DAUPHIN LAKE INTEGRATED WATERSHED MANAGEMENT PLAN

SURFACE WATER HYDROLOGY REPORT[1]

1. General Description

Figure 1 provides a map of the Dauphin Lake River Watershed.

Dauphin Lake is situated ~ 306 km northwest of Winnipeg and ~ 13 km east of the Town of Dauphin. It has a maximum length and width of 41.8 km and 19.3 km, respectively with a surface area of ~ 500 km^2. Normally, its maximum and average depths are 3.66 m and 2.35 m. It has a drainage area of 8417.5 km^2, bounded on the south by Riding Mountain National Park, on the west by the Duck Mountain Provincial Park, and on the east by the divide separating Lake Manitoba and Dauphin Lake.

There are seven major streams draining into Dauphin Lake: Turtle River and Ochre River from the south and Vermillion River, Wilson River, Edwards Creek, Valley River and Mink River from the west, and no major streams from the east. The first five major streams originate in the Riding Mountains, the last two major streams in the Duck Mountains. These major streams account for approximately 80 % of the total drainage area. Approximately 23 % of the total drainage area is located in the Riding and Duck Mountains. The streams draining from the Riding Mountains and Duck Mountains originate at elevations of approximately 823 m and 671 m a.s.l. respectively and fall to an elevation of 260.6 m a.s.l. at Dauphin Lake.

The waters flow out of Dauphin Lake through the Mossy River to Lake Winnipegosis, a distance of 35.4 km with a drop in elevation of approximately 8.2 m.

[1] Excepts for some sections have been taken from various reports (see bibliography)

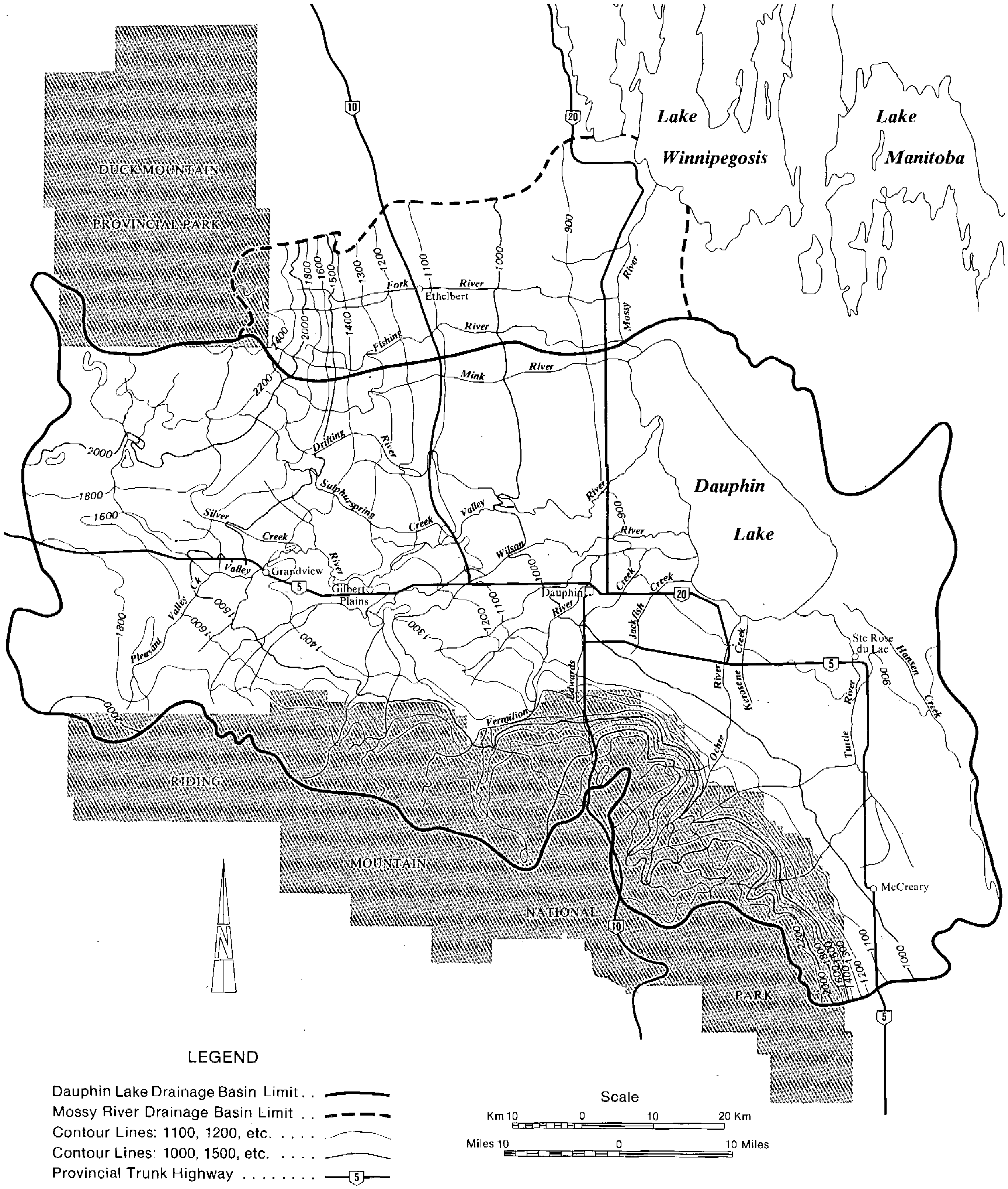


Figure 1: Dauphin Lake Watershed

2. Climate

Climatic conditions within the basin differ appreciably depending on the elevation. Precipitation is generally about 5 cm higher on the eastern slopes of both the Duck and Riding Mountains than for the rest of the region. The mean annual precipitation is slightly over 500 mm of which one-quarter comes from snowfall and the remaining as rain, which is generally from convective weather systems causing localized and intense storm events that can result in local flash flooding. The runoff hydrograph from the spring freshet, too, can occur very suddenly and have very high peaks.

Climate data was extracted from Environment Canada's data base for Dauphin and Gilbert Plains (see Figure 2 for locations). The data series from the Dauphin station is longer but extends only to 2003. The series from Gilbert Plains is included to fill the more recent data gaps. The monthly totals of precipitation, both as rain and as snow, for both stations are provided in Figure 3. Monthly precipitation normals for a 30 year time span (1971 – 2000) are provided in Figure 4. From 1971 to 2000, Dauphin and Gilbert Plains received an annual average of 508 mm and 530 mm of precipitation, respectively. Monthly temperature normals between 1971 and 2000 are provided in Figure 5. The average annual temperatures at Dauphin and Gilbert Plains were respectively 2.0°C and 1.4°C.

