CENTRAL ASSINIBOINE INTEGRATED WATERSHED MANAGEMENT PLAN

SURFACE WATER HYDROLOGY REPORT

Planning Area Boundary:

The Central Assiniboine planning area covers the reach of the Assiniboine River from just downstream of the confluence with the Little Saskatchewan River upstream of Brandon, to just downstream of the confluence with the Cypress River near Holland, as well as the Lower Souris River watershed and other smaller local tributaries along the reach. The Central Assiniboine planning area is shown on Figure 1.

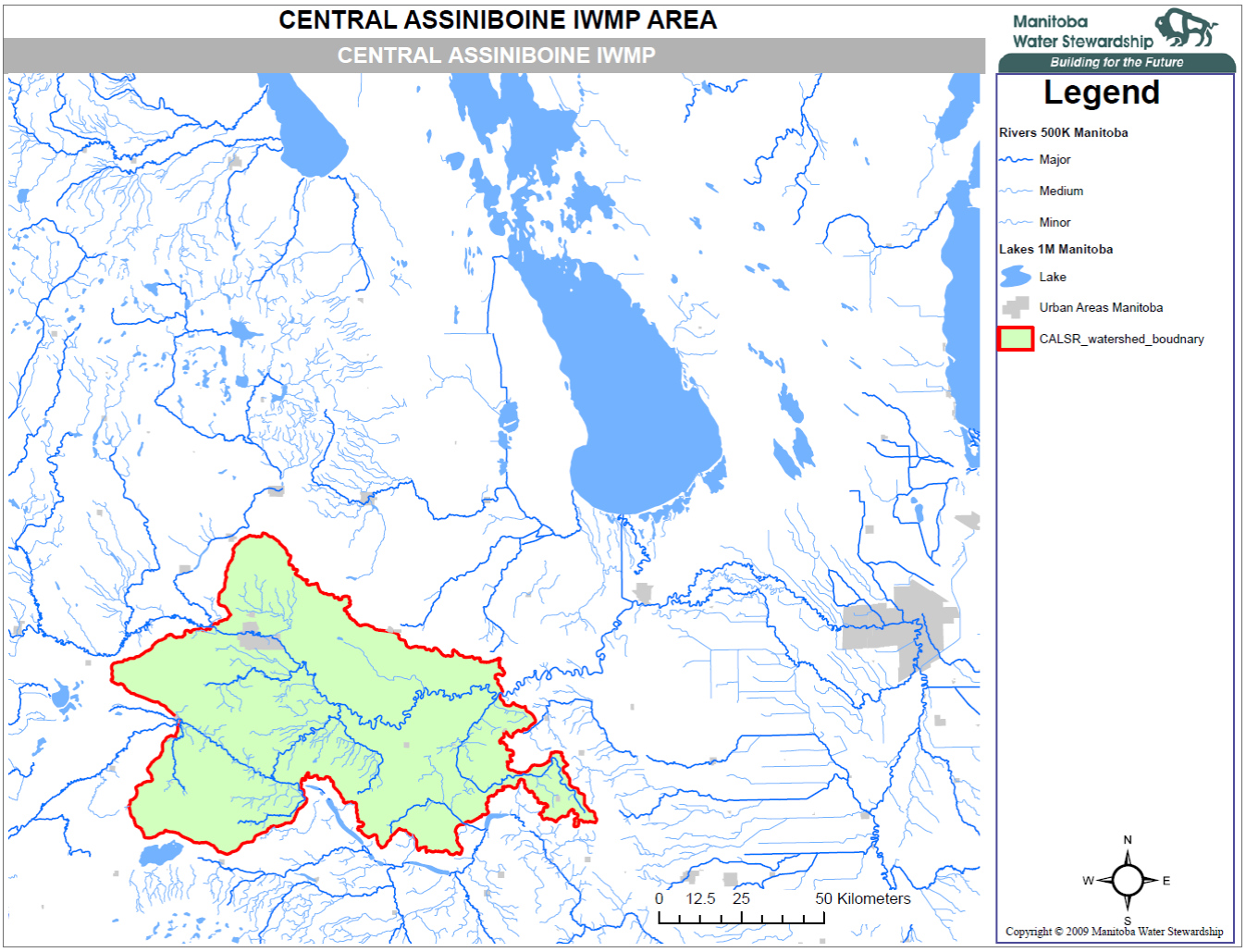


Figure 1: Central Assiniboine IWMP Area

The planning area in this case is a watershed, but is made up of a number of sub-watersheds such as the Lower Souris River including Elgin Creek, Little Souris River, Cypress River, Oak Creek, Epinette Creek and Willow Creek. By definition, a watershed is the land area that contributes surface water runoff to a common point. It is separated from adjacent watersheds by a land ridge or divide. Watersheds can vary in size, from a few acres to thousands of square kilometers. A larger watershed

can contain many smaller sub-watersheds which are defined in the same manner as a watershed. On a larger scale, a basin is defined as a collection of watersheds that feed into a common main tributary or large body of water (e.g. the Red River Basin). A sub-basin is a division of a basin and will be made up of multiple watersheds.

Watershed and basin boundaries form a prime ecological unit for:

- information and knowledge management and analysis, and
- water and land use planning and management.

Watershed and basin boundaries are defined through the application of the best available science and modified with documented and verifiable local input. Agriculture and Agri-Food Canada through the efforts of the Prairie Farm Rehabilitation Administration (AAFC-PFRA) and Manitoba Water Stewardship have delineated a system of watershed and basin boundaries for Manitoba. These boundaries have been designed to extend to the mouths of some rivers and streams and along large bodies of water. The Central Assiniboine planning area boundaries were established using this system of watersheds.

Climate:

Climate data was extracted from Environment Canada's data base for Brandon, MB.

From 1960 to 2009, Brandon received an annual average of 462 mm of precipitation. Precipitation varies from year to year as shown in Figure 2. The average annual temperature at Brandon is 2.0°C. The Central Assiniboine planning area receives the largest portion of its annual precipitation in the spring and summer months. The monthly mean precipitation and temperature are shown in Figure 3 and Figure 4.

