LAKE WINNIPEG
COMMUNITY-BASED MONITORING NETWORK

2017 REGIONAL REPORTS

PEMBINA VALLEY CONSERVATION DISTRICT

Agriculture and Agri-Food Canada

Pembina Valley Conservation District

LWF LAKE WINNIPEG FOUNDATION

LAKE WINNIPEG COMMUNITY-BASED MONITORING NETWORK: OVERVIEW

Lake Winnipeg, the world's 10th largest freshwater lake, receives its water from a vast watershed – an area of land 40 times larger than the lake itself which includes many smaller sub-watersheds. All human activities across this huge watershed have the potential to impact our water quality. However, the closer you are to Lake Winnipeg, the bigger your impact will likely be.

Phosphorus is the nutrient responsible for the potentially harmful blue-green algae blooms on Lake Winnipeg and on other lakes within the watershed. Different sub-watersheds contribute different proportions of Lake Winnipeg's total phosphorus load. With the help of a strong network of local organizations and citizen scientists, the Lake Winnipeg Community-Based Monitoring Network (LWCBMN) is identifying phosphorus hotspots on the landscape, creating opportunities to target funding and action to achieve the greatest return on investment.

Snow melts, floods and heavy rainfall events are responsible for most of the phosphorus that is flushed from the land and carried into our waterways. LWCBMN samples frequently throughout the season, and particularly during the spring melt, to ensure we capture phosphorus runoff during these high water events.

Most community-based monitoring (CBM) sampling is conducted at stations where water flow is continuously monitored by the Water Survey of Canada. By tracking flow online using the Water Survey of Canada's real-time data, the network can mobilize partners and citizen scientists across the watershed to ensure frequent sampling during peak flows. Sampling at these stations provides corresponding flow data, allowing CBM data to be used to calculate **phosphorus loads**. We need several samples throughout the season to accurately calculate these loads. Phosphorus loads can subsequently be used to calculate **phosphorus exports**, based on the area of the watershed sampled.

Phosphorus load is the total amount of phosphorus flowing past a sample site over a given period of time.

Phosphorus export is the amount of phosphorus exported by each hectare of land in a year, expressed as kg/ha/y.

The network in action – 2017

In 2017, in its second field season, LWCBMN focused its efforts on the Assiniboine and Red River valleys, collecting samples in the East-Interlake, Seine-Rat River, La Salle Redboine, Upper Assiniboine River and Pembina Valley Conservation Districts. A total of 800 samples were collected from 75 sites.

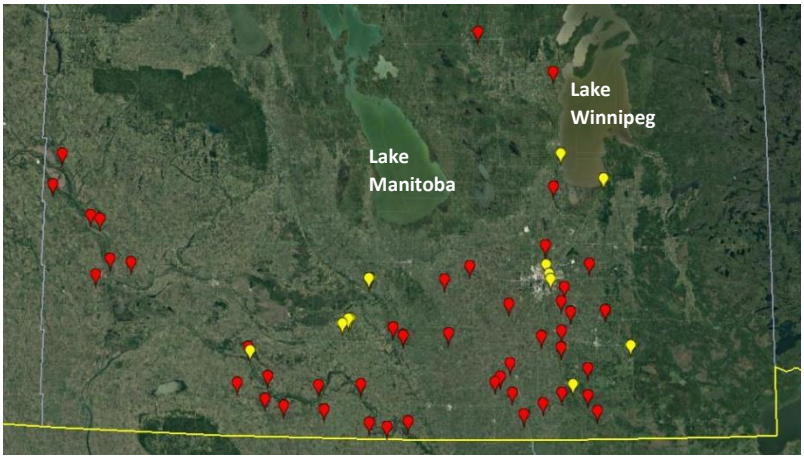

Figure 1. 2017 sample sites. Sites in red are located at Water Survey of Canada flow-metered stations. Sites in yellow are monitored by volunteer samplers where flow is not measured.

2017 RESULTS OVERVIEW

Table 1. Overview of findings from 2017 LWCBMN phosphorus monitoring data.

