SWAN LAKE INTEGRATED WATERSHED MANAGEMENT PLAN

SURFACE WATER HYDROLOGY REPORT[1]

1. General Description

Figure 1 provides a map of the Swan Lake Watershed. The watershed is characterized by two major parallel flowing rivers, situated approximately 9.6 km apart, the Woody River an the north and the Swan River to the south. These rivers, which have breached the Manitoba Escarpment, flow from the southwest portion of the basin (at the Manitoba - Saskatchewan border) and both have their headwaters in the Porcupine Hills. The Woody River has its origin in the central part of the Porcupine Hills and flows almost due southerly until it reaches the provincial boundary where it turns east and northeast and ultimately empties into Swan Lake. The Swan River originates in the Western portion of the Porcupine Hills, flows southeastward in Saskatchewan until it turns northeastward some 16 km west of the provincial boundary. The river crosses the boundary and flows roughly parallel to the Woody River before emptying into the west central part of Swan Lake where it has build a delta since the last glacial retreat.

The Swan and Woody River Valley is fairly narrow (24 – 32 km) and is flanked by the Porcupine Hills on the north and the Duck mountains on the south. In the Manitoba portion of the basin, The Woody River captures all the discharge from tributaries originating on the south and southeast side of the porcupine hills, whereas the Swan River captures all the discharge from its tributaries which originate on the north side of the Duck mountains. The development of a continuous pattern of meanders in the two major rivers, coupled with topographical information, indicates a flat valley plain. A few kilometers east of the towns of Swan River and Bowsman there is a north-south ridge that drops 6 to 9 meters.

[1] This report serves to extend the data provided in the report “Swan Lake Basin Hydrology” (2001). Excerpts from that report have been used here.

Figure 1: Swan Lake Watershed

The planning area in this case is a watershed, but is made up of a number of sub-watersheds, the main ones being Swan River, Roaring River, Woody River and Birch River. 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 hectares 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.

2. Climate

Climate data was extracted from Environment Canada's data base for Swan River and Boggy Creek (see Figure 2 for locations). The meteorological station at Swan River is situated quite central in the Manitoba portion of the watershed and has a fairly long time series (1908 – 2008) of daily date for precipitation and air temperature.

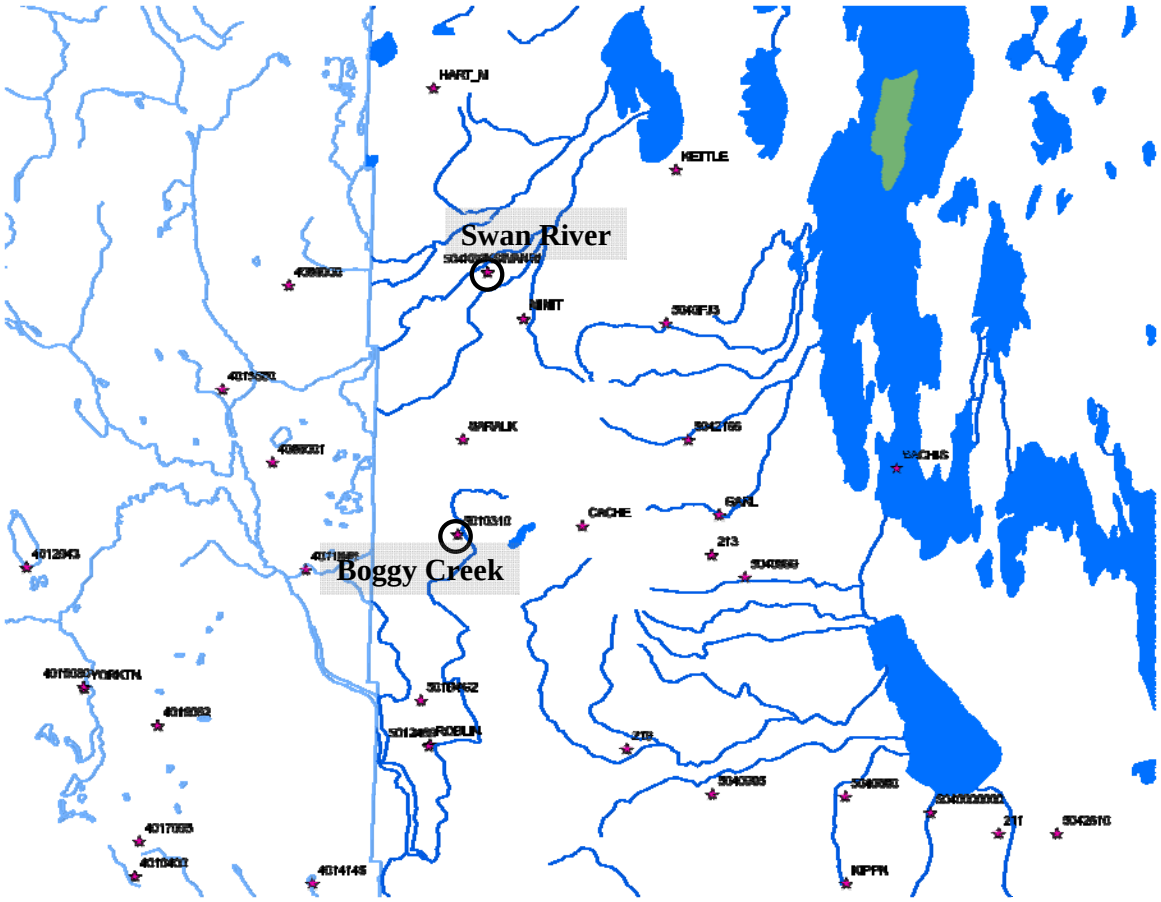

Figure 2: Location of meteorological stations from which data was used in this study

The monthly totals of precipitation, both as rain and as snow, for the Swan River station are provided in Figure 3. Notice that the second half of the time series is wetter than the first half. Monthly precipitation normals for a 30 year time span (1971 – 2000) are provided in Figure 4. From 1971 to 2000, Swan River received an annual

average of 530 mm of precipitation. Monthly temperature normals are provided in Figure 5. The average annul temperature at Swan River between 1971 and 2000 is 1.6°C.