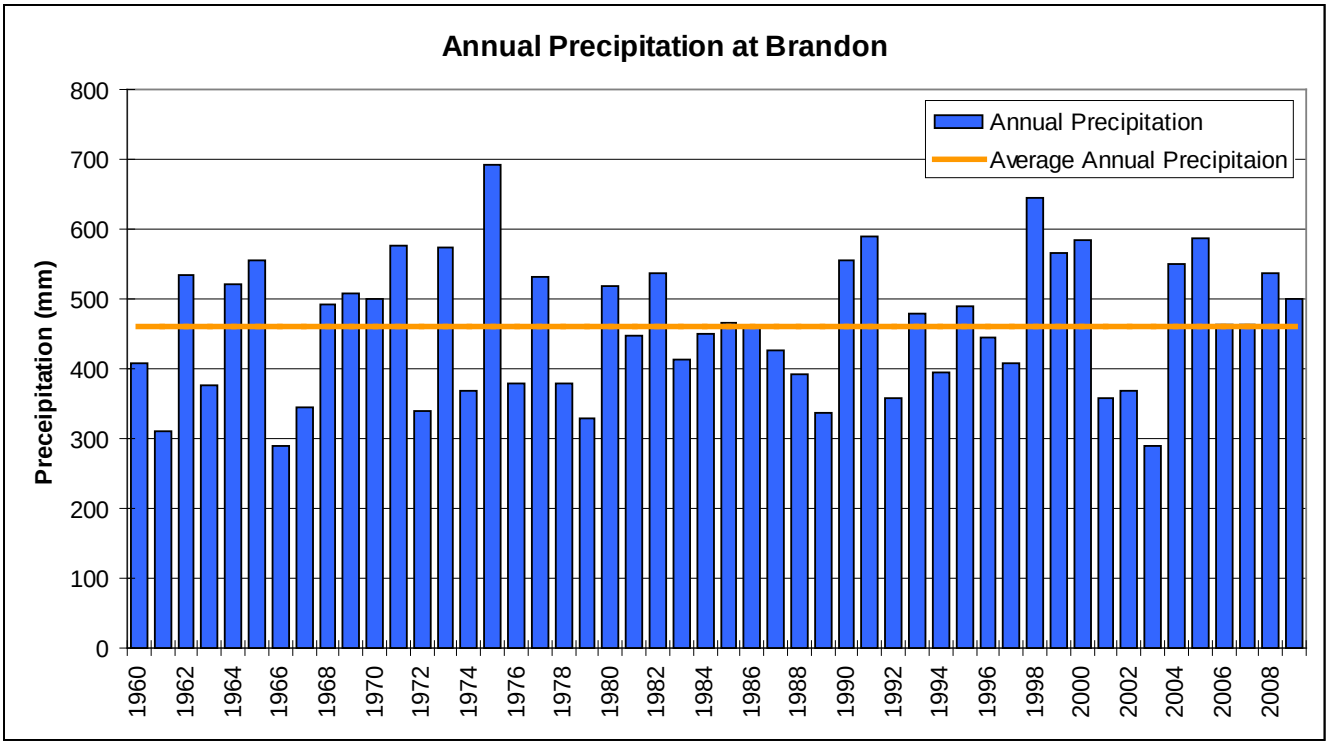


Figure 2: Annual Precipitation at Brandon

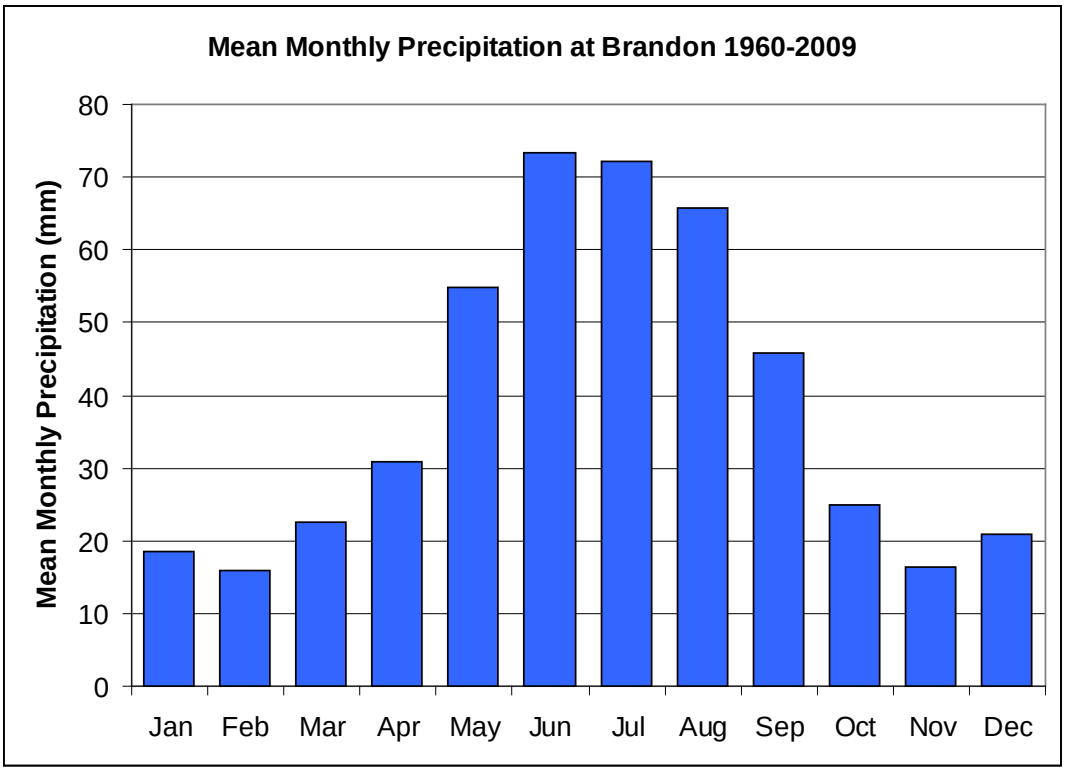


Figure 3: Mean monthly precipitation at Brandon

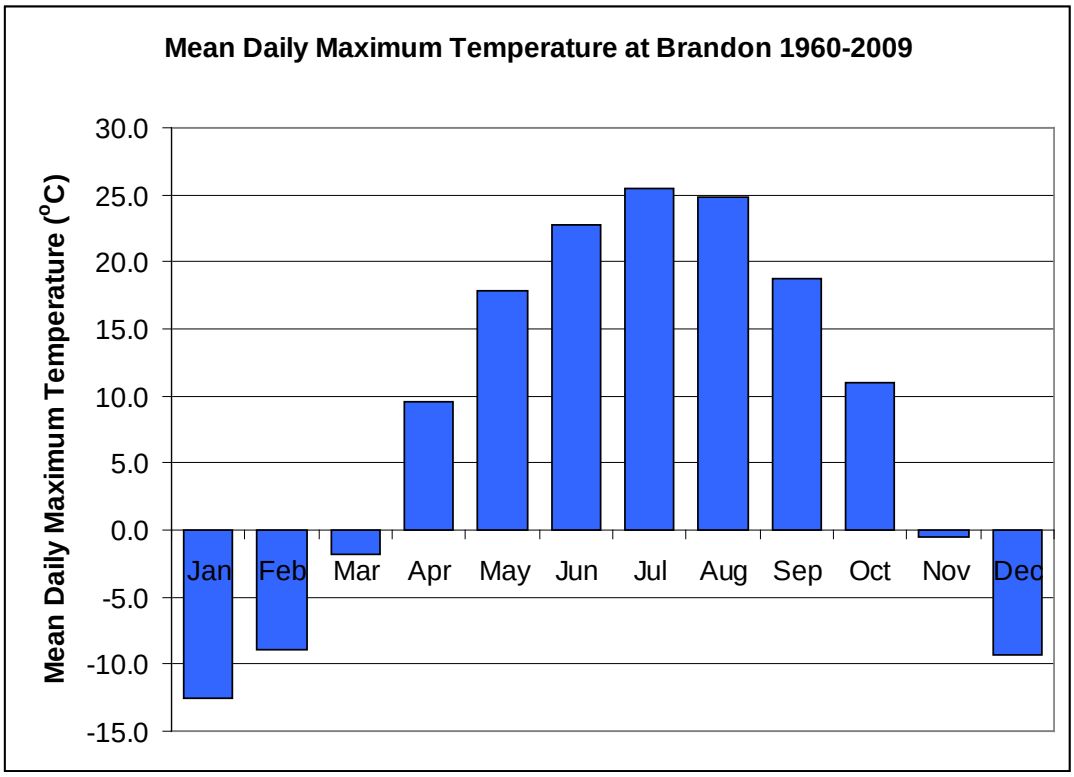


Figure 4: Average daily maximum temperature at Brandon

Hydrometric Data:

The collection of hydrometric data is critical to the understanding of the availability, variability and distribution of water resources and provides the basis for responsible decision making on the management of this resource. Historic hydrometric data provides the basis for understanding the potential extent and limitation of the resource. Water level and stream flow data collected under the Canada-Manitoba Hydrometric Agreement, which is part of a National Hydrometric Program, supports activities such as policy development, operation of water control works, flow forecasting, water rights licensing, water management investigations and hydrologic studies, ecosystem protection and scientific studies. Environment Canada, the Province of Manitoba and Manitoba Hydro operate 143 discharge and 133 water-level gauging stations under this Agreement.

Stream flow or water level data have been collected at many hydrometric gauging stations within the Central Assiniboine planning area for varying time periods since the 1960s, with some dating back to the early 1900s for the Souris and Assiniboine Rivers. The locations of hydrometric stations are shown on Figure 5. Table 1 provides information relating to the station ID number, name, location, effective and gross drainage area, type of data collected, and the years of operation.