REGION	# years of LWCBMN data	# sites in 2017	# samples collected in 2017	Highest phosphorus export in region (2017)	Regional lead
East Interlake Conservation District	1	4	67	0.33 kg/ha/y (Icelandic River)	Armand Belanger (EICD)
Seine Rat River Conservation District	2	14	151	1.64 kg/ha/y (Manning Canal)	Jodi Goerzen and Chris Randall (SRRCD)
La Salle Redboine Conservation District	2	9	148	0.76 kg/ha/y (La Salle River at Sanford)	Justin Reid (LSRBCD)
Upper Assiniboine River Conservation District	1	6	111	0.62 kg/ha/y (Arrow River)	Ryan Canart (UARCD)
Pembina Valley Conservation District	1	11	138	1.88 kg/ha/y* (Pembina River near Windygates)	Cliff Greenfield (PVCD) and Jason Vanrobaeys (AAFC)

There was high spatial variation in phosphorus loads between **sub-watersheds**, highlighting the importance of sampling at many stations. For example, the Manning Canal sub-watershed, a phosphorus hotspot in both 2016 and 2017, saw an increase in phosphorus export from 1.10 to 1.64 kg/ha/y. In the Upper Seine River sub-watershed directly north of the Manning Canal, phosphorus export declined from 0.48 to 0.29 kg/ha/y. These watersheds are directly adjacent to one another, yet continue to have very different phosphorus contributions and annual trends.

The high phosphorus exports reported by LWCBMN in both 2016 and 2017 also highlight the importance of sampling more frequently during the spring melt and high water events, when most phosphorus runoff occurs**. In 2017, LWCBMN identified 1,348 tonnes of phosphorus**, of which, 96% occurred during the spring. The average total phosphorus load to Lake Winnipeg is reported to be 7,655 tonnes annually; the average phosphorus load from the Red River is reported to be 5,380 tonnes annually (State of Lake Winnipeg report, 2011).

A **sub-watershed** is the area of land that drains past a particular LWCBMN sampling location. Multiple sub-watersheds flow together to form larger watersheds, such as the Red River Basin.

LWCBMN data in context

Other phosphorus monitoring projects are also reporting large amounts of spatial variation and high phosphorus exports. In 2017, an Environment and Climate Change Canada research group published a study, "Quantifying seasonal variation in total phosphorus and nitrogen from prairie streams in the Red River Basin, Manitoba Canada", that looked at 11 sub-watersheds west of the Red River. Like LWCBMN, researchers sampled frequently during the spring melt and after large rain events, and report a wide range of phosphorus exports for sub-watersheds in a relatively small region, from 0.07-1.88 kg/ha/y.

Using the data

CBM provides valuable information for water management in Manitoba. The LWCBMN's data complements provincial and federal water-quality data sets, and can help guide the development of evidence-based policies and practices.

*** 1.88 kg/ha/y is a relatively high phosphorus export for the PVCD region. We recommend that no conclusions be drawn until we have additional data from this sample site.**

PEMBINA VALLEY CONSERVATION DISTRICT

The Pembina Valley Conservation District (PVCD) is located in southern Manitoba along the Canada-United States border. Approximately half of the Pembina River basin is located in the United States. The Pembina River is the main waterway in this region, with many tributaries and lakes flowing into it. The primary land-use and economy in PVCD is agriculture, specifically cereal, oilseed and forage crops (2006 census). Other potential phosphorus contributors include the approximately 780 livestock farms in the watershed (2006 census). In addition to agricultural activities, wastewater treatment plants and lagoons in municipalities throughout PVCD contribute phosphorus to local waterways. Major municipalities include Winkler, Morden and Manitou.

In partnership with LWCBMN, PVCD staff and partners from the Agriculture and Agri-Food Canada (AAFC) Morden Research and Development Center sampled 11 sites in the PVCD region, of which 10 were at stations where flow is measured. For the site where flow is not measured, useful information can be drawn from the phosphorus concentrations; however, we cannot calculate the phosphorus load because we cannot multiply the concentration by the volume of water flowing by the site.

Table 2. Phosphorus loads and exports for samples sites in PVCD.

Sampling station	Phosphorus load (tonnes/y)	Phosphorus export (kg/ha/y)
A. Badger Creek	54	0.35
B. Mowbray Creek	20	0.76
C. Snowflake Creek	41	0.42
D. Cypress Creek	22	0.56
E. Long River	13	0.22
F. Pelican Lake	16	0.23
G. Pembina River near Lorne Lake	43	0.75
H. Pembina River below Crystal Creek	25	0.18
I. Pembina River near La Riviere	-13	-0.15
J. Pembina River near Windygates	162	1.88

Together, PVCD and AAFC were able to collect samples frequently at all 11 sites, specifically during the spring runoff period, resulting in high-quality data that included all discharge peaks. For all sample sites, most of the water (95 %) and phosphorus (97 %) contribution occurred during the spring melt, from March 1st to May 31st.