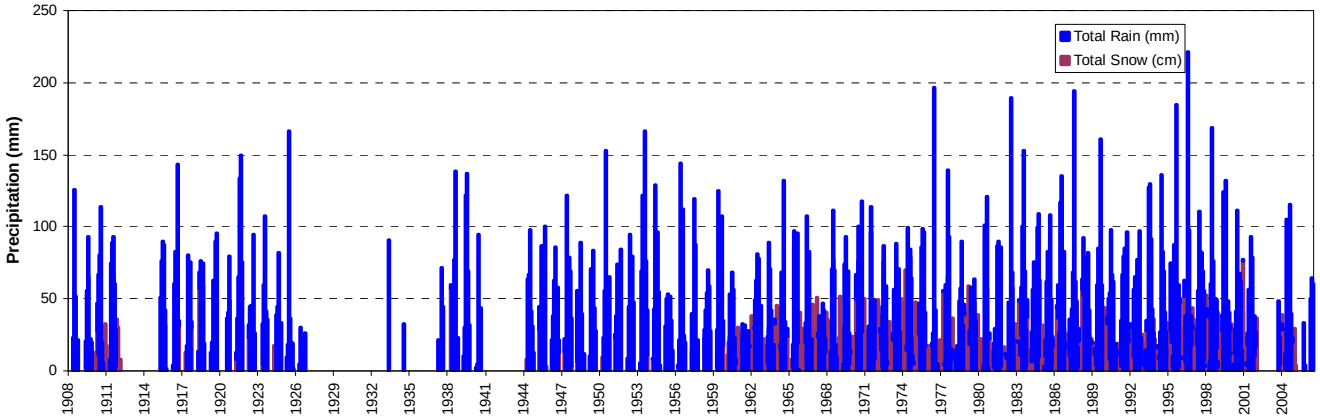

Figure 3: Monthly precipitation totals at Swan River.

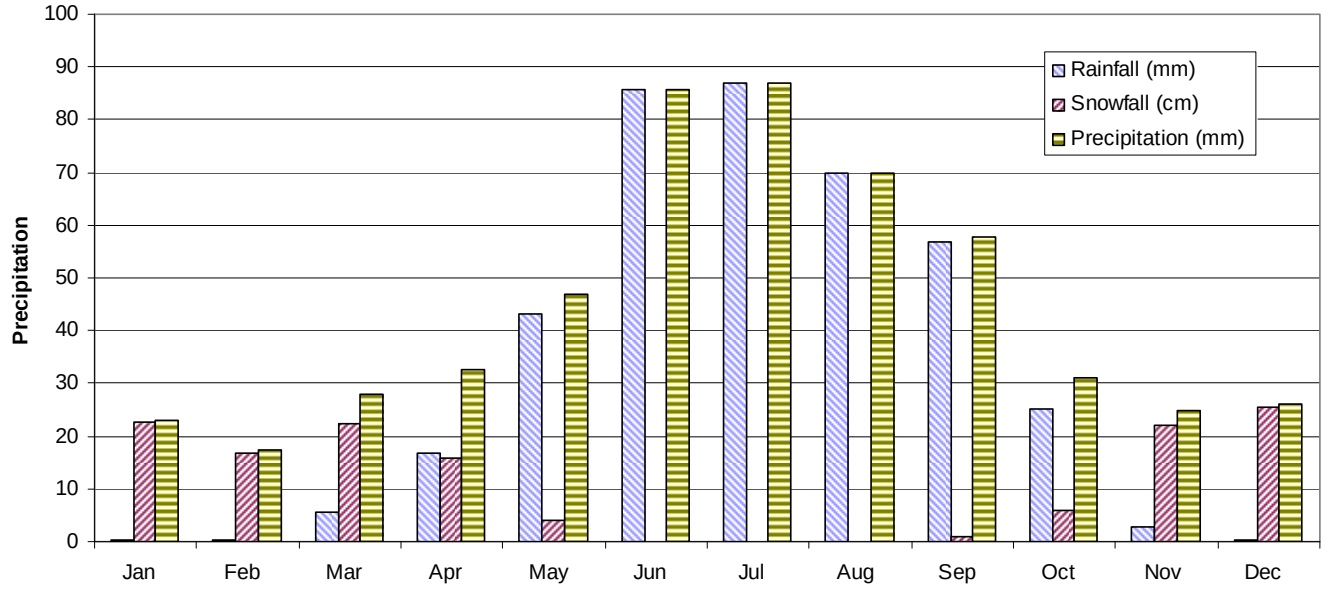

Figure 4: Long-term monthly precipitation normals at Swan River.