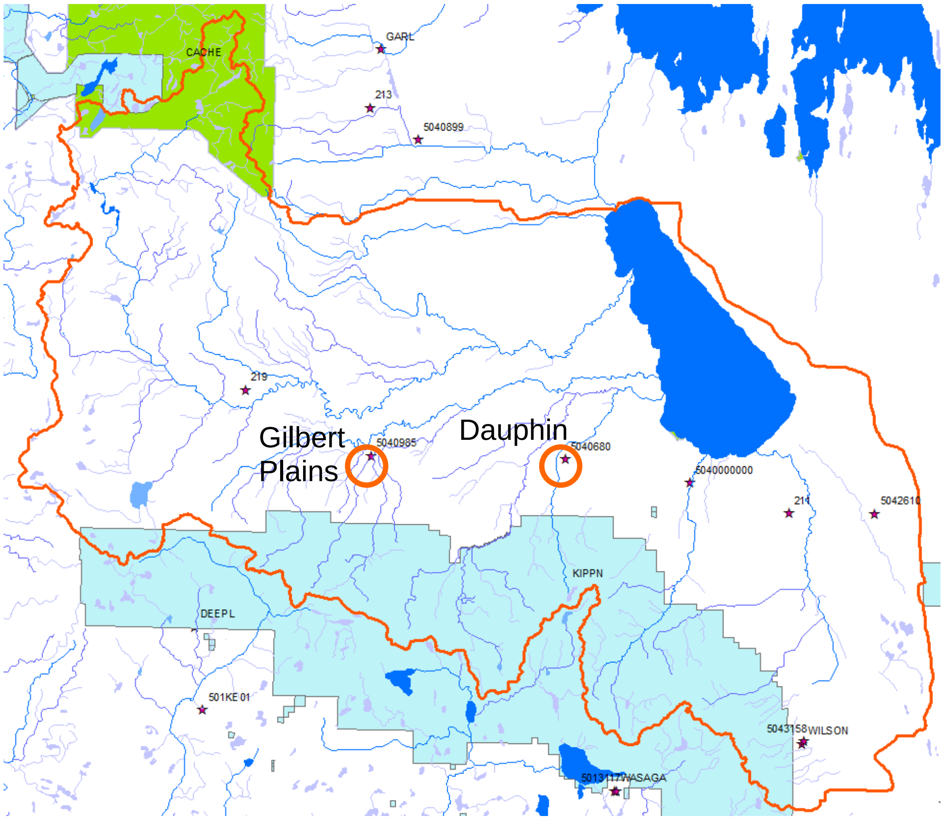
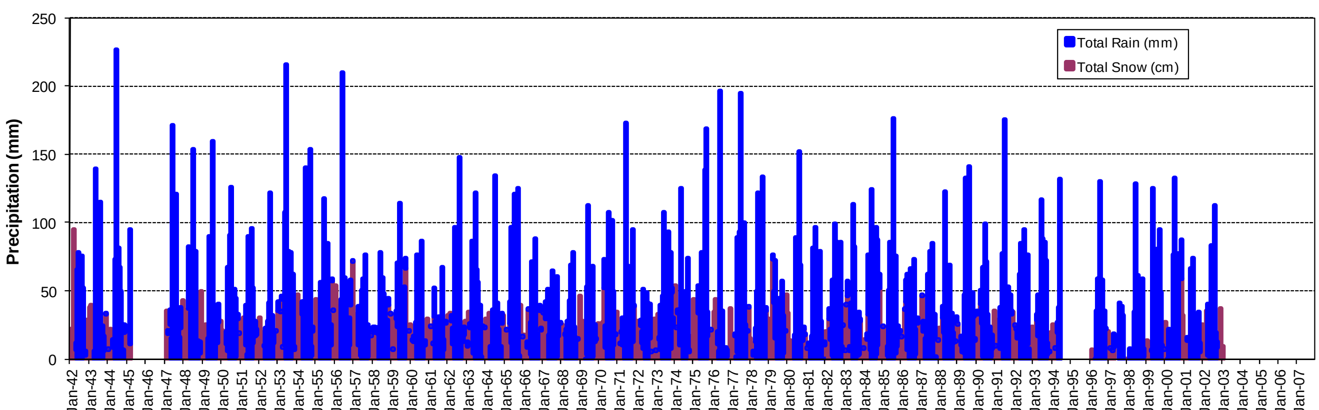


Figure 2: Location of meteorological stations. Those used for this study are encircled.

Dauphin (1942 – 2003):



Gilbert Plains (1959 – 2007):

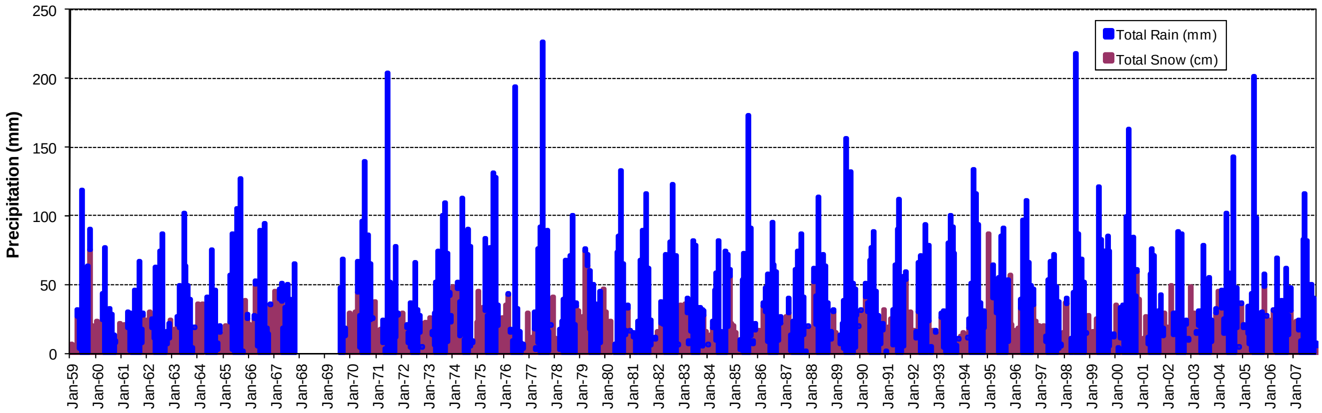
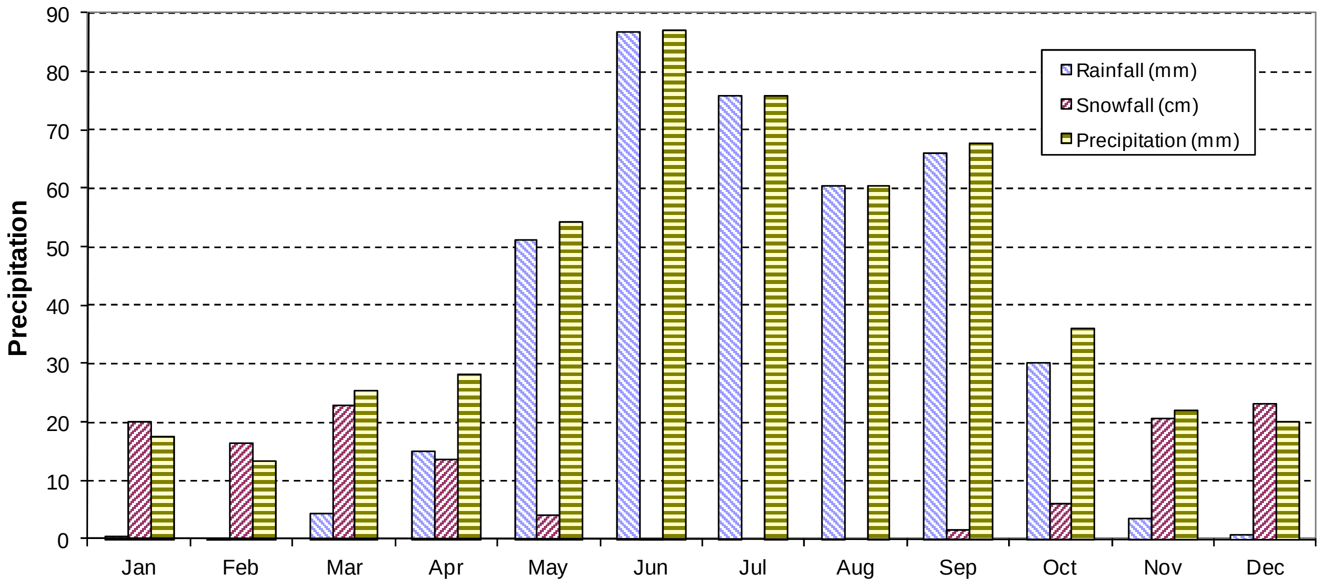


Figure 3: Monthly precipitation totals

Dauphin:



Gilbert Plains:

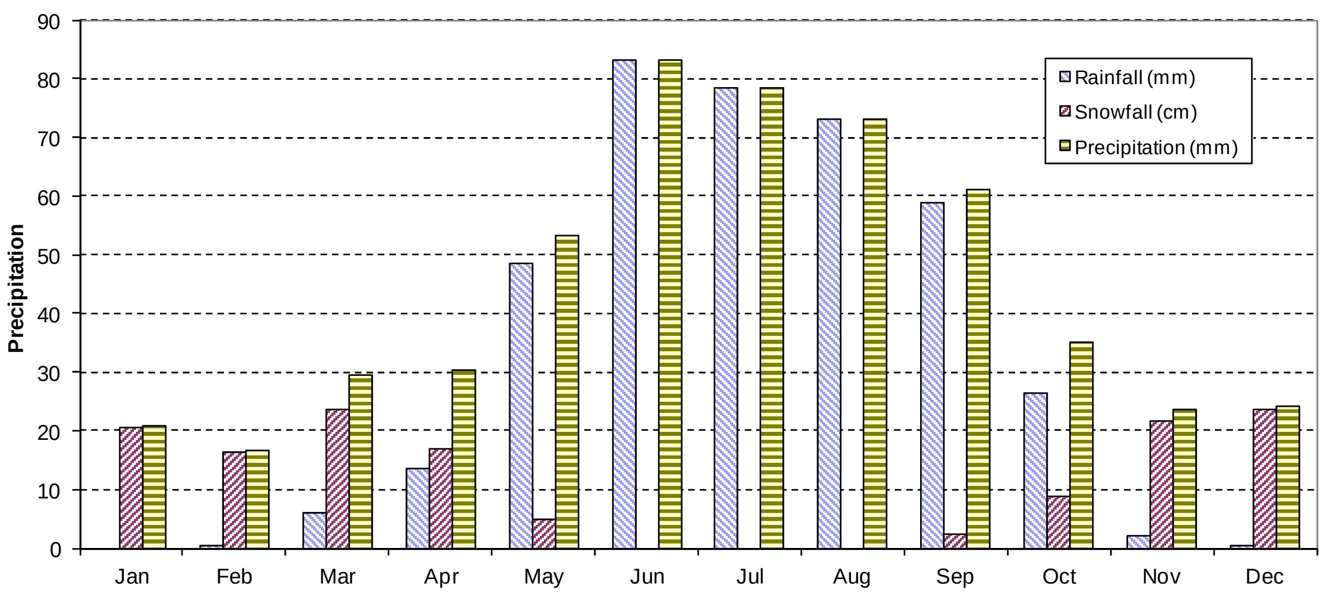
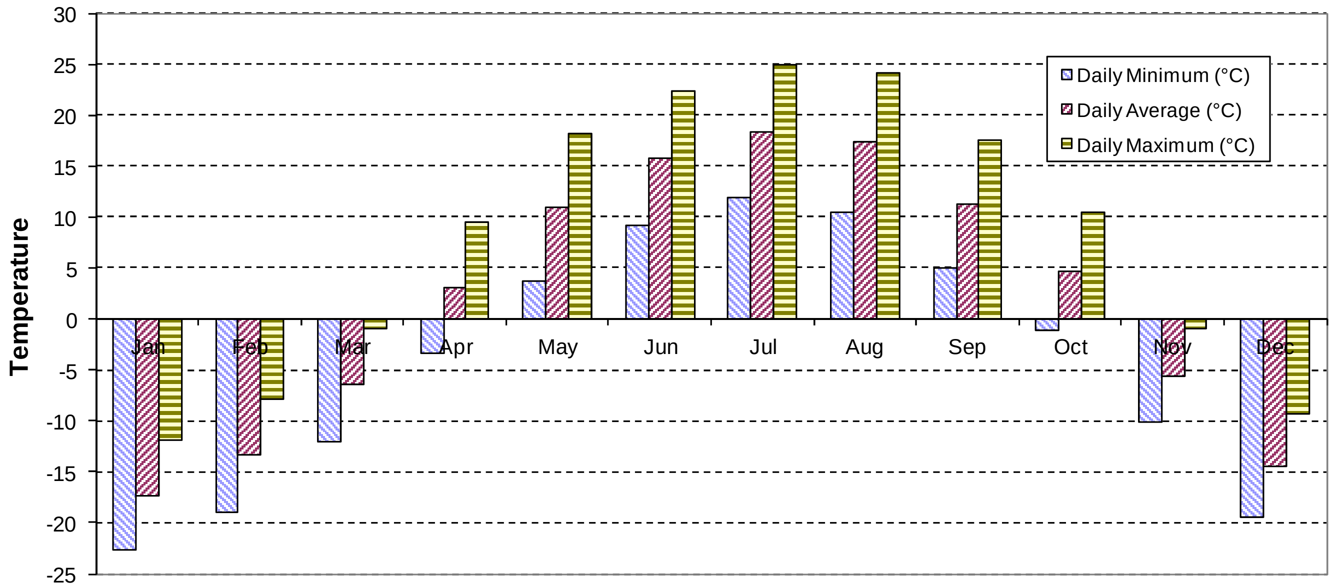


Figure 4: Long-term monthly precipitation normals

Dauphin:



Gilbert Plains:

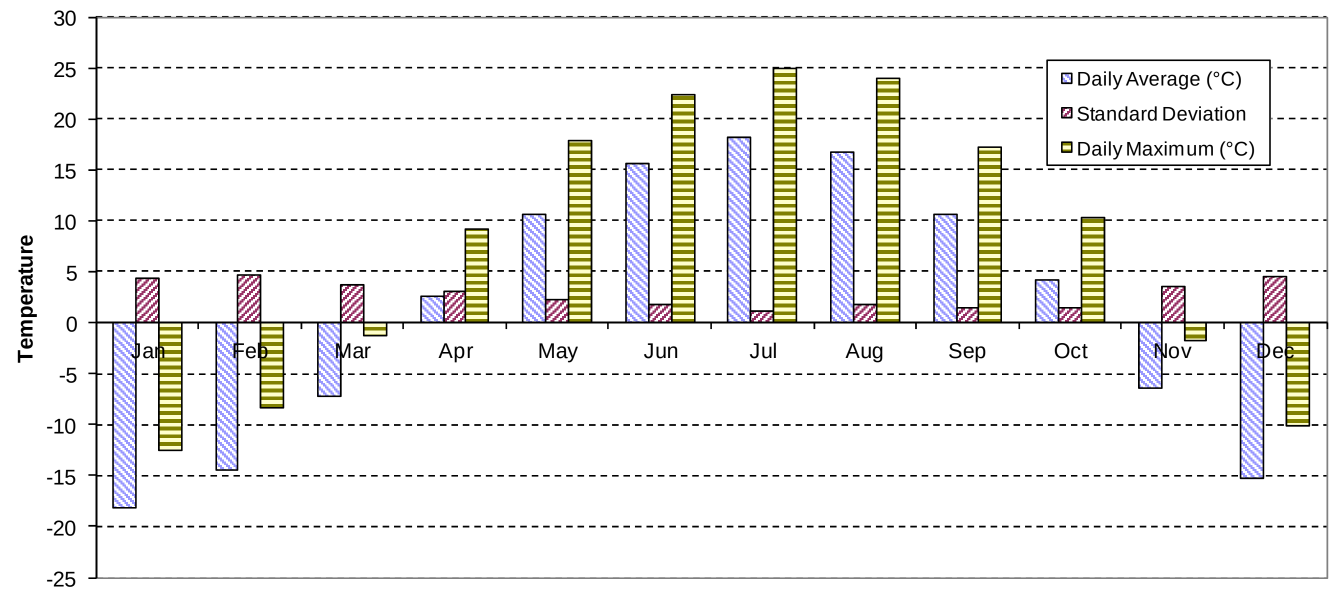


Figure 5: Long-term monthly temperature normals

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.

An overview of selected flow gauges within the basin is provided in Table 1. The extent of available data and the months of operation are also provided in the table. The locations of the gauges are provided in Figure 6.

Table 1: Selected gauges from the Dauphin Lake Watershed

Gauge number	**Gauge name**	**Season**	**Series**
05LJ005	Ochre River at Ochre River	8 months (March – October)	1956 – 2011
05LJ007	Turtle River near Laurier	8 months (March – October)	1956 – 2011
05LJ010	Valley River near Dauphin	8 months (March – October)	1957 – 2011
05LJ012	Vermillion River near Dauphin	8 months (March – October)	1956 – 2011
05LJ019	Mink Creek near Ethelbert	8 months (March – October)	1956 – 1993 2010 – 2011
05LJ045	Wilson River near Ashville	8 months (March – October)	1979 – 2004 2006 – 2011
	Edwards Creek	*not active since 1994*	

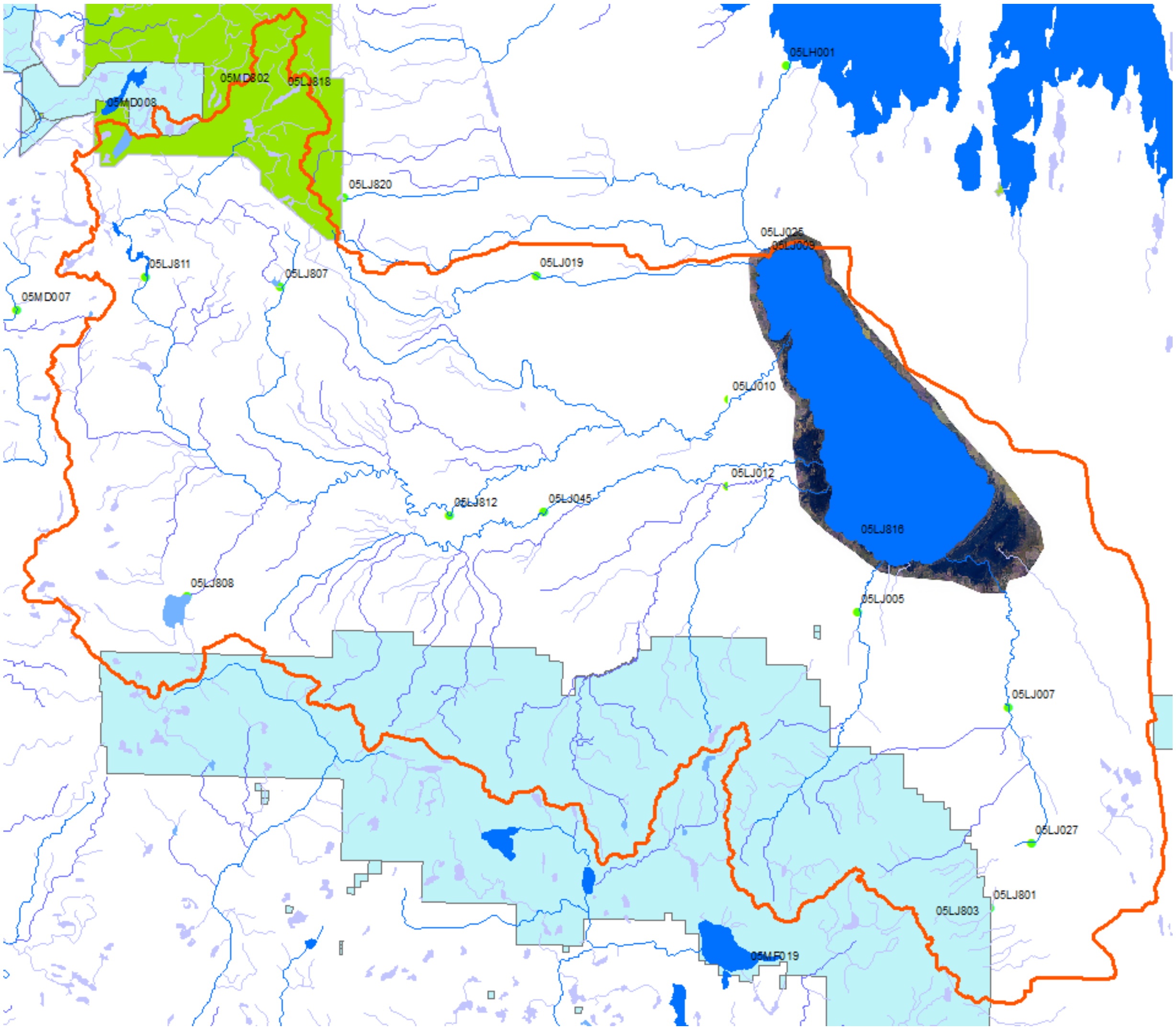
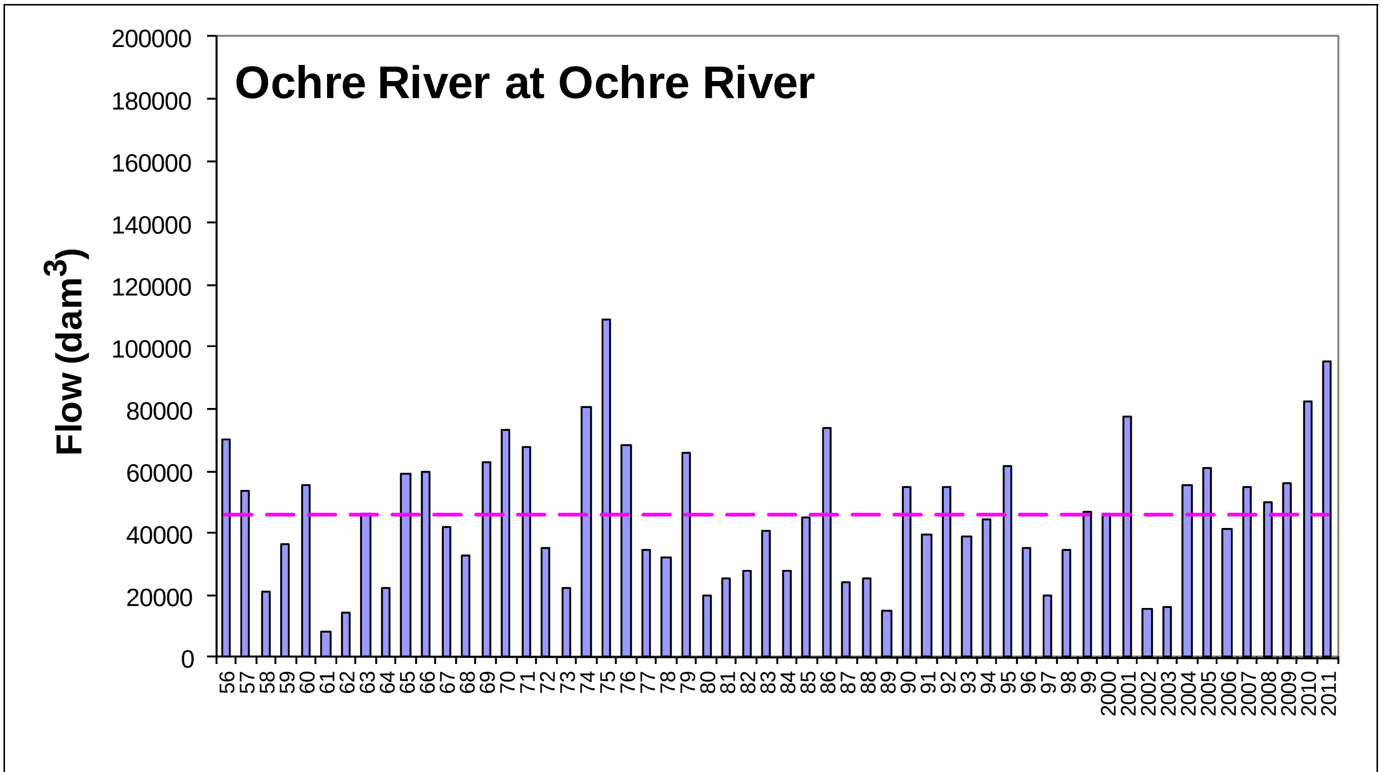
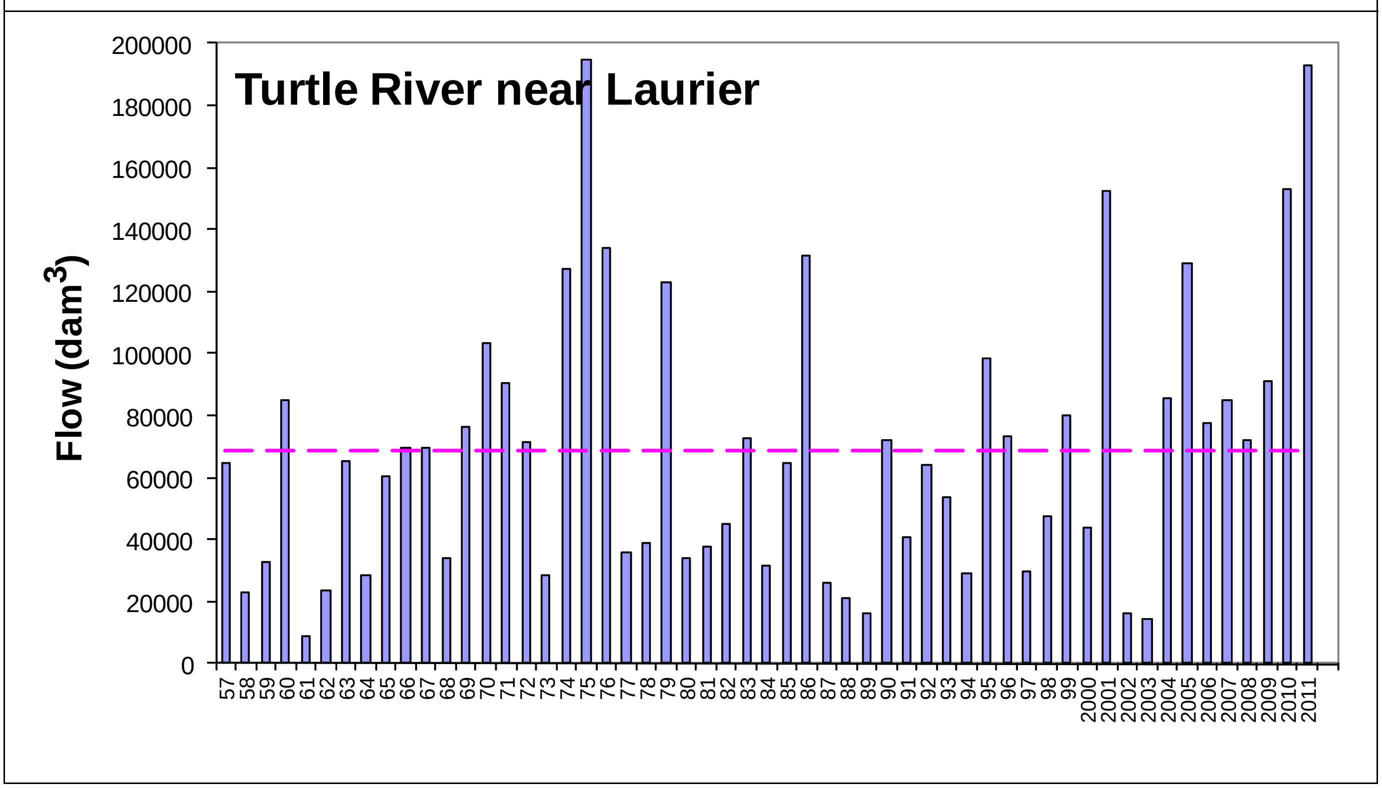
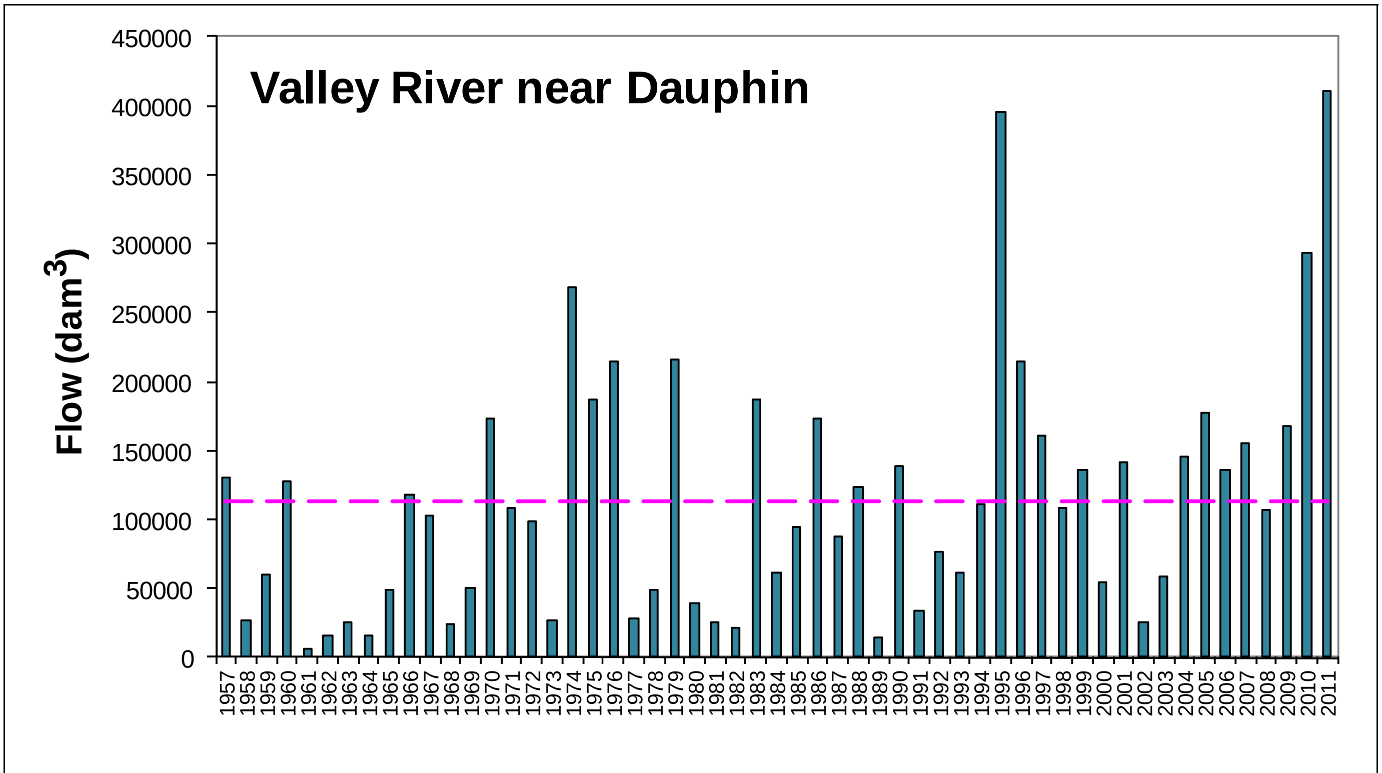


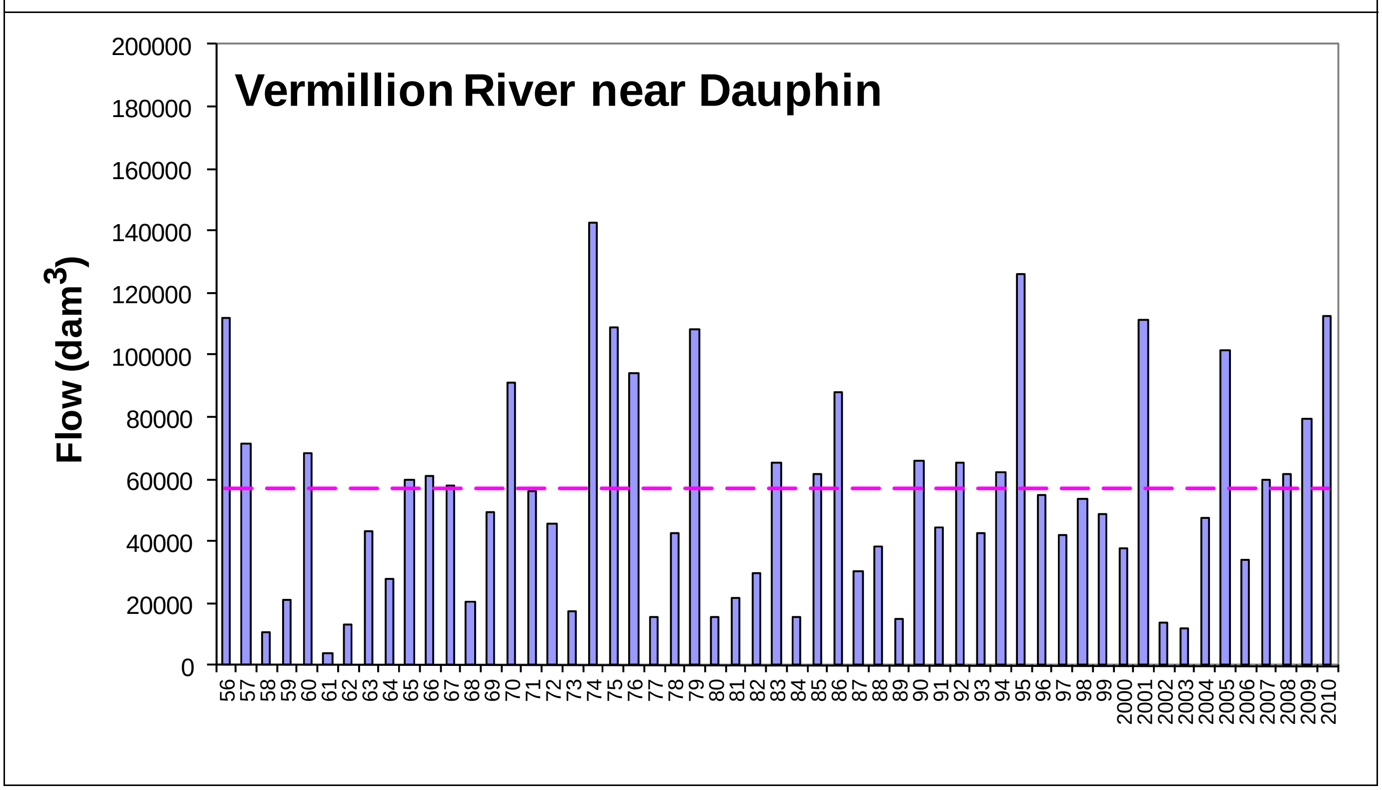
Figure 6: Dauphin Lake watershed with active stream gauges (green dots)

The annual total flows and the average flow for each of the gauges is presented in Figure 7. The monthly distribution of the total annual flows averaged over the data time period is provided in Figure 8 for each station. The majority of the annual flow discharges (≈ 60%) during the spring freshet in the months of April and May.