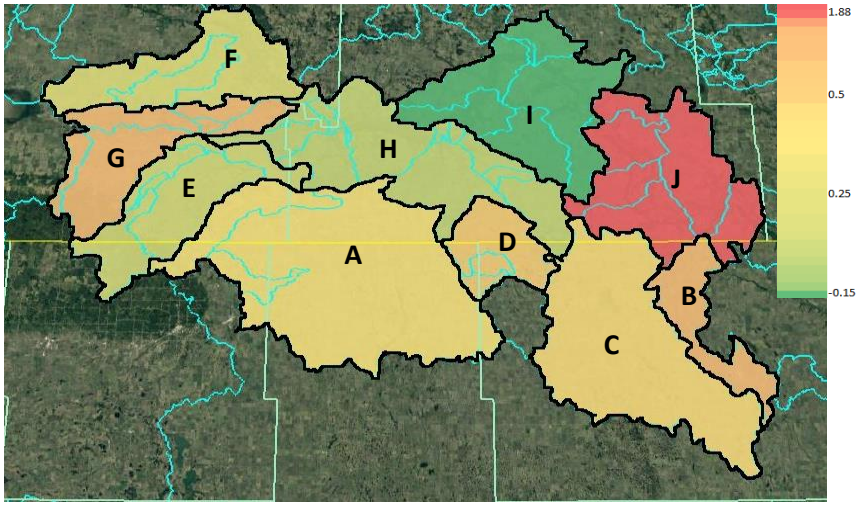

Figure 2. Phosphorus export (kg/ha/y) for sub-watersheds in the Pembina Valley Conservation District.

2017 RESULTS BY SAMPLE SITE

Pembina River tributaries

Badger Creek near Cartwright

Badger Creek is located south of the Pembina River. The majority of the Badger Creek drainage area is located in North Dakota. The drainage area for this sample site is approximately 779 km^2 and drains the Rural Municipality of Cartwright, Manitoba and the city of Rolla, North Dakota.

Samples were taken at Water Survey of Canada flow meter 05OA007, near Cartwright. In 2017, 12 samples were collected between March 27th and June 16th.

- **Discharge peaked**: March 31st
- **Greatest phosphorus concentration**: 779 µg/L* measured on March 31st
- **Total phosphorus load:** 54 tonnes
- **Total water load:** 0.115 km^3
- **Phosphorus export:** 0.35 kg/ha/y
- **Percent water load occurred during spring**:** 97%
- **Percent phosphorus load occurred during spring:** 97%

*The symbol "µg" is used to express micrograms

**Spring was considered to be March 1st to May 31st

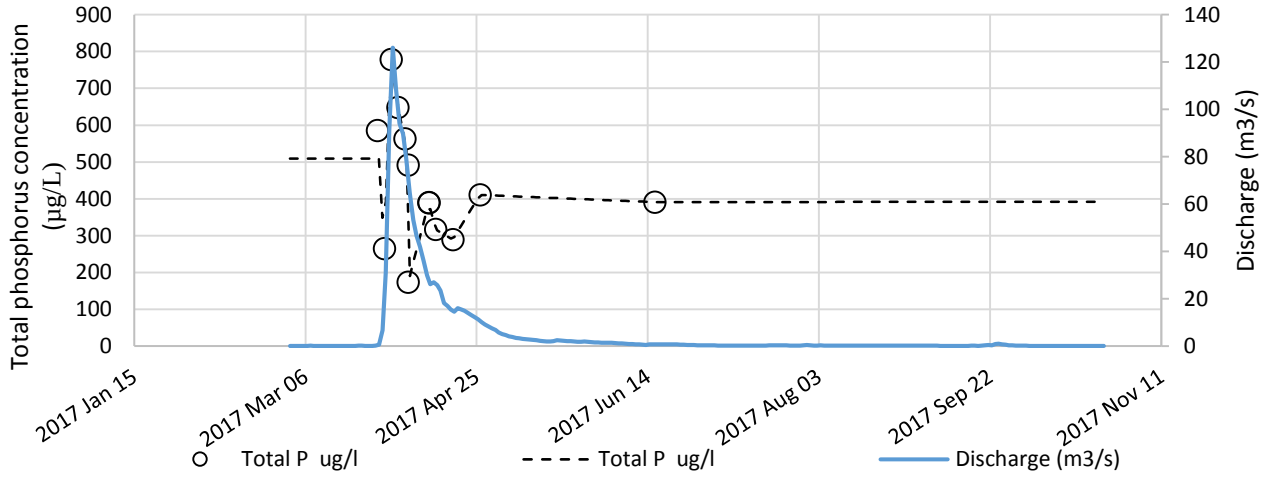

Figure 3. Discharge and total phosphorus concentration over the 2017 sampling season at Badger Creek (Water Survey of Canada Station 05OA007).