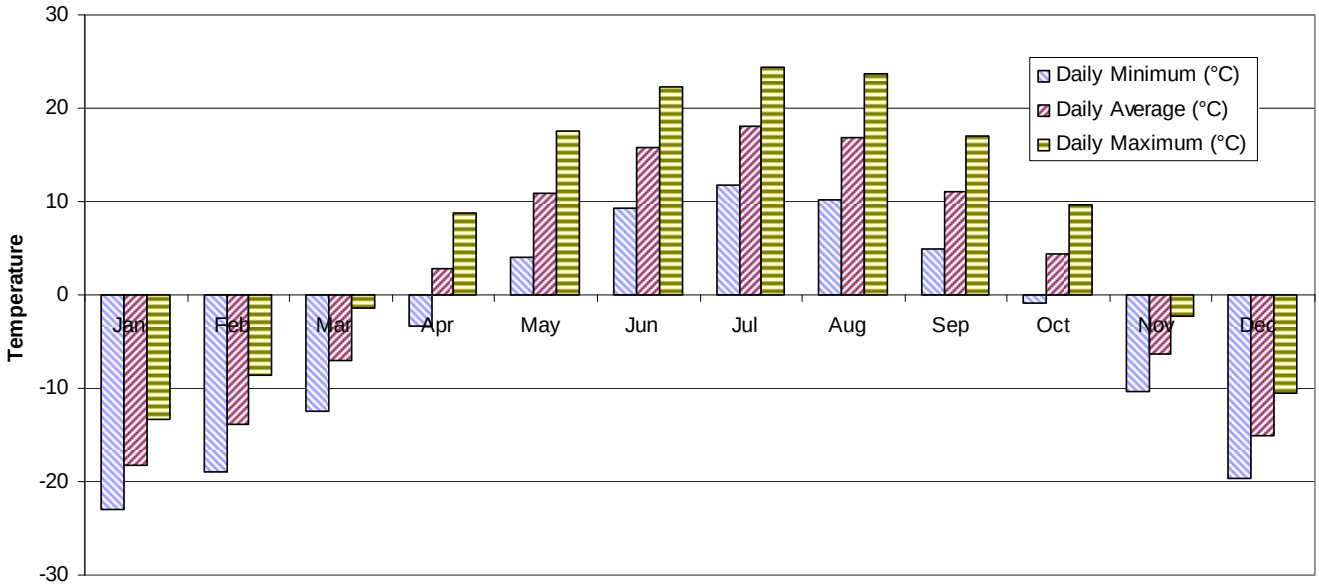

Figure 5: Long-term monthly temperature normals at Swan River.

3. 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.

There are currently four active long-term hydrometric stations in the watershed recording the stage and streamflow of watercourses:

Gauge number	Gauge name	Season
05LE006	Swan River near Minitonas	All year
05LE005	Roaring River near Minitonas	8 months (March – October)
05LE004	Woody River near Bowsman	8 months (March – October)
05LE010	Birch River near Birch River	8 months (March – October)

The locations of the gauges in the watershed are indicated in Figure 6.

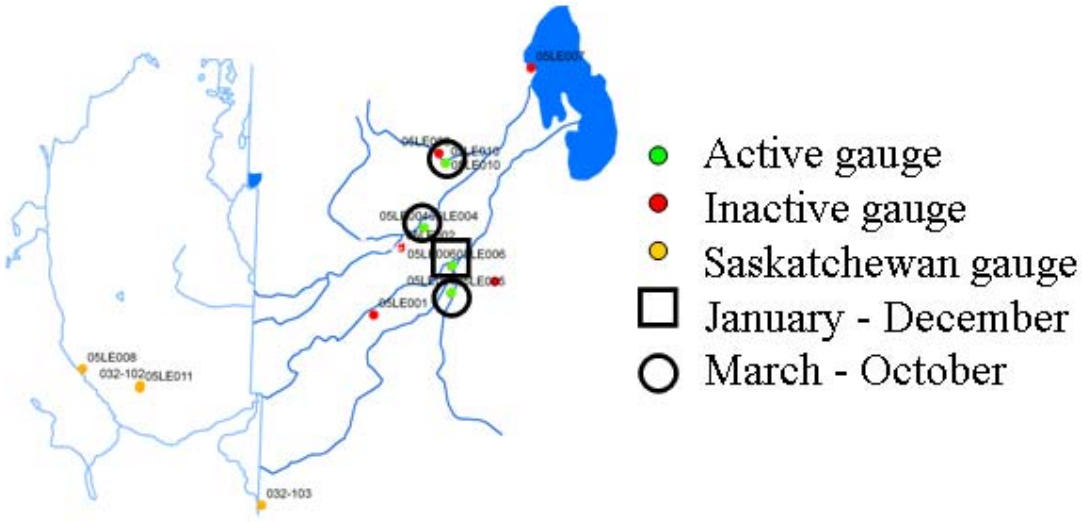

Figure 6: Location of active flow gauges along four water courses in the Swan Lake Watershed

The annual total flows for each station is provided in Figure 7 (Swan River), Figure 8 (Roaring River), Figure 9 (Woody River) and Figure 10 (Birch River). The monthly distribution of the total annual flows averaged over the data time period is provided in Figure 11 for each station.

The surface water supply throughout the year is also highly variable in the Swan Lake Watershed. The patterns of flow are very similar between the Swan and Woody Rivers. In addition, the proportion of the annual runoff volume occurring in any one month in a tributary stream generally is similar to the runoff proportion in the main river. (An exception to this generality is the Birch River which appears to exhibit a base flow component in the August to October period.)