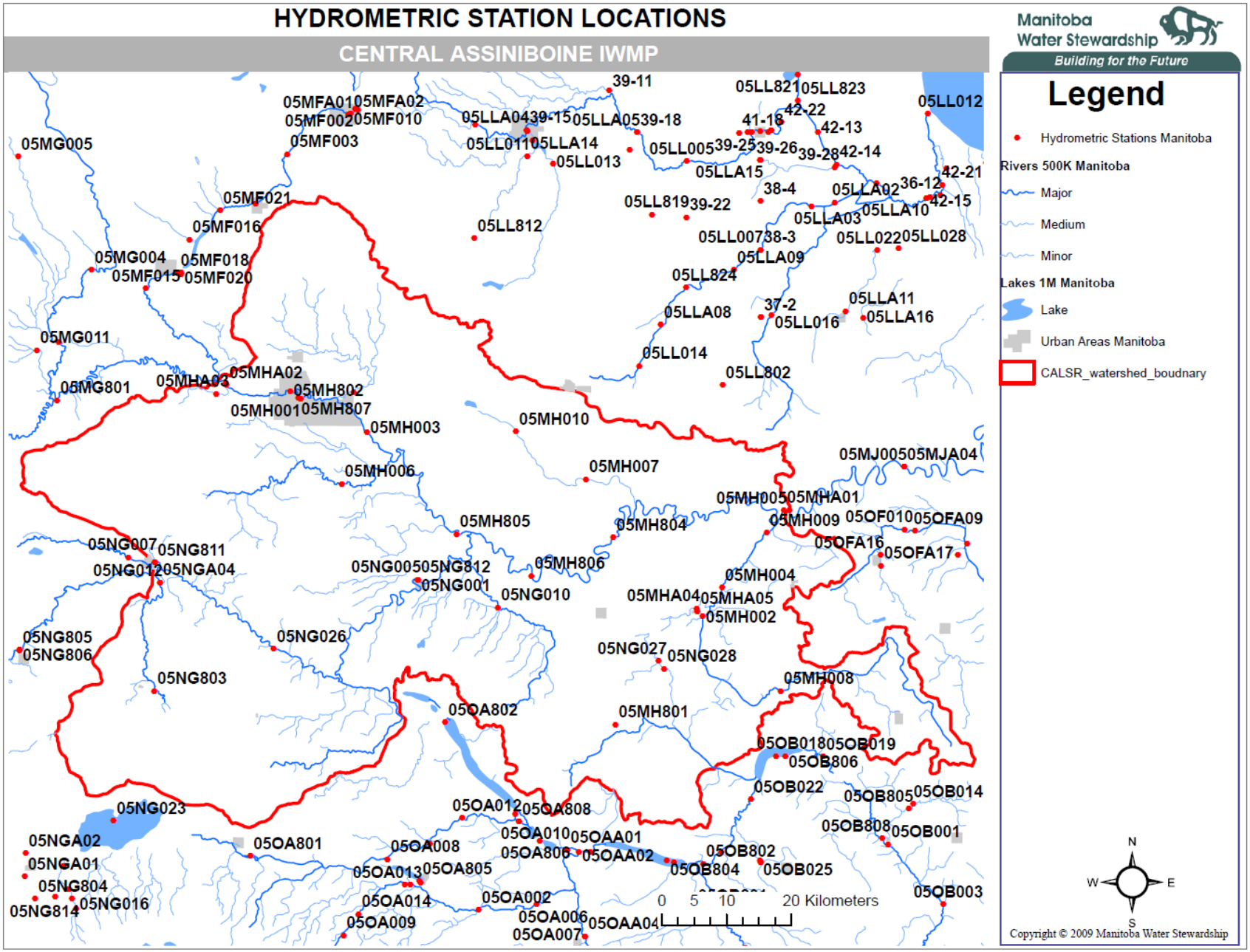


Figure 5: Hydrometric Station Locations

Table 1: Hydrometric station information

Station ID	Station Name	Station Location	Gross Drainage Area (km^2)	Effective Drainage Area (km^2)	Period of Record F – Flow Data L – Level Data
05MH001	Assiniboine River at Brandon	NW24-10-19-W1	93,790.0	30,074.6	F – 1906-1973
05MH002	Cypress River at Cypress River	SW08-07-12-W1	377.4	278.8	F – 1957-1960
05MH004	Cypress River near Cypress River	SW27-07-12-W1	631.9	470.7	F – 1961-1991 L – 1985-1991
05MH005	Assiniboine River near Holland	SE33-08-11-W1	160,472.5	54,953.8	F – 1961-2008 L – 1995-2010
05MH006	Little Souris River near Brandon	NW10-09-18-W1	644.1	262.1	F – 1961-2009 L – 2002-2010
05MH007	Epinette Creek near Carberry	SW16-09-14-W1	382.0	135.0	F – 1961-2009 L – 2003-2010
05MH008	Cypress River near Bruxelles	SW04-06-11-W1	276.3	198.4	F – 1965-2010 L – 1985-2010
05MH011	Willow Creek near Chater	SE27-10-18-W1	665.8	497.9	F – 1966-1994 L – 1985-1994
05MH013	Assiniboine River near Brandon	NE27-10-20-W1	93,663.1	29,960.8	F – 1974-2010 L – 1985-2010
05MH801	Bottomless Lake near Balder				L – 1978-1980
05MH802	Assiniboine River at Brandon (18^{th} Street Bridge)	SW26-10-19-W1	93,780.6	30,065.2	L – 1987-1996
05MH803	Assiniboine River at Brandon (1^{st} Street Bridge)	NE23-10-19-W1	93,790.0	30,074.6	L – 1936-2003
05MH804	Assiniboine River at P.T.H. No. 5 near Glenboro	NE14-08-14-W1	158,658.2	53,856.6	L – 1976-2009
05MH805	Assiniboine River near Treesbank	NE17-08-16-W1	95,786.5	31,462.9	L – 1988-1989
05MH806	Assiniboine River near Stockton	SE33-07-15-W1	158,366.3	53,745.3	L – 1988-1989
05NG001	Souris River at Wawanesa	NW26-07-17-W1	61,076.9	21,477.2	F – 1912-2009 L – 1985-2009
05NG010	Oak Creek near Stockton	SE13-07-16-W1	1,025.5	439.6	F – 1964-2009 L – 1985-2009
05NG012	Elgin Creek near Souris	NE22-07-21-W1	449.0	221.8	F – 1961-2009 L – 1985-2010
05NG021	Souris River at Souris	NE34-07-21-W1	59,354.3	20,573.0	F – 1967-2009 L – 1985-2009
05NG027	Oak Creek near Glenboro	SW21-06-13-W1	492.5	197.4	F – 1986-1994 L – 1986-1994
05NG028	Oak Creek near Cypress River	SW15-06-13-W1	429.4	172.2	F – 1975-1985 L – 1985-1985
05NG803	Elgin Reservoir near Elgin	NE33-05-21-W1	240.5	53.0	L – 1968-2009
05NG811	Souris River at Souris (Above Souris Dam)	NE34-07-21-W1	59,354.3	20,573.0	L – 1989-1999
05NG812	Souris River above Wawanesa Dam	NW26-07-17-W1	61,076.9	21,477.2	L – 1993-1996

Streamflow Characteristics:

Assiniboine River

The main river in the CA IWMP area is the Assiniboine River. The Assiniboine River has a large drainage basin of 163,000 km^2 covering portions of southeast Saskatchewan, northwest North Dakota and southwest Manitoba. The major tributaries of the Assiniboine River are listed with their drainage areas in Table 2. The flows each portion contributes for median, dry (1-in-10 year), and drought (1-in-50 year) conditions are also listed in Table 2.

Table 2: Assiniboine River Flow Sources

Sub-basin	Drainage Area (km^2)	% of Drainage Area	% Flow Source		
			Median	Dry	Drought
Qu'Appelle River	58,900	36	15	10	5
Souris River	61,000	38	15	10	3
Upper Assiniboine (upstream of Shellmouth Dam)	19,000	12	23	24	27
Manitoba Local Tributaries					
- upstream Brandon	15,800	10	28	26	16
- downstream Brandon	7,900	4	9	14	24
- total			37	40	40
Assiniboine Delta Aquifer	3,900	---	10	16	25

The annual average flow for the Assiniboine River at Holland (05MH005) is shown for 1961 to 2008 on Figure 6. As typical for prairie streams, the flow variability from year to year is quite large.

The runoff contributed to the Assiniboine River by the CA IWMP area was calculated and is shown on Figure 7. Due to data availability the calculations could only be completed for the months of March to October from 1967 to 2008. The CA IWMP area contributes an average of 12 cms (425 cfs) to the Assiniboine River, although the amount of flow can vary greatly from year to year. The area of the CA IWMP area is approximately 2,850 square miles, with the average annual run off approximately 110 acre-feet per square mile.

The Assiniboine Delta Aquifer (ADA) provides significant base flow to the Assiniboine River in the reach between Brandon and Holland. It is estimated that the ADA provides approximately 4 cms (140 cfs) to the Assiniboine River.

The monthly distribution of runoff from the CA IWMP area is shown in Figure 8. As expected, the highest runoff occurs in spring from the spring melt. Flows gradually decline over summer until reaching a base flow of just under 5.7 cms (200 cfs), most of which is contributed by the ADA.

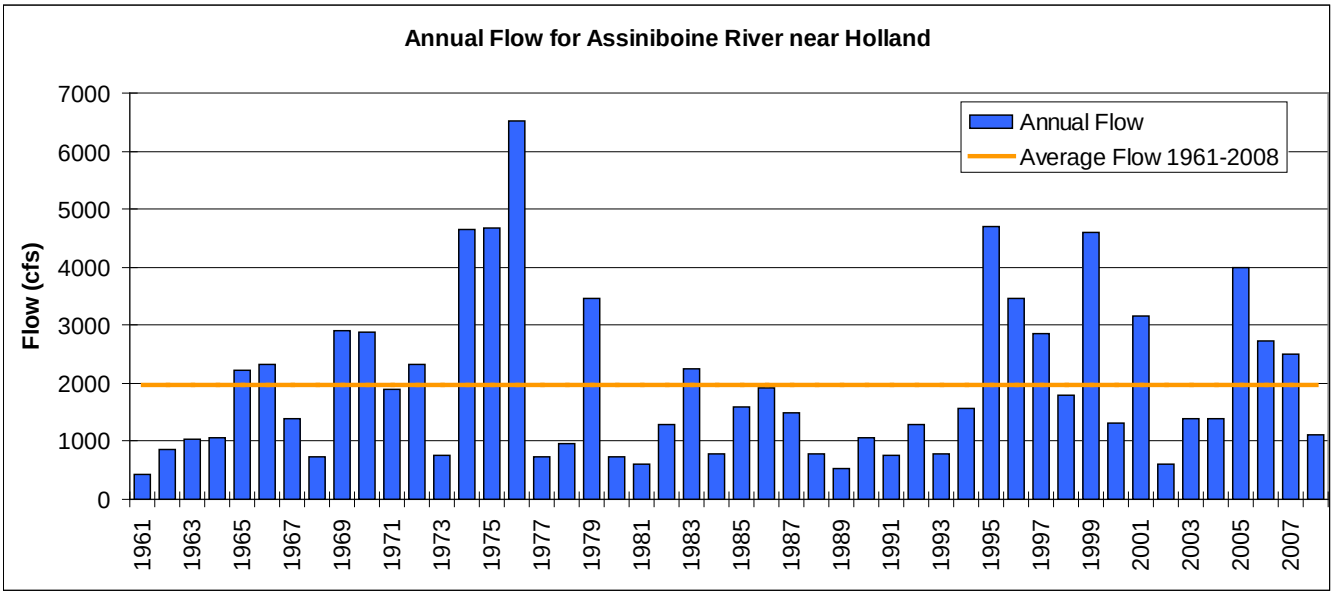


Figure 6: Average annual flows for the Assiniboine River near Holland (05MH005)