Mowbray Creek near Mowbray

Mowbray Creek is located south of the Pembina River. The majority of the Mowbray Creek drainage area is located in North Dakota. The drainage area for this sample site is approximately 263 km^2 and drains a portion of the Rural Municipality of Mowbray, MB as well as the city of Langdon, North Dakota.

Samples were taken at Water Survey of Canada flow meter 05OB021, near Mowbray. In 2017, 13 samples were collected between March 26th and June 16th.

- **Discharge peaked**: April 2nd
- **Greatest phosphorus concentration**: 1196 µg/L measured on March 26th
- **Total phosphorus load:** 20 tonnes
- **Total water load:** 0.025 km^3
- **Phosphorus export:** 0.76 kg/ha/y
- **Percent water load occurred during spring:** 97%
- **Percent phosphorus load occurred during spring:** 97%

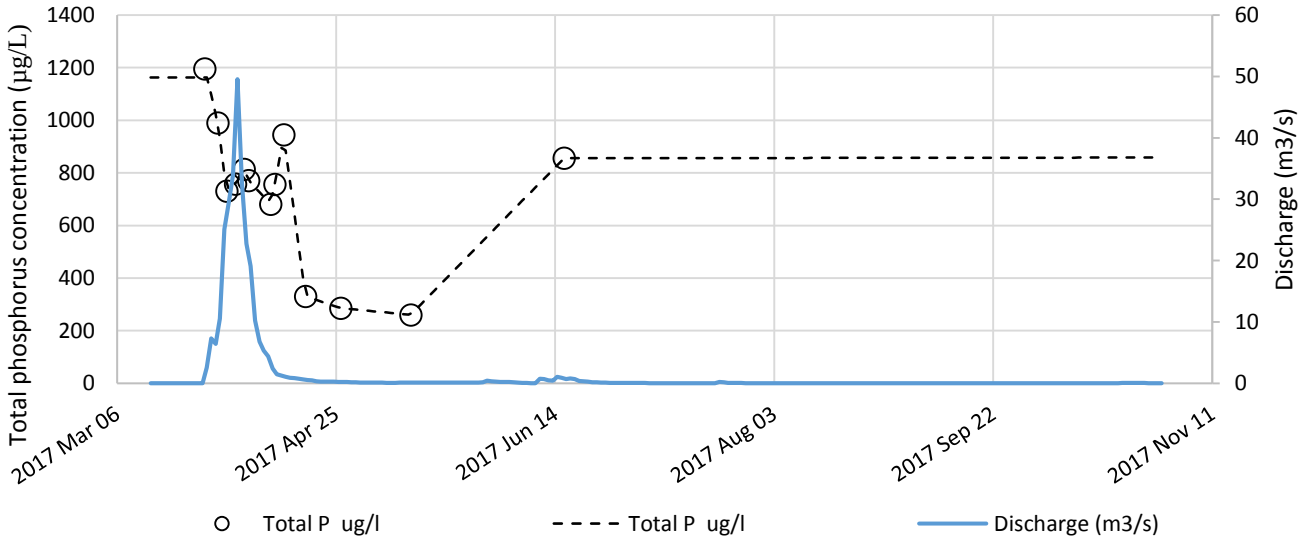

Figure 4. Discharge and total phosphorus concentration over the 2017 sampling season at Mowbray Creek (Water Survey of Canada Station 05OB021).

Snowflake Creek near Snowflake

Snowflake Creek is located south of the Pembina River. The majority of the Snowflake Creek drainage area is located in North Dakota. The drainage area for this sample site is approximately 975 km^2 and drains a largely agricultural area and a portion of the Rural Municipality of Snowflake.

Samples were taken at Water Survey of Canada flow meter 05OB016, near Snowflake. In 2017, 14 samples were collected between March 20th and June 16th.