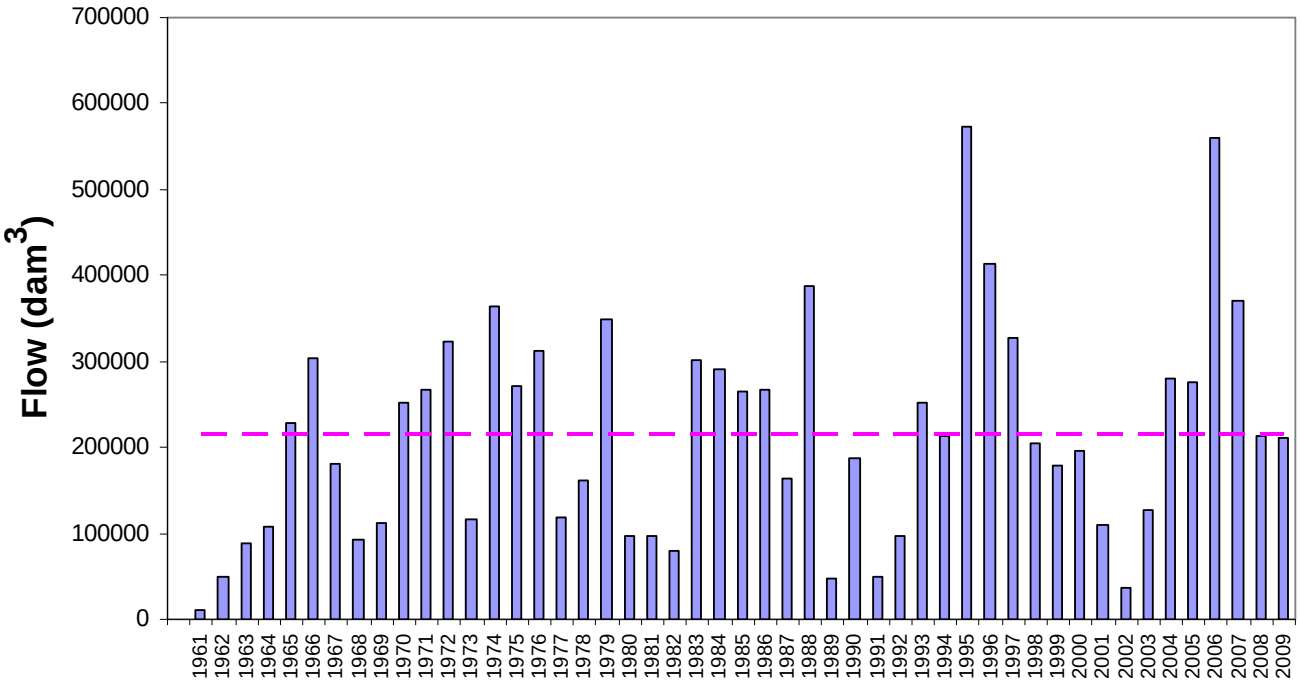

Figure 7: Annual total flows and average flow for the Swan River gauge near Minitonas

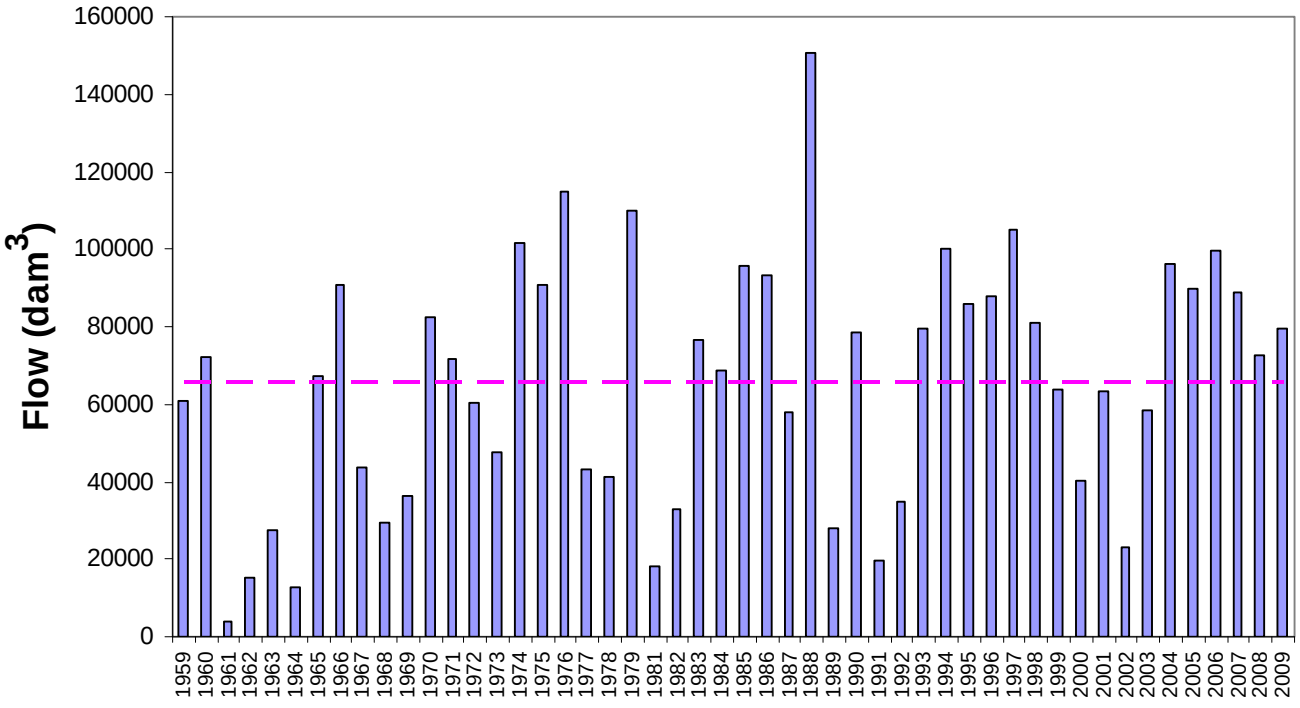

Figure 8: Annual total flows and average flow for the Roaring River gauge near Minitonas