Ochre River at Ochre River
Flow (dam3)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011


Turtle River near Laurier
Flow (dam3)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011


Valley River near Dauphin
Flow (dam3)


Vermillion River near Dauphin
Flow (dam3)

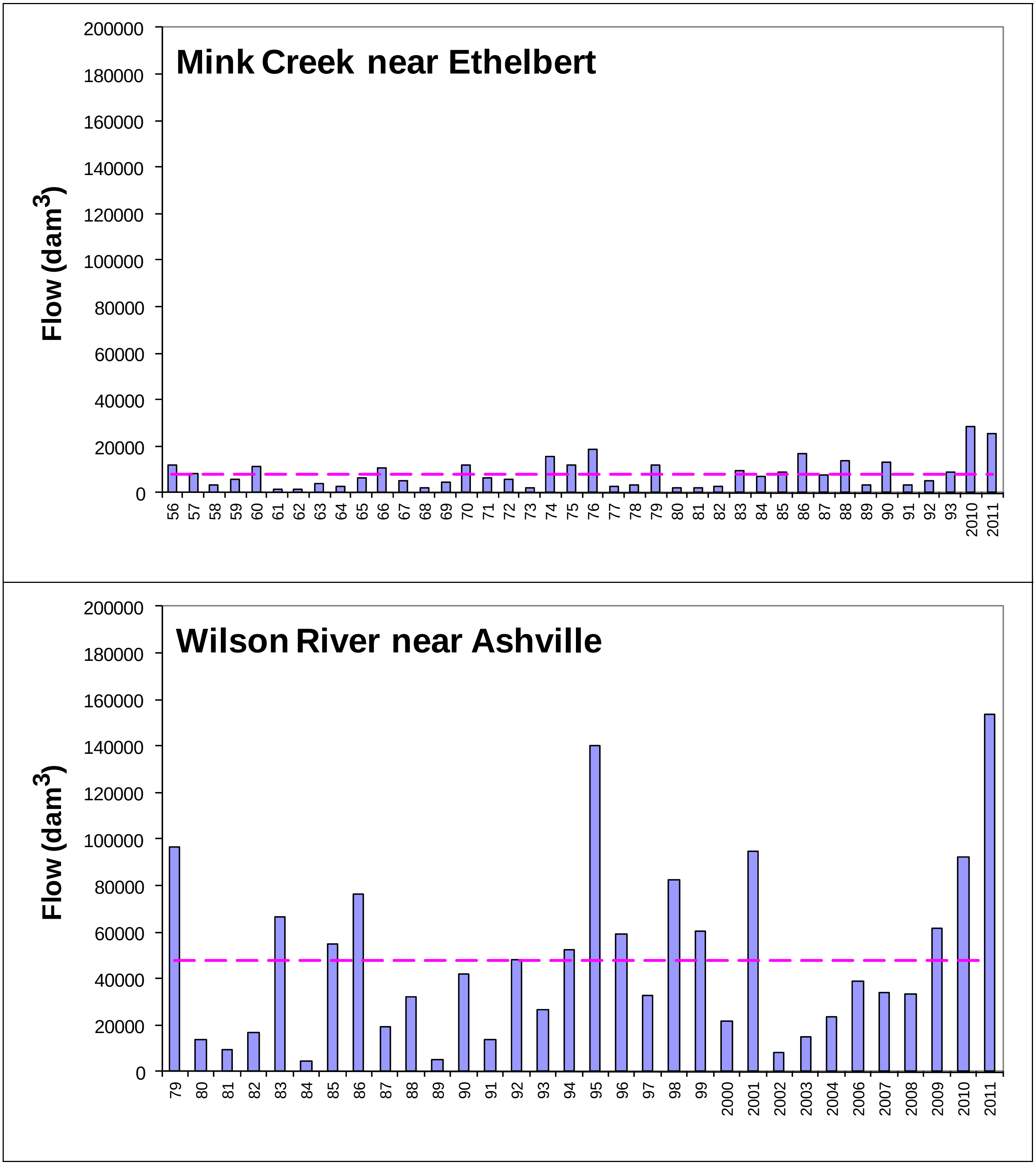
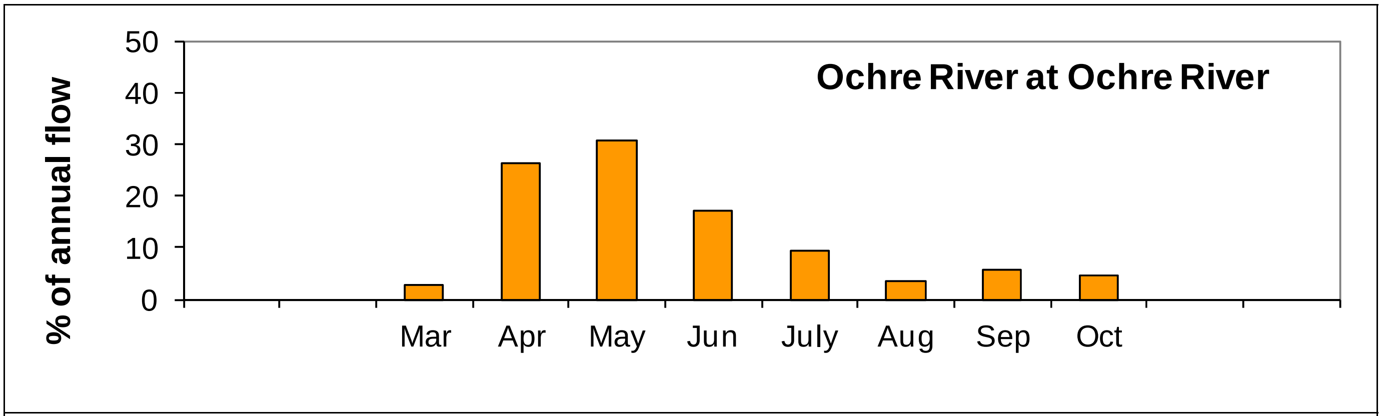
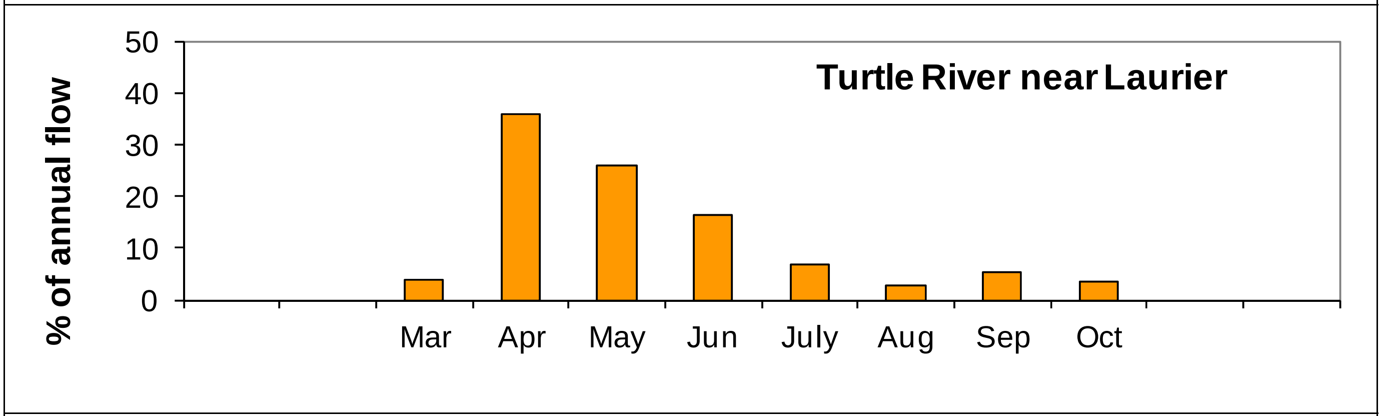
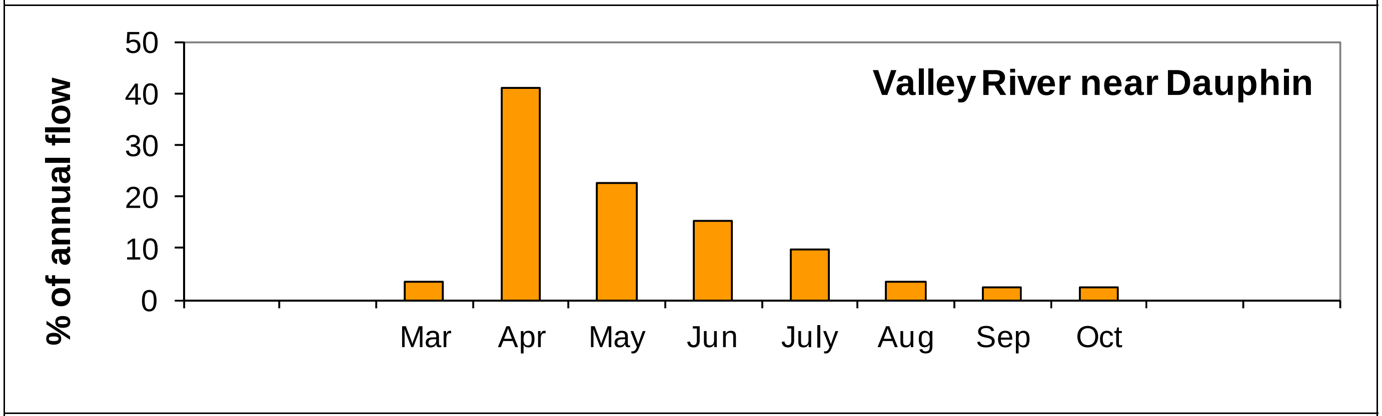
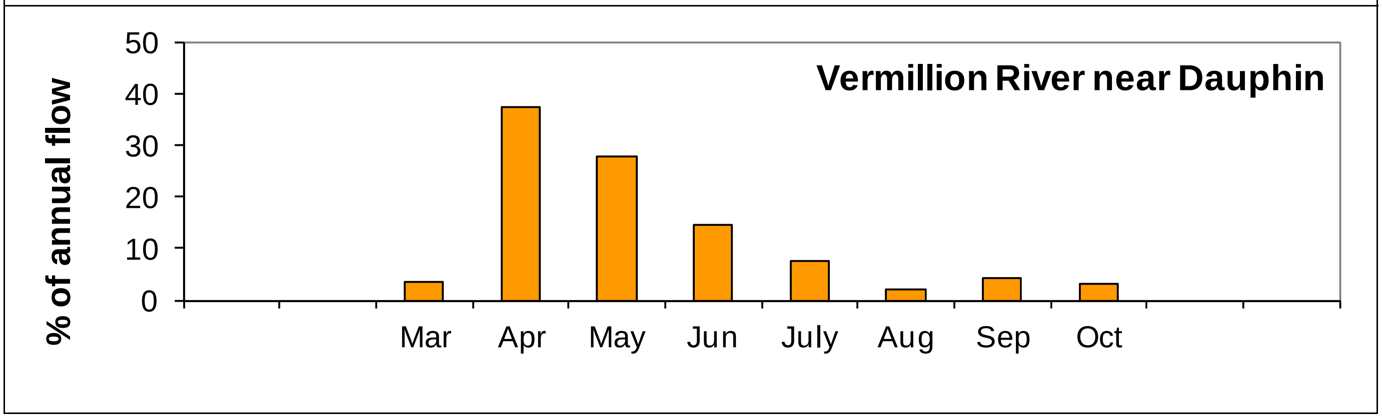


Figure 7: Annual total flows and average flows of selected stream gauges in the Dauphin Lake watershed


Ochre River at Ochre River
% of annual flow
0
10
20
30
40
50
Mar
Apr
May
Jun
July
Aug
Sep
Oct


Turtle River near Laurier
% of annual flow
0
10
20
30
40
50
Mar
Apr
May
Jun
July
Aug
Sep
Oct


Valley River near Dauphin
% of annual flow
0
10
20
30
40
50
Mar
Apr
May
Jun
July
Aug
Sep
Oct


Vermillion River near Dauphin
% of annual flow
0
10
20
30
40
50
Mar
Apr
May
Jun
July
Aug
Sep
Oct

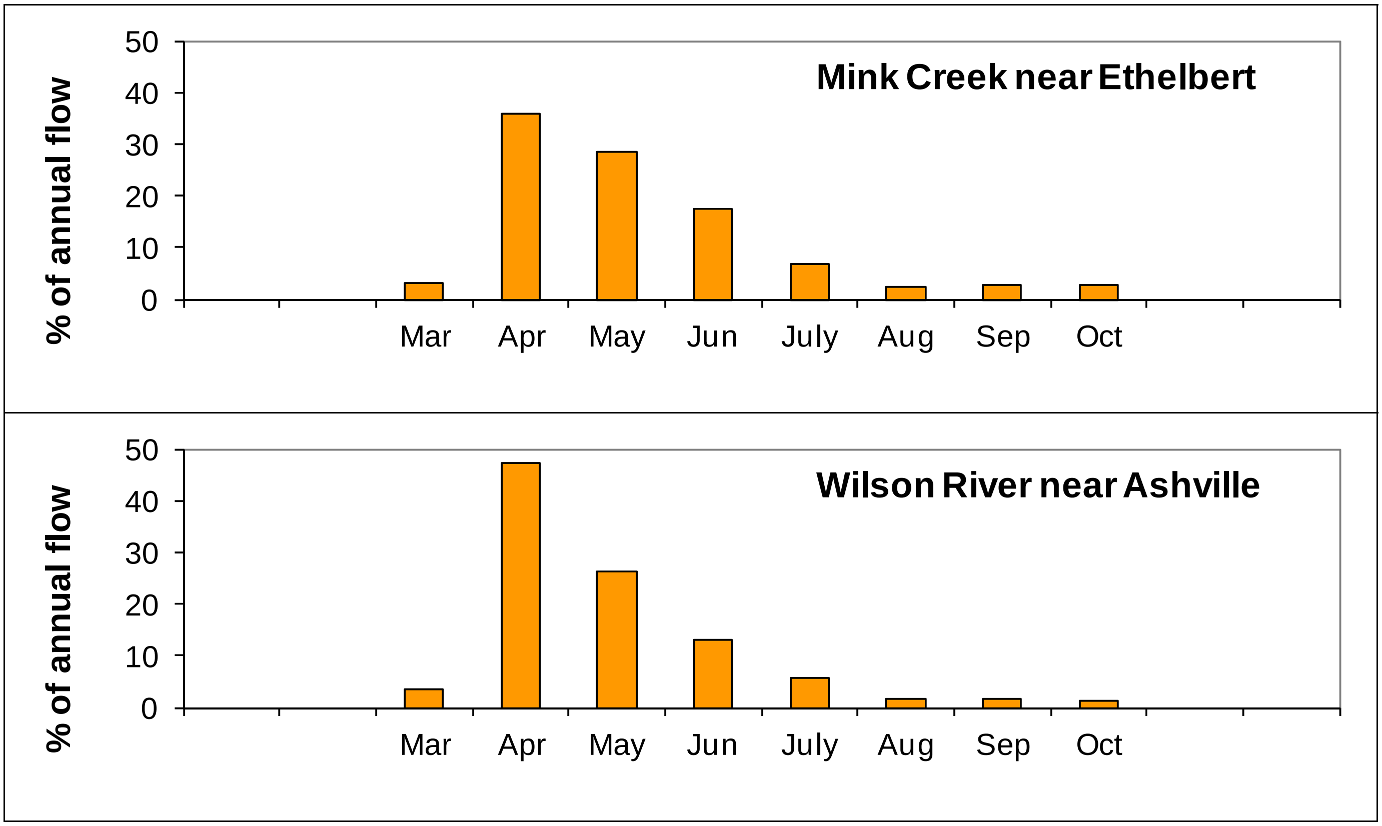


Figure 8: Monthly distribution of total annual flows averaged over the data time period for each gauge

4. Floods

2011 was a record flood year for Dauphin Lake which peaked at 262.351 m a.s.l. (860.73 ft a.s.l.) on June 18th equivalent to ~ 1:110 year flood event (see Figure 9). The second largest peak was 261.942 m a.s.l. (859.39 ft a.s.l.) on 5. June 1974. As in other locations, high antecedent soil moisture of approximately 150% of normal, together with a snow pack in the range 110-130 mm over the Riding Mountains, contributed to an intensive runoff from all tributaries towards Dauphin Lake which only has a limited outflow capacity through Mossy River. As the lake levels were rising, several rain storms followed during May, when 14.3 and 35.4 mm fell on 30. and 31. May, respectively. In combination with strong northerly winds, the latter had devastating impacts on Ochre Beach and other areas around Dauphin Lake. Another 26.8 mm of precipitation fell on 13. June which prolonged the high water levels and increased the peak lake level. Aerial photography was taken on 17. July 2011 along the shores of Dauphin Lake to determine the extent of flooding (see Figure 6).

Because of the extremely high water levels on Lake Manitoba, Dauphin Lake, and Lake Winnipeg, Water Stewardship developed inundation maps for these lakes, and added a wind warning and alert system as part of the regular flood reporting. The latter is being applied to all major lakes in Manitoba.

5. Dauphin Lake Basin Stream Rehabilitation Program (1992 – 1997)

The Dauphin Lake Basin Management Plan (1992) described nutrient and sediment loading to Dauphin Lake as a key environmental problem in the basin. One of the first steps of this plan was to undertake the Dauphin Lake Basin Stream Rehabilitation Study (1992 – 1993). This study classified stream corridors, identified priority sites and described rehabilitation measures and was the basis for planning subsequent nutrient and sediment reduction projects.

Starting in the fall of 1993, sediment and nutrient reduction projects were implemented. Prior to implementing year projects, a planning report was prepared. Project sites were identified and rehabilitation options were discussed with fisheries biologists, landowners and other stakeholders. 19 nutrient reduction projects and 28 sediment reduction projects were initiated. The latter consisted of the construction of 127 riffles and 495 m of shoreline armoring on Dauphin Lake.

The project came to a close in 1997 due to lack of funding. Since that time, no follow-up studies were carried out by the Manitoba Government to assess the effectiveness of the measures that were implemented in the Stream Rehabilitation Program.

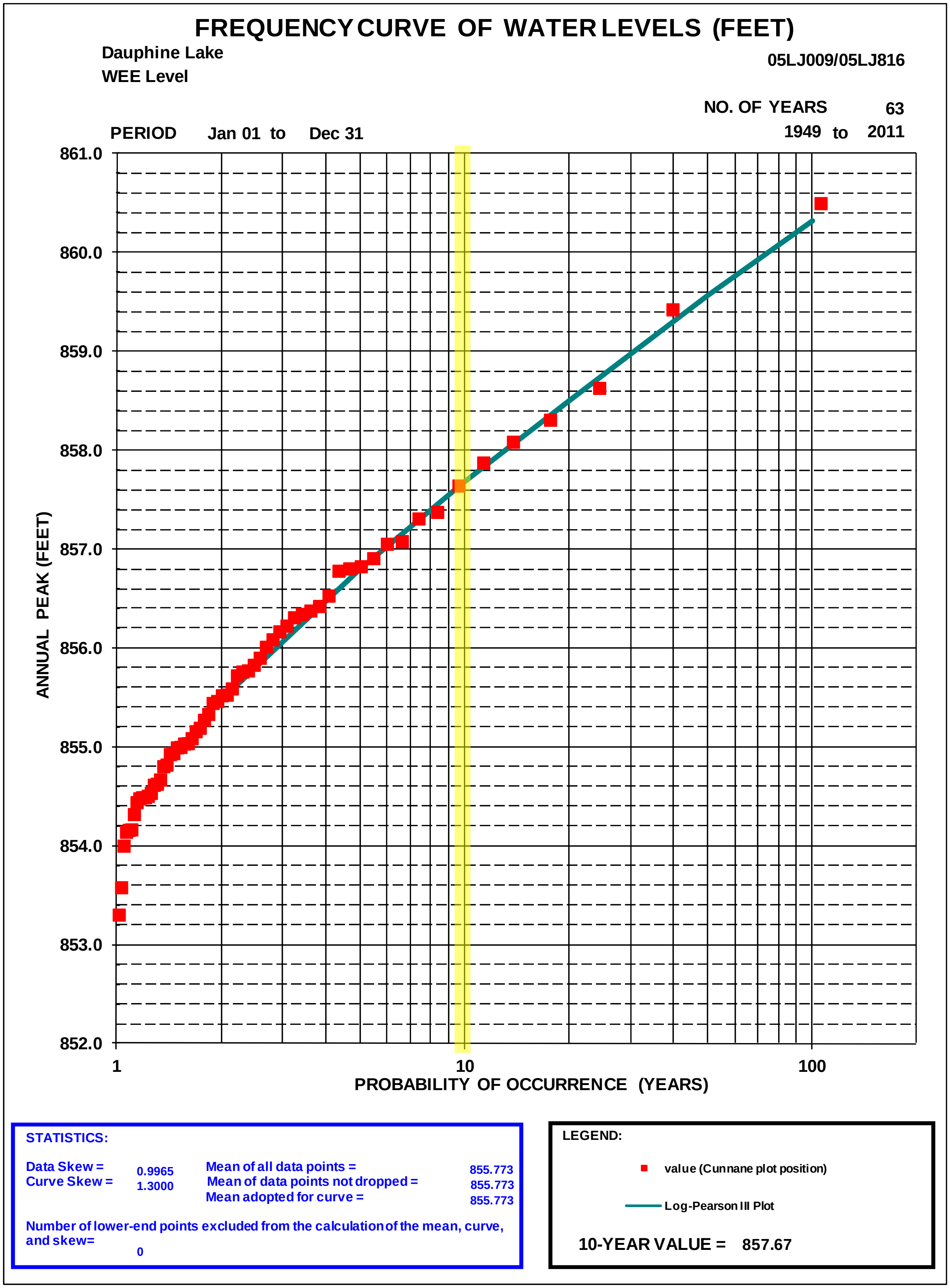


Figure 9: Frequency curve of peak wind-eliminated water levels of Dauphin Lake

6. Bibliography

(1) Dauphin Lake Working Group (1979) Dauphin Lake study proposal. Winnipeg, Manitoba.

(2) Oshoway, R. and Penner, F. (1982) Dauphin Lake Sedimentation Study. Water Resources Branch. Manitoba Department of Natural Resources.

(3) Pokrant, H. and Gaboury, M. (1983) Remote Sensing to Assess to Land Use/Land Cover Changes Affecting the Dauphin Lake Fishery. Government of Manitoba, Surveys and Mapping Branch.

(4) Manitoba Water Commission (1984) Dauphin Lake Regulation and Siltation Study. Manitoba Department of Natural Resources.

(5) Oswald, B (1990) Dauphin Lake Basin Sediment Monitoring 1990. Water Control & Conservation Section. Manitoba Department of Natural Resources.

(6) Oswald, B (1992) Dauphin Lake Basin Sediment Sourcing 1991. Water Control Section. Manitoba Department of Natural Resources.

(7) Ewashko, A. (1994) Year One – Dauphin Lake Basin Stream Rehabilitation Plan Implementation (Technical Report). A. Ewashko Consulting Ltd.

(8) Ewashko, A. (1995) Dauphin Lake Basin Stream Rehabilitation Program 1994-1995. A. Ewashko Consulting Ltd.

(9) Ewashko, A. (1996) Dauphin Lake Basin Advisory Board Stream Rehabilitation Program 1995-1996. A. Ewashko Consulting Ltd.

(10) Ewashko, A. (1997) Dauphin Lake Basin Advisory Board Stream Rehabilitation Program 1992-1997 Summary Report. A. Ewashko Consulting Ltd.

(11) Lockhart, T.E. (2000) Water management issues in the Turtle River Watershed CoThesisnservation District: from theory to practice. Master Thesis submitted to the University of Manitoba. http://hdl.handle.net/1993/2651

(12) Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration, Prairies East Region. (2004) Summary of Resources and Land Use Issues Related to Riparian Areas in the West Dauphin Lake Watershed Study Area. Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration, Winnipeg.