- **Discharge peaked**: April 5th
- **Greatest contributing phosphorus concentration***: 912 µg/L measured on March 31st
- **Total phosphorus load:** 41 tonnes
- **Total water load:** 0.066 km^3
- **Phosphorus export:** 0.42 kg/ha/y
- **Percent water load occurred during spring:** 98%
- **Percent phosphorus load occurred during spring:** 97%

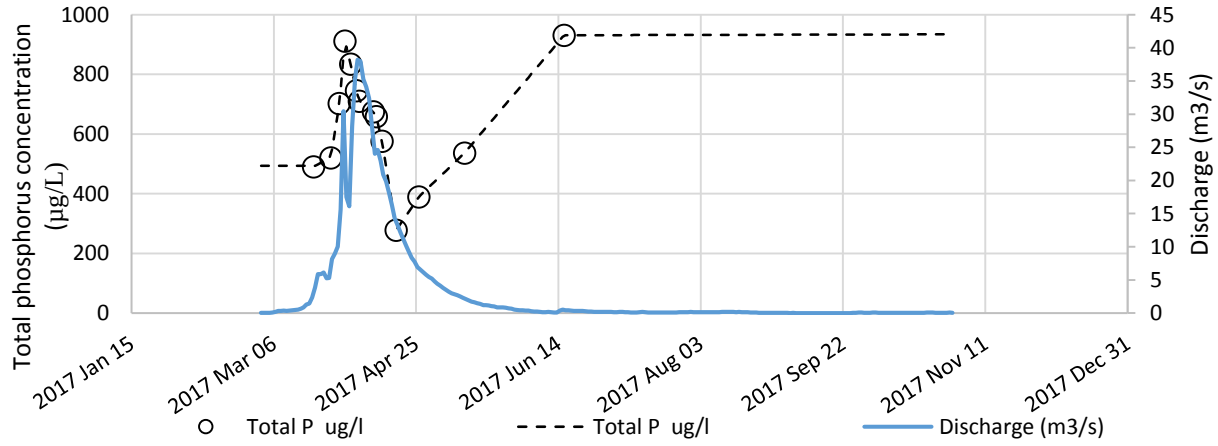

Figure 5. Discharge and total phosphorus concentration over the 2017 sampling season at Snowflake Creek (Water Survey of Canada Station 05OB016).

*** The greatest contributing phosphorus concentration is the greatest phosphorus concentration measured during a period when water was flowing. Total phosphorus concentrations at this site increased throughout the dry summer and fall. This is a common occurrence when flow slows down and evaporation causes phosphorus to become more concentrated in the waterway. High phosphorus concentrations during low flow periods do not contribute a significant amount of phosphorus to the annual load.**

Cypress Creek near Clearwater

Cypress Creek is located south of the Pembina River. There are portions of the drainage area in Manitoba and North Dakota. The drainage area for this sample site is approximately 397 km^2 and drains a largely agricultural area.

Samples were taken at Water Survey of Canada flow meter 05OB010, near Clearwater. In 2017, 13 samples were collected between March 27th and June 16th.

- **Discharge peaked**: March 30th
- **Greatest phosphorus concentration**: 1271 µg/L measured on March 27th
- **Total phosphorus load:** 22 tonnes
- **Total water load:** 0.027 km^3
- **Phosphorus export:** 0.56 kg/ha/y
- **Percent water load occurred during spring:** 98%
- **Percent phosphorus load occurred during spring:** 100%