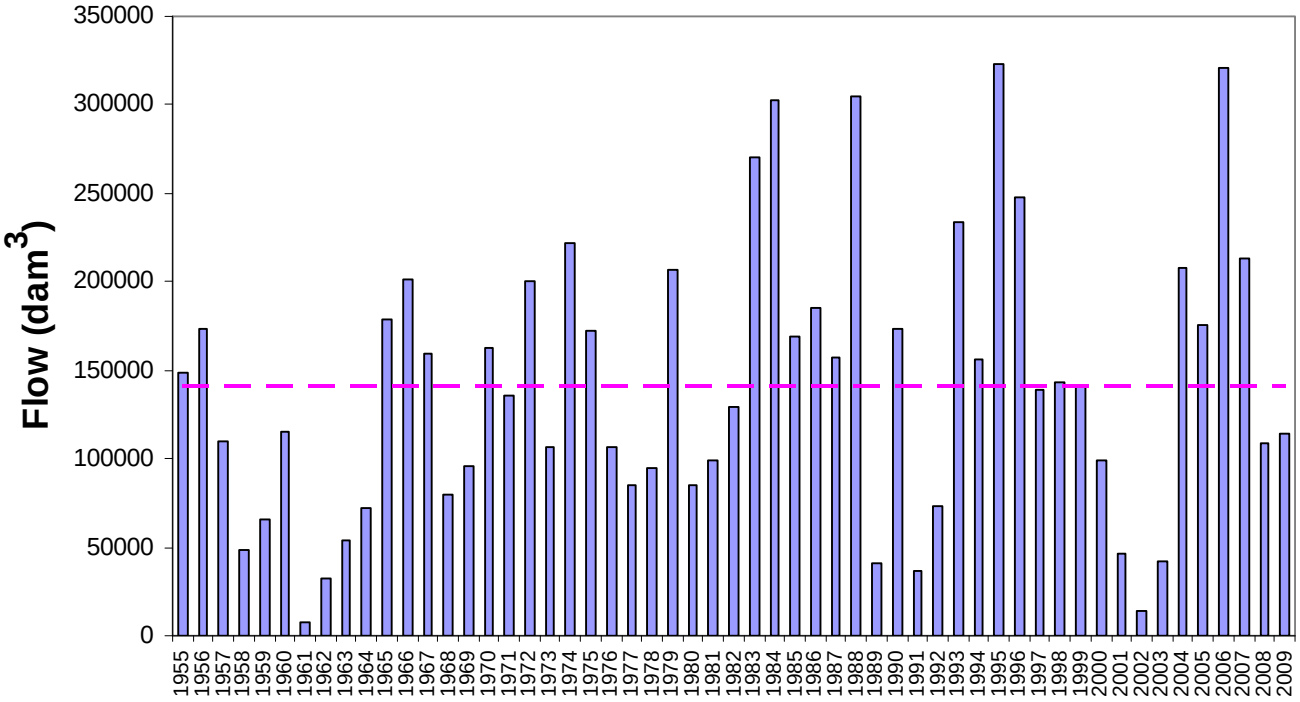

Figure 9: Annual total flows and average flow for the Woody River gauge near Bowsman

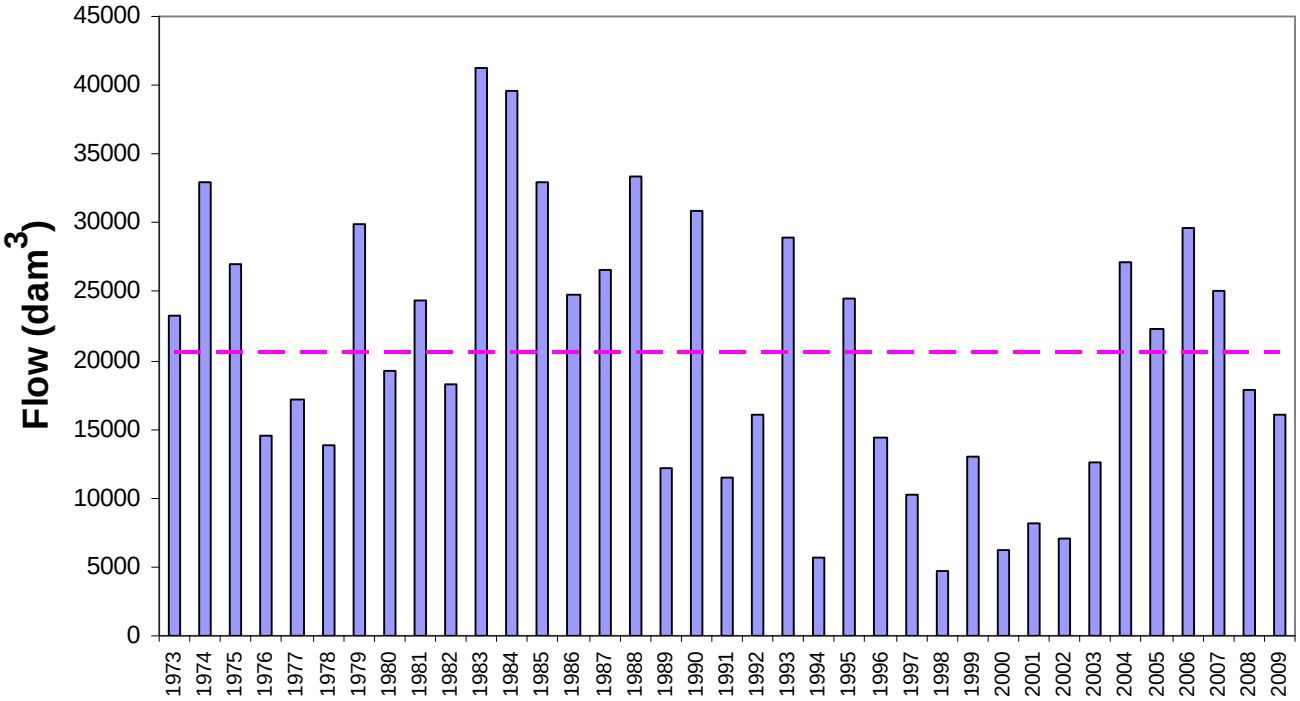

Figure 10: Annual total flows and average flow for the Birch River gauge near Birch River

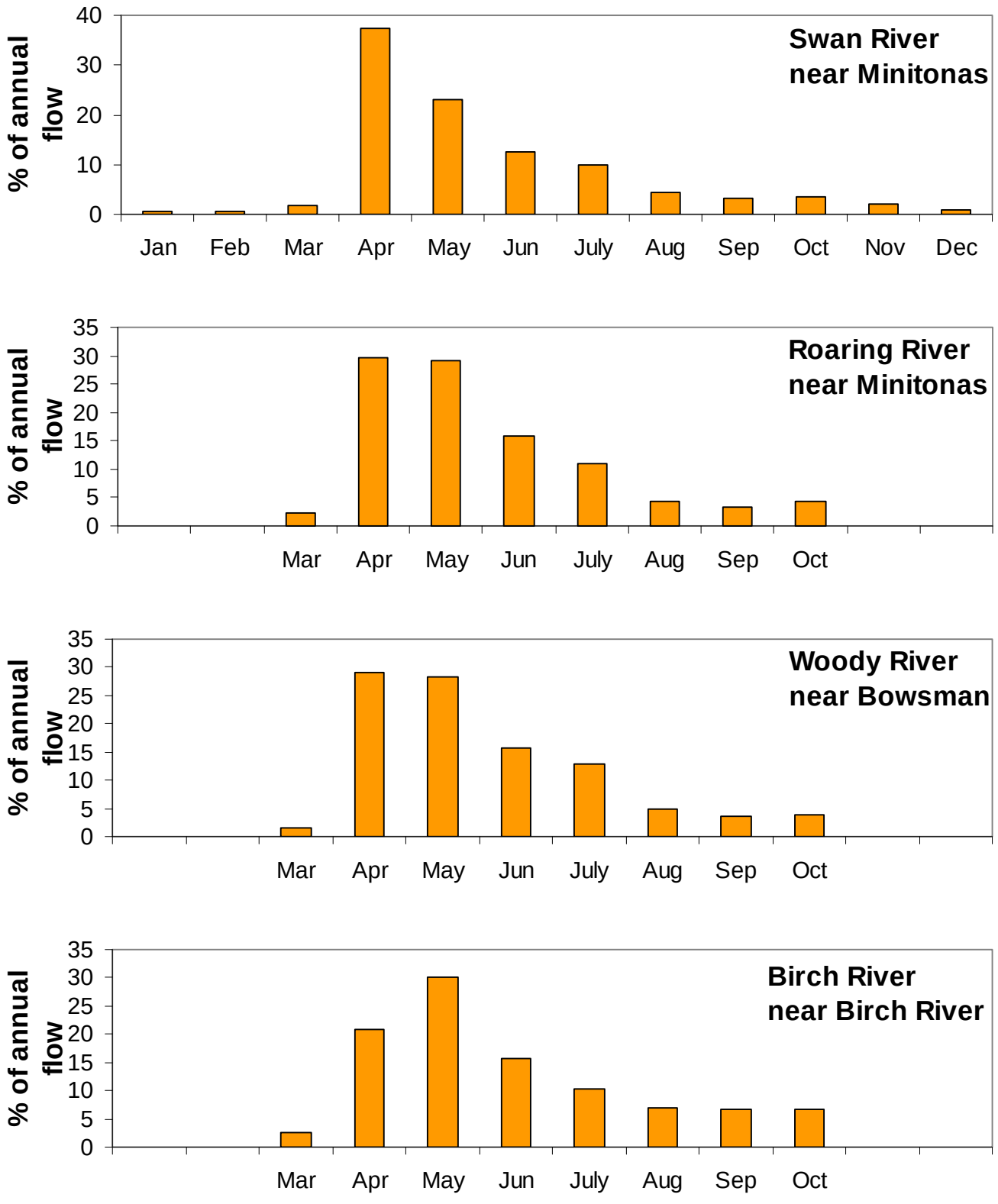

Figure 11: Monthly distribution of total annual flows averaged over the data time period for each gauge

4. Floods

Major flooding events have occurred in the past along the Swan River, three of which have been analyzed here in greater detail. The events occurred during the spring runoff of the years 1988, 1995 and 2006. The precipitation at the boggy Creek meteorological station (location shown in Figure 2) during those floods are highlighted in Figure 12.

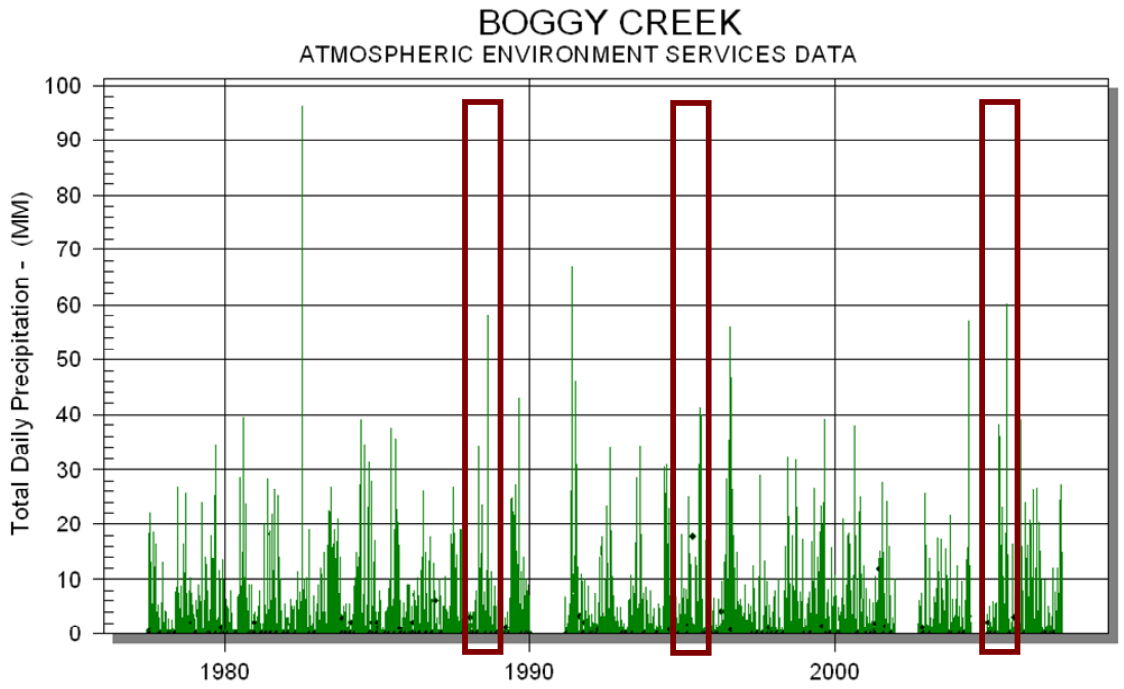

Figure 12: Daily precipitation at the Boggy Creek meteorological station

The daily discharges at Swan River for these flood years are superimposed in Figure 13. Usually a hydrograph peak occurs from the spring freshet at the beginning of April. The 1988 flood period has two peaks, one at the beginning and the other at the end of March. The first is from the snowmelt freshet and the second is due to a late April snowstorm coupled with a major rainfall. Major over-winter snow accumulation coupled with an average melt rate produced a near record peak flow in 1995.

Flow typically peaks during spring runoff in March to May, declines steadily during June, July and August and slowly declines through the autumn. On average, flow in the spring months of March, April and May account for about 60% of the total yearly volume. The summer months (June to August) account for about 30%.