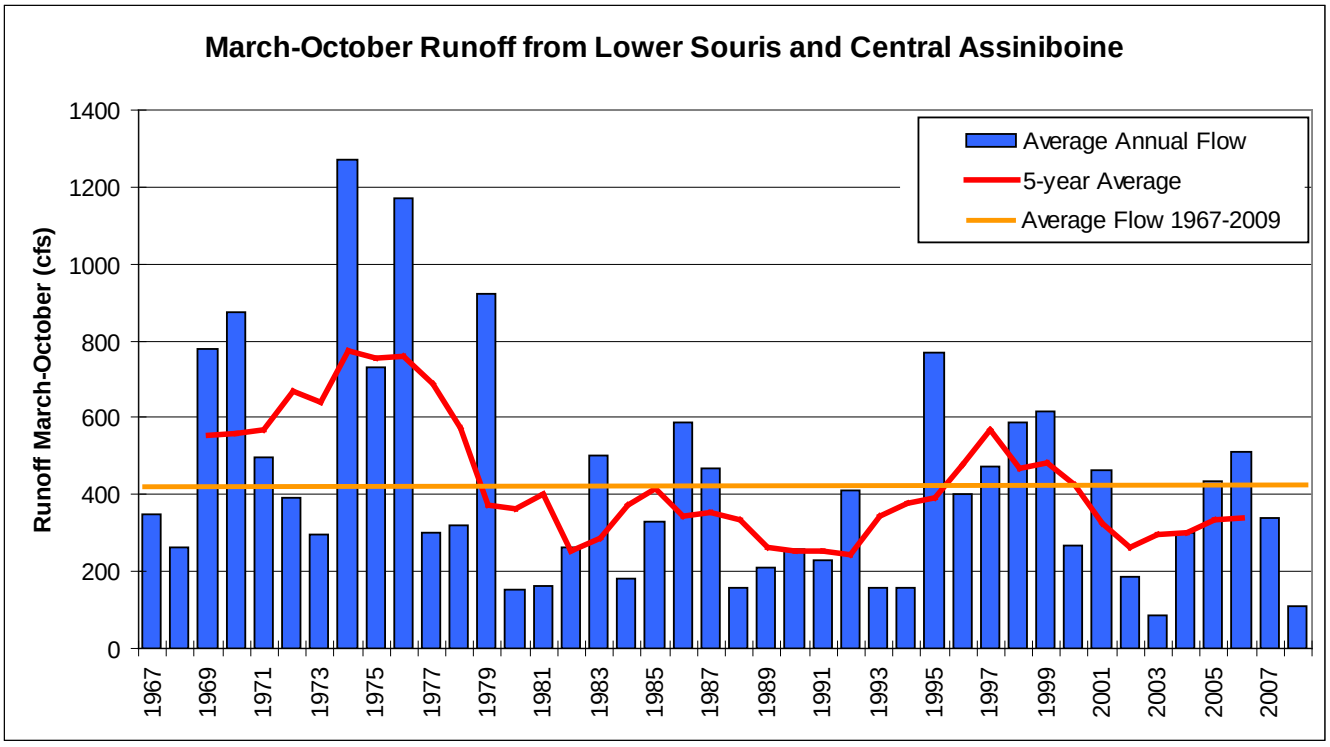


Figure 7: Flow contributed to the Assiniboine River by the CA IWMP area

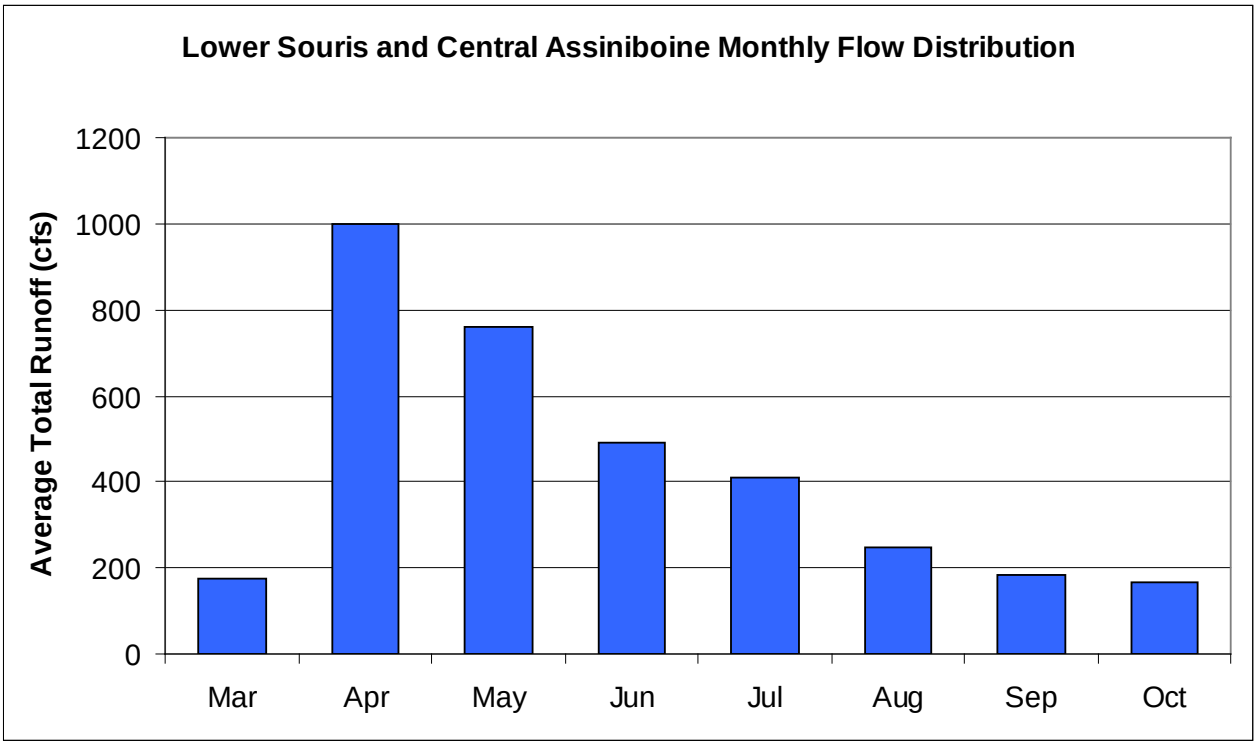


Figure 8: CA IWMP watershed average monthly flow distribution

Sub-watersheds

The CA IWMP area contains a number of sub-watersheds including the Little Souris River, Oak Creek, Cypress River, Willow Creek, Epinette Creek and the lower portion of the Souris River watershed. A map of sub-watersheds within the CA IWMP area is shown in Figure 9.

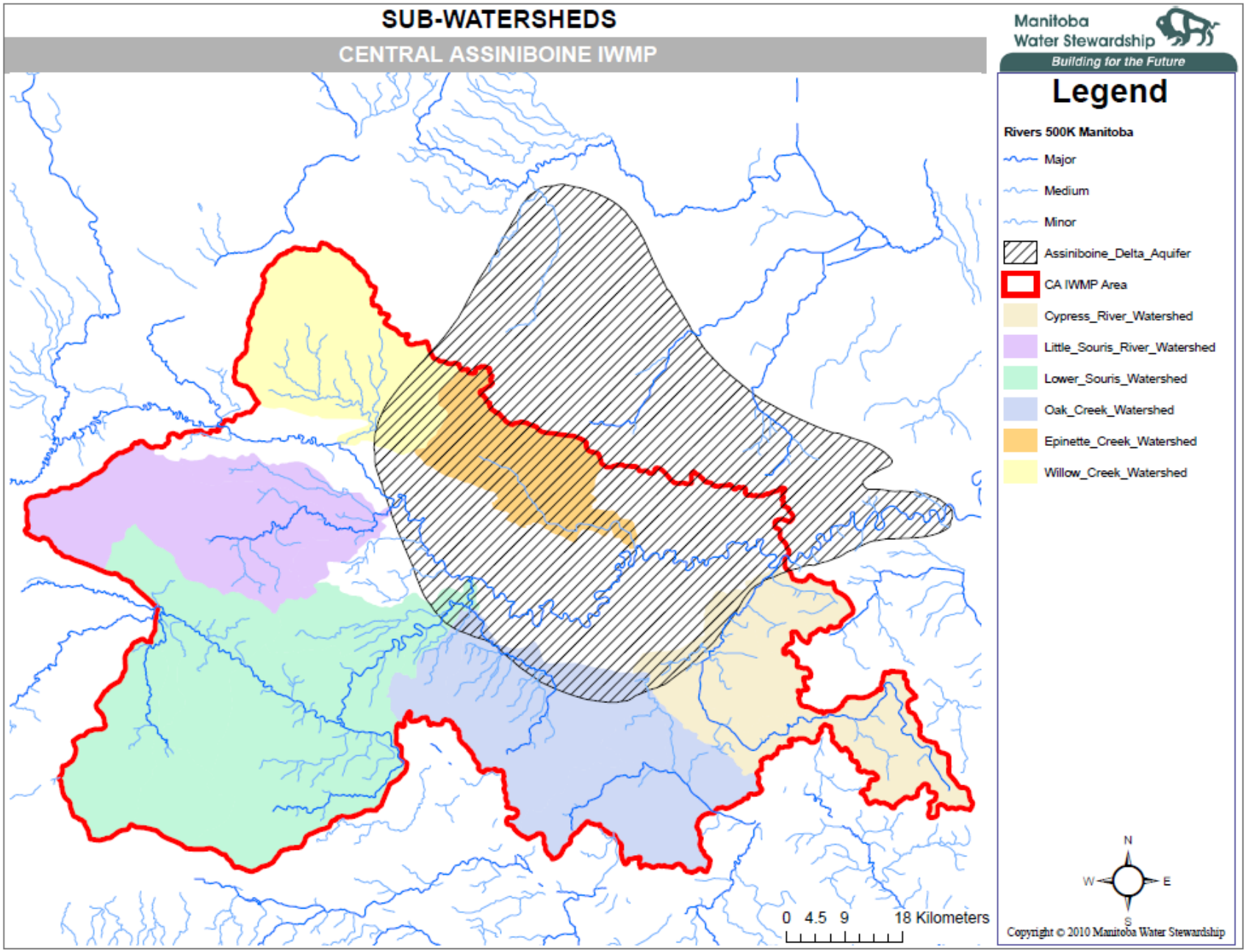


Figure 9: Central Assiniboine sub-watersheds

The runoff productivity of different sub-watershed areas within the CA IWMP area was calculated. The results are shown in Table 3. Productivity is fairly consistent across the watershed with the exception being the Epinette Creek watershed. The Epinette watershed overlays the Assiniboine Delta Aquifer and has sandier soils than the other areas of the watershed that are composed mostly of clay and loams. The sandy soil allows more water to infiltrate in the spring and the summer productivity is higher due to discharge from the Assiniboine Delta Aquifer.

The productivity of the entire CA IWMP area was also calculated. The spring productivity is similar to the sub-watershed productivity. However, the summer productivity is much higher which can be explained by the presence of the ADA in the ungauged portion of the watershed not included in the calculations for the sub-watershed portions. This ungauged area is almost completely underlain by the Assiniboine Delta Aquifer, as shown in Figure 9. The 4 cms (140 cfs) of base flow contributed by the ADA would is mostly contributed in this ungauged portion of the basin.

Table 3: Sub-watershed productivity

Sub-watershed	Area (km^2 (sq. mi.))	Average Runoff (acre-feet per square mile)	
		March-May	June-October
Lower Souris River	1899 (733)	45.7	3.5
Little Souris River 61-93,94-09*	836 (323)	28.2	1.4
Oak Creek 61-96,02-09*	1147 (443)	30.9	5.0
Cypress River 65-09	813 (314)	45.7	3.5
Willow Creek 66-94	670 (259)	40.9	5.3
Epinette Creek	410 (158)	22.0	10.6
CA IWMP Area	7400 (2856)	40.8	31.8

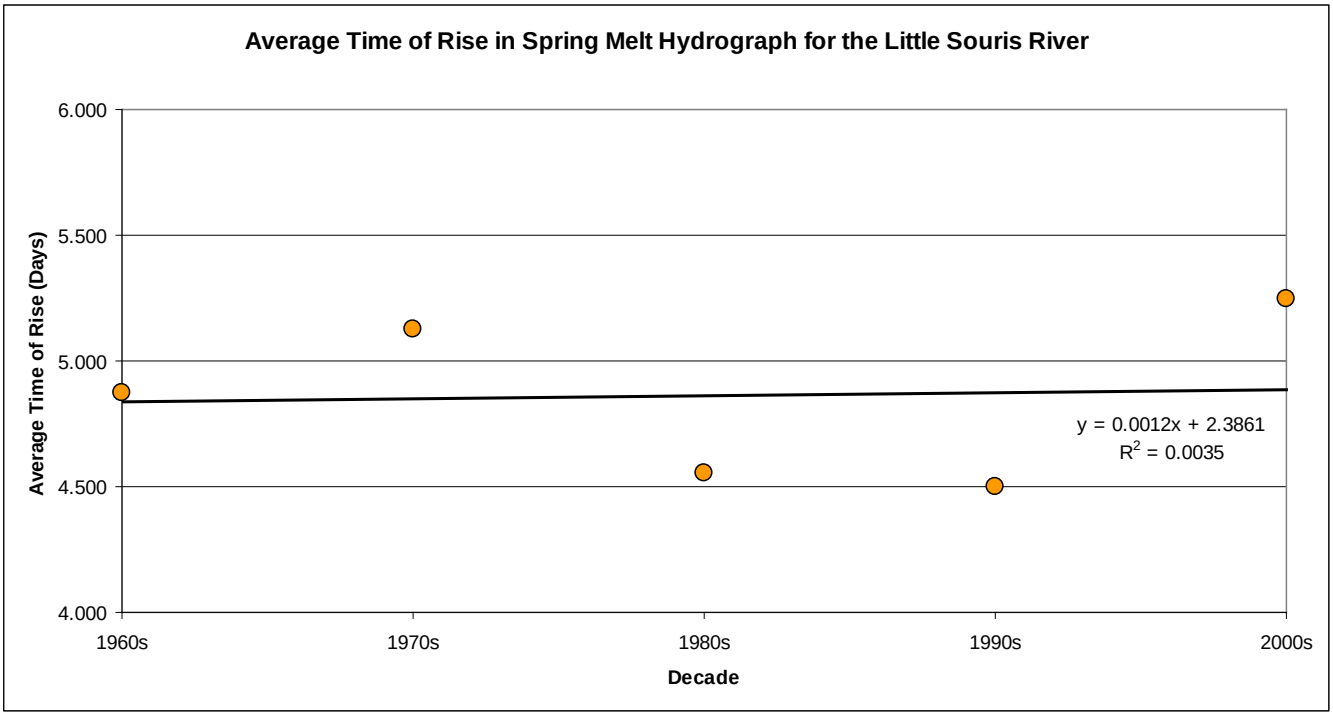
Answers to specific questions were asked to be included in this hydrological input for the CA IWMP. Firstly, are the waterways experiencing more “flash floodiness”? Secondly, are flows less consistent during dry times? And thirdly, are there opportunities for the construction of waterway control structures to reduce extreme peak flows and ensure a more natural and ecologically-supportive flow regime in this watershed? The third question of water storage is important, but is beyond the scope of a typical submission by the Surface Water Management section. Valuable input on this topic could be provided by locals during the planning activities and studied at a later date.

Is there a trend in flash floods?

To investigate whether or not the watershed is experiencing more “flash flood” behavior in recent years, data from the Little Souris River Watershed was investigated for any noticeable trends.

For every year from 1961 to 2009 the date of the peak flow due to snowmelt was identified. The time of rise in the hydrograph was then determined by counting how many days it took to reach the peak once flow started. The average time of rise for each of the five decades of data calculated and examined for any trend. If the characteristics of the watershed or climate conditions were changing to increase flash

floods, the time of rise should be trending to faster rises in the hydrograph. Although there is variability from year to year, overall the data from the Little Souris River showed no decreasing trend in the time of rise for spring floods. Time of rises as short as two to three days were common in the 1960s and 1970s. The average time of rise in the Little Souris River Watershed has stayed consistently between 4.5 to 5.5 days for the past 50 years.



Are flows less consistent during dry times?

To investigate whether or not flows are less consistent during dry times, duration curves were constructed for the months of June to August for two of the sub-watersheds, Epinette Creek and Cypress River. These sub-watersheds were chosen because they have a long record of summer flows.