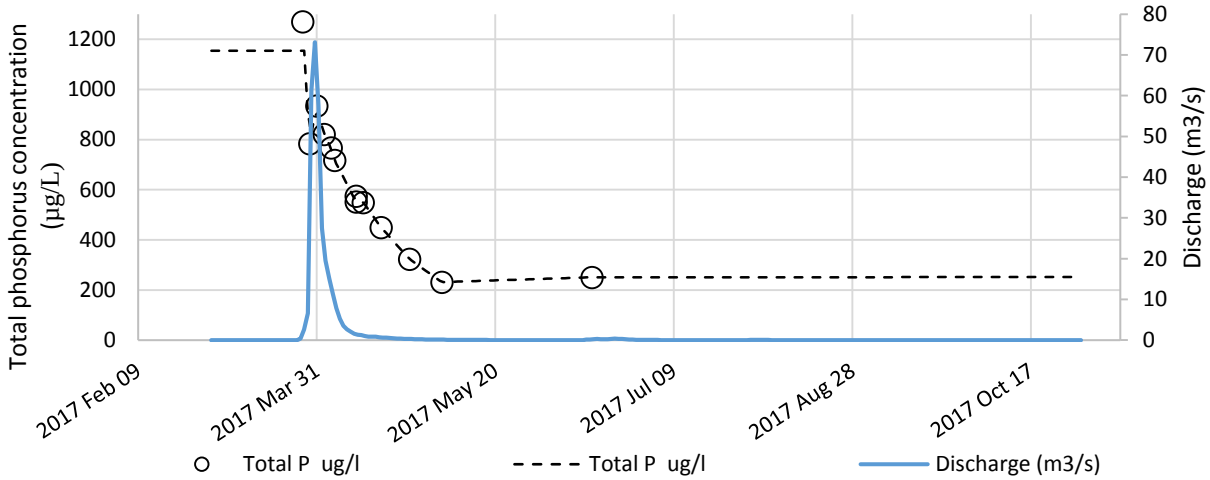

Figure 6. Discharge and total phosphorus concentration over the 2017 sampling season at Cypress Creek (Water Survey of Canada Station 05OB010).

Long River near Holmfield

Long River is located south of the Pembina River. The drainage area for this sample site is approximately 574 km^2 and drains a largely agricultural area and a portion of the town of Killarney.

Samples were taken at Water Survey of Canada flow meter 05OA006, near Holmfield. In 2017, 11 samples were collected between March 31st and September 20th.

- **Discharge peaked**: April 2nd
- **Greatest phosphorus concentration**: 608 µg/L measured on March 31st
- **Total phosphorus load:** 13 tonnes
- **Total water load:** 0.038
- **Phosphorus export:** 0.22 kg/ha/y
- **Percent water load occurred during spring:** 95%
- **Percent phosphorus load occurred during spring:** 98%

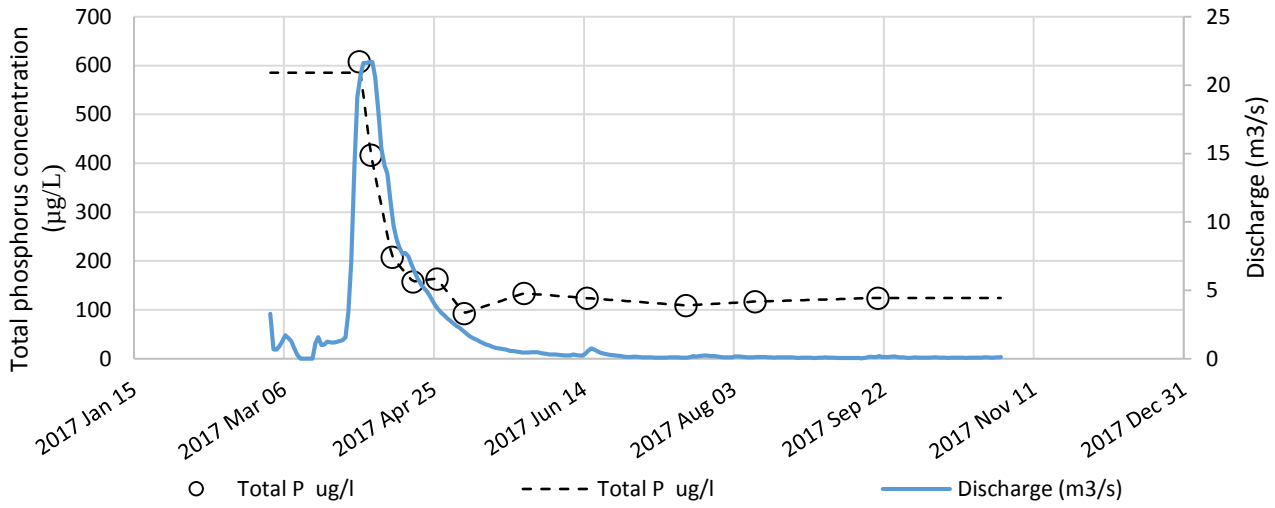

Figure 7. Discharge and total phosphorus concentration over the 2017 sampling season at Long River (Water Survey of Canada Station 05OA006).

Pelican Lake outlet

Pelican Lake is a popular camping and cottage destination in south-western Manitoba. The drainage area for this sample site is approximately 686 km^2 and drains the town of Ninette, located at the north end of the lake.

Samples were taken at a Manitoba Infrastructure flow meter at the outlet of Pelican Lake. In 2017, 5 samples were collected between April 11th and May 22nd.

- **Discharge peaked**: April 8th to May 2nd
- **Greatest phosphorus concentration**: 462 µg/L measured on May 5th
- **Total phosphorus load:** 16 tonnes
- **Total water load:** 0.044 km^2
- **Phosphorus export:** 0.23 kg/ha/y
- **Percent water load occurred during spring runoff:** 100%
- **Percent phