus	stonecat	STON
Perca flavescens	yellow perch	YLPR
Percina maculata	blackside darter	BLDR
Percopsis omiscomaycus	trout-perch	TRPR
Pimephales promelas	fathead minnow	FTMN
Pungitius pungitius	ninespine stickleback	NNST
Rhinichthys atratulus	blacknose dace	BLDC
Rhinichthys cataractae	longnose dace	LNDC
Semotilus atromaculatus	creek chub	CRCH
Stizestedion vitreum	walleye	WALL

Data sources:
McCulloch, B.R. and W.G. Franzin. 1996. *Fishes of the Canadian portion of the Assiniboine River drainage.* Can. Tech. Rep. Fish . Aquat. Sci. 2087:v + 62 p
Sentar Consultants Ltd. 1996. *Inventory of fish occurrences and morphological characteristics of streams in the Assiniboine River drainage basin in Saskatchewan.* Prepared for Dept. Fisheries and Oceans Canada.
SERM file information

(Note: Only native species and introduced species that have established self-sustaining populations are listed. Exotic species that rely on stocking to maintain a population are not included).

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