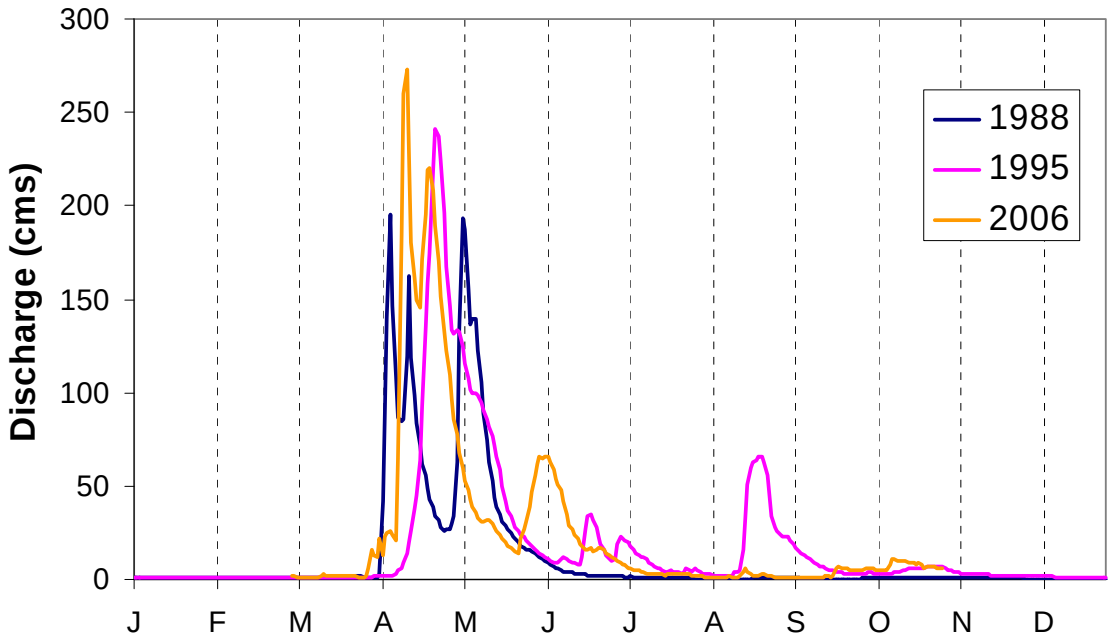

Figure 13: Daily discharges at the Swan River gauge emphasizing spring flooding

5. Water supply and licensed allocations

Figure 14 shows graphs of yearly total municipal water withdrawals for the towns of Benito, Birch River, Bowsman, Minitonas and Swan River. The abstractions at Swan River are an order of magnitude large than at the other locations, hence their values are plotted on a separate graph for Swan River. Throughout the 2000s, most abstractions have reached or are approaching a plateau. There are some large decreases in the abstraction values for 2000 and 2001 at the towns of Minitonas and Bowsman, but the values follow their plateau again for the years thereafter. These withdrawals are three orders of magnitude less than the water production at each studied river gauge (see Figure 15).

Approved license allocations in the Manitoba portion of the watershed are given in Table 1. These maximum allowable water abstractions are overshadowed by the rivers' water production by two to four orders of magnitude.

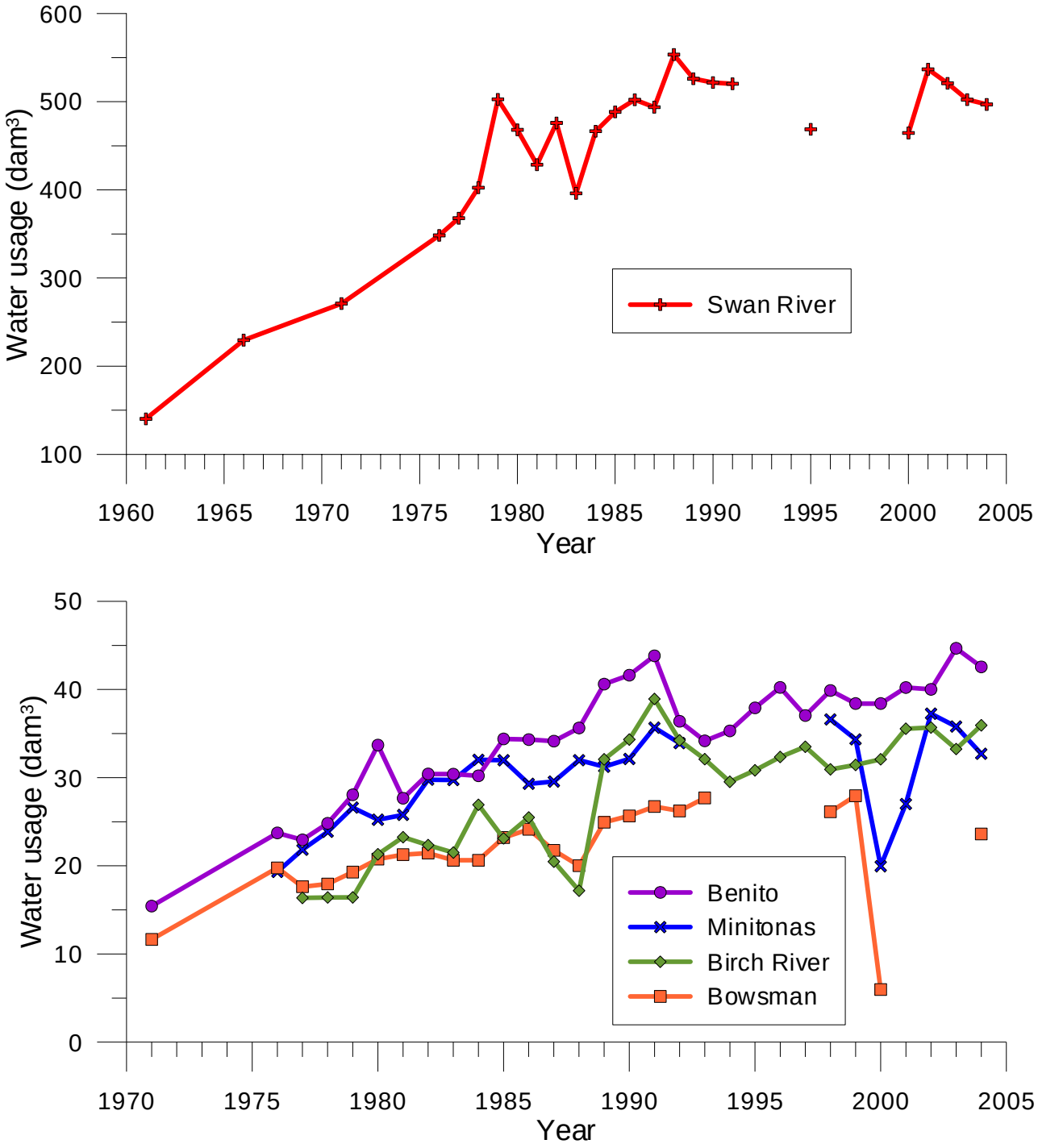

Figure 14: Municipal water abstractions at Benito, Birch River, Bowsman, Minitonas and Swan River

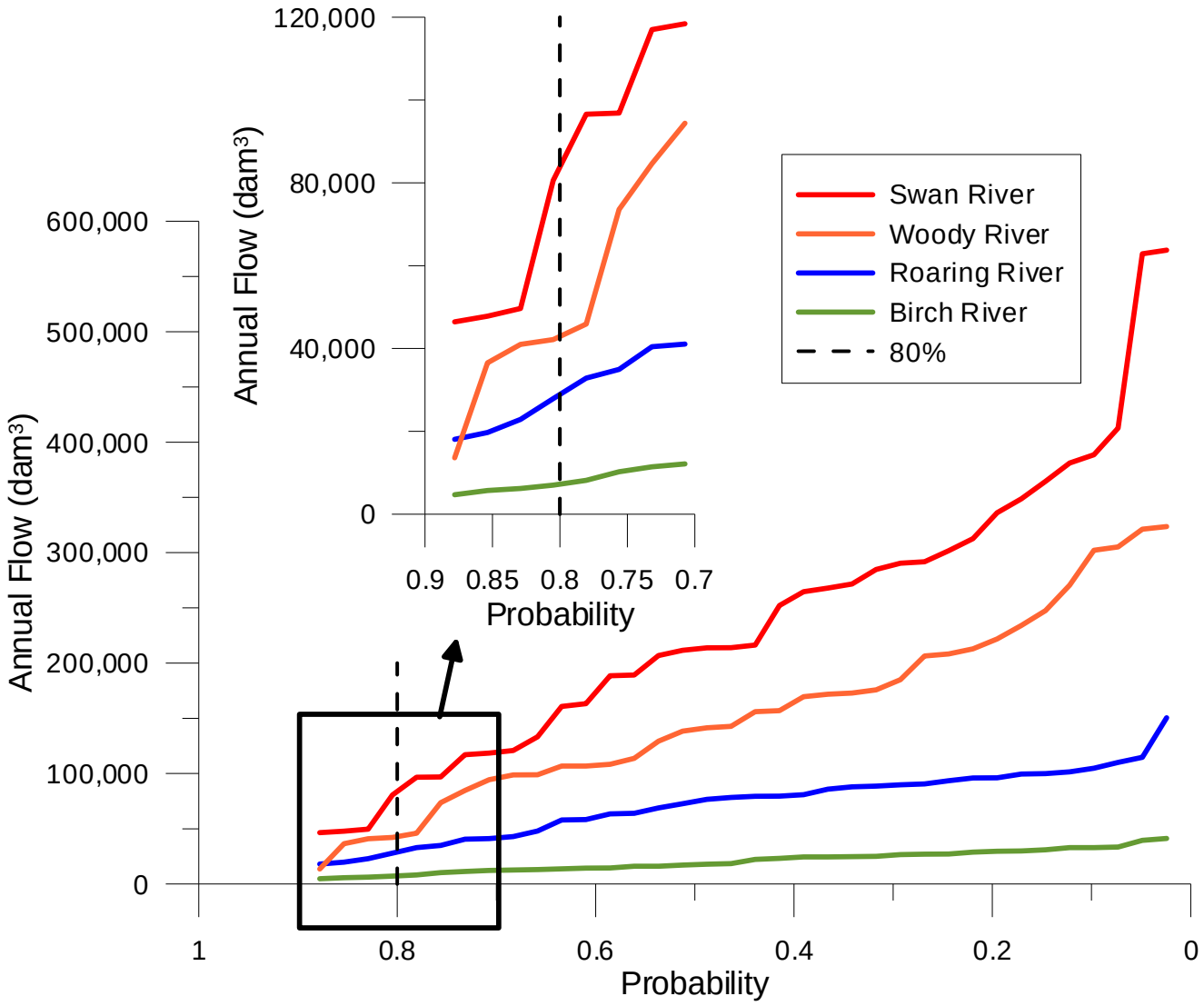

Figure 15: Flow duration curves at the gauges on Swan, Roaring, Woody and Birch rivers for the time series 1973 – 2009. Water production is taken to be the flows that are not exceeded 80% of the time.

Table 1: Approved license allocation

PROJECT ID	X	Y	WATER SOURCE	USAGE	FULL LOCATION	LICENSE NO	EXPIRY DATE	MAX ANNUAL FLOW (acre-ft)	MAX ANNUAL FLOW (dam^3)
2037	374534	5822328	Woody River	Municipal	--041-24-W-	93-067	06-Dec-2013	54	66.6
2038	383210	5841525	Shoal River & Lake Winnipegosis	Municipal	--043-23-W-	93-066	03-Dec-2013	108	133.2
2108	346375	5782197	Avonlea Drain tributary	Irrigation	NW-10-037-27-W-	92-132	01-Dec-2012	6	7.4
3470	332953	5770503	Swan River tributary	Irrigation	SW-05-036-28-W-	63-12	31-Dec-2300	19	23.4
7059	382431	5841554	Lake Winnipegosis	Municipal	--043-23-W-		31-Dec-2300	31.81	39.2
8447	329685	5766792	Swan River	Irrigation	SE-25-035-29-W-	2010-022	16-Apr-2020	12.33	15.2
8792	341261	5774312	Swan River	Irrigation	NW-18-036-27-W-	2009-066	09-Sep-2019	62.91	77.6