A duration curve shows the percentage of time that a given flow volume is equaled or exceeded. For example, the 80% volume is expected to be exceeded in 80% of years on average. For each of the sub-watersheds, a curve was constructed for 1990 to 2009, and another curve was constructed for data that was available before 1990. By comparing the curves for the different time periods, any changes in low flow variability can be observed.

The data shows that both of the sub-watersheds have had larger low flows for the last 20 years, compared to the previous 20 to 30 years. These results are consistent with the general trend that southern Manitoba has been experiencing wetter than normal conditions for the last 10 to 15 years.

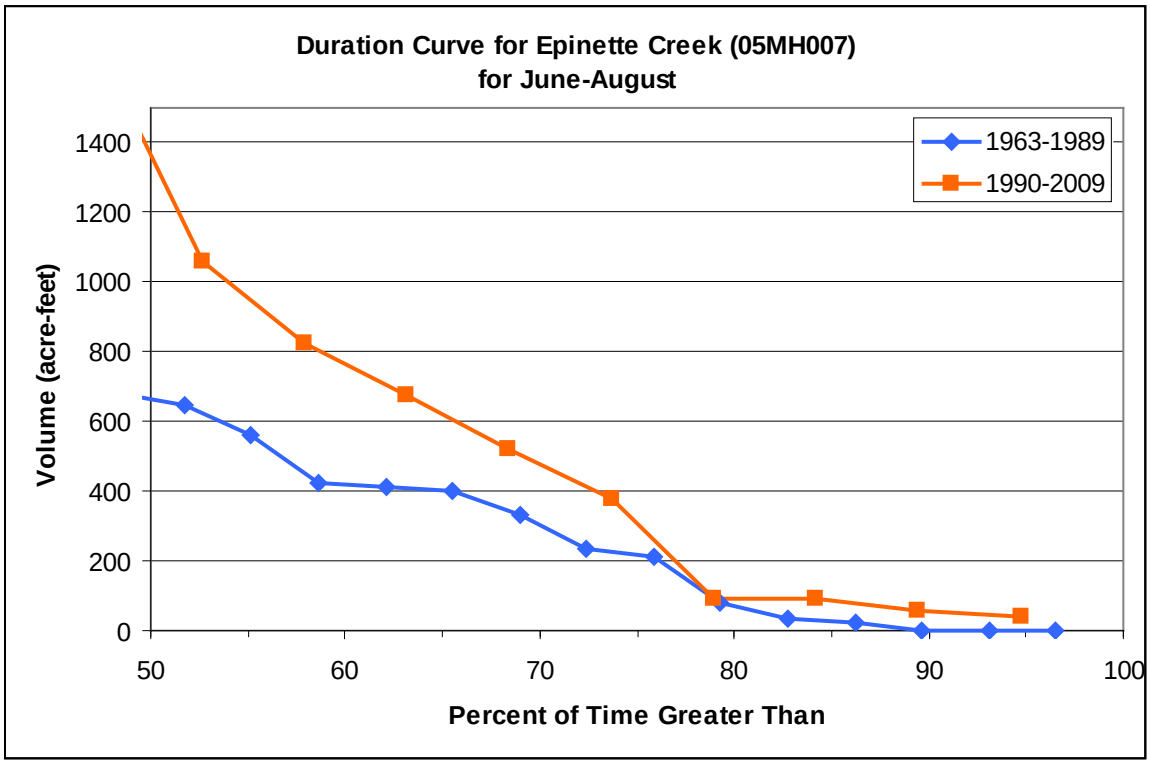


Figure 10: Summer duration curve for Epinette Creek

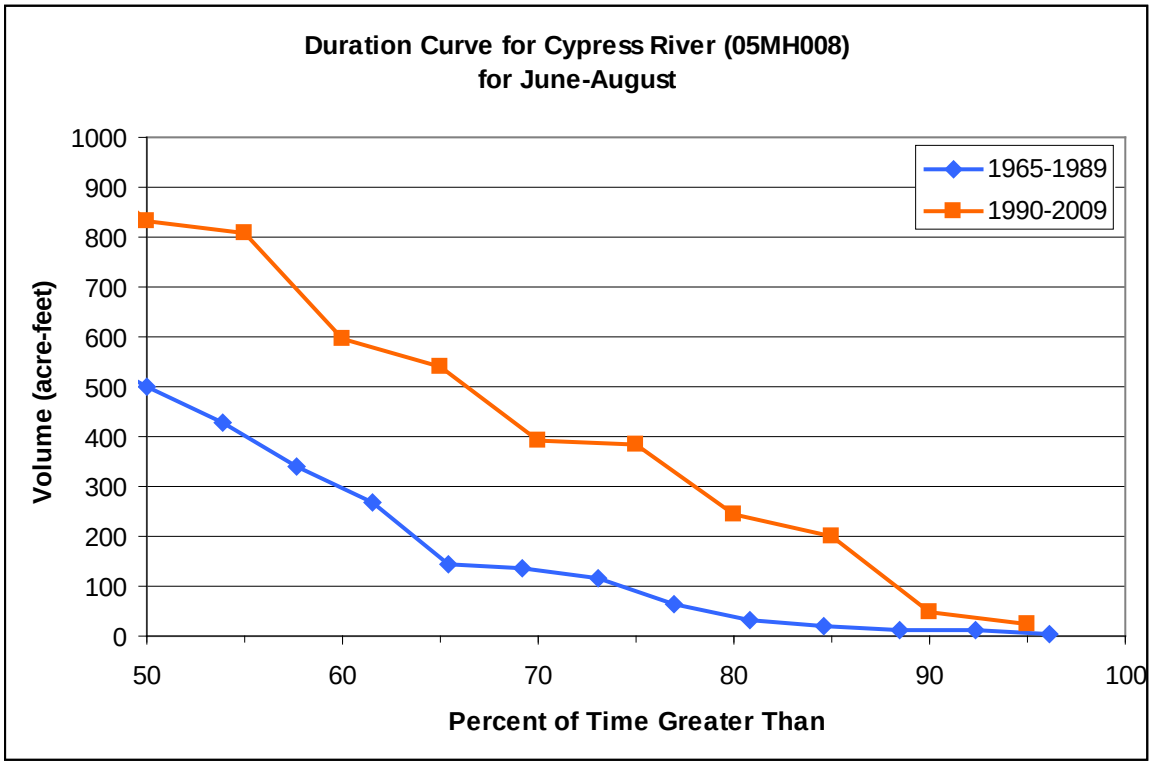


Figure 11: Summer duration curve for Cypress River