

## **19. Appendix 3**

**Derivation of summer hydrographs at Walhalla**

**(from Manitoba Conservation Water Stewardship)**



## Memorandum

---

**DATE:** March 31, 2011

**TO:** R. W. Harrison, P. Eng.  
Manager Surface Water Management  
Water Science and Management Branch  
Manitoba Water Stewardship

**FROM:** Bin Luo, P. Eng.  
Hydrologist  
Surface Water Management Section  
Manitoba Water Stewardship

**PHONE NO.:**

**File No.:** 5.5.1

**SUBJECT:** Summer Design Flood Hydrograph - Pembina River at Walhalla

---

This memo is in response to your request for summertime design flood hydrographs at the location of the Pembina River at Walhalla (05099600). Summertime is defined as the period from May 1<sup>st</sup> to September 30<sup>th</sup> during which peak flows are generated from rainfall events.

Table 1 lists the time series of annual maximum instantaneous summertime discharge and the corresponding storm volume which were calculated from recorded flow using USGS data. A correlation between the annual maximum summertime instantaneous discharge and the corresponding storm volume was developed, as shown in Figure 1. The correlation, with a correlation coefficient of 0.778, was used to calculate the storm volume for each instantaneous summertime design discharge under a given return period.

The calculation of summertime design discharges for the Pembina River at Walhalla is documented in the memo entitled "Instantaneous Summer Design Discharges - Pembina River at Walhalla, Manitoba Water Stewardship, 2011" from Bin Luo to Bob Harrison dated February 15, 2011. Table 2 shows the calculated storm volumes under different return periods of summertime design discharges.

Dimensionless unit hydrographs for the Pembina River at Walhalla were derived for 2004, 2005, 2007, and 2009 summertime peak discharge storm events, which were further used to design a final dimensionless unit hydrograph as shown in Figure 2.

The summertime design flood hydrographs for the Pembina River at Walhalla were obtained for return periods of 5, 10, 20, and 50 years, by applying the designed dimensionless unit hydrograph to each corresponding design discharge and associated storm volume. Figure 3 shows the resulting design flood hydrographs with the values listed in the attached Excel file as Table 3.

*Original Signed By*

BIN LUO, P. Eng.

Attachment  
cc: Duane Kelln

Table 1. Pembina River at Walhalla Summer Peak Flow

Date	Instantaneous Discharge (cfs)	Flow Volume (ac-ft)
1940-08-01	58	518
1941-09-04	1182	5534
1942-08-01	568	2930
1943-06-04	1206	13718
1944-08-04	1511	100427
1945-07-20	476	6877
1946-07-10	109	815
1947-08-17	1216	7644
1948-07-03	640	5849
1949-06-02	1230	15924
1950-07-15	1122	9535
1951-06-03	424	2594
1952-06-26	239	2953
1953-08-01	359	2093
1954-07-06	1265	47106
1955-06-04	2031	20166
1956-09-01	321	2654
1957-09-03	329	2868
1958-07-05	95	776
1959-06-10	449	1759
1960-08-26	71	623
1961-06-01	151	1057
1962-05-31	736	10038
1963-07-26	1295	11861
1964-06-19	708	9719
1965-06-06	747	128
1966-07-03	556	7730
1967-09-28	13	135
1968-09-28	552	13524
1969-06-01	1701	11441
1970-06-11	4241	51075
1971-06-11	959	6627
1972-07-25	260	10622
1973-08-09	302	3099
1974-05-21	9980	170521
1975-06-22	715	4011
1976-07-19	1663	6740
1977-05-19	321	2979
1978-06-01	482	2299
1979-07-03	997	5833
1980-05-31	123	1218
1981-05-24	310	2947
1982-06-07	1892	22755
1983-06-22	307	1476
1984-06-17	295	1702
1985-07-01	554	5695
1986-06-04	1063	10209
1987-08-20	110	2015
1988-06-15	13	69
1989-06-29	46	480
1990-06-13	607	5125
1991-06-17	715	
1992-06-18	285	
1993-07-30	4311	
1994-09-13	432	6327
1995-08-19	8634	68980
1996-06-02	1828	
1997-07-16	4404	
1998-06-12	862	
1999-06-02	4531	
2000-06-16	136	738
2001-06-21	920	18934
2002-06-11	3700	40001
2003-06-10	795	4284
2004-05-31	3009	25198
2005-06-30	10500	200201
2006-05-27	1970	
2007-06-26	2430	7250
2008-09-23	796	3251
2009-06-27	4470	27729
2010-06-22	1330	25500

 No Records

**Table 2. Summertime Design Discharge and Corresponding Volume  
Pembina River at Walhalla (05099600)**

<b>Return Period</b> (Years)	<b>Instantaneous Design Discharge</b> (cfs)	<b>Storm Volume</b> (ac-ft)
5	2310	21378
10	3820	36029
20	5740	54975
50	8970	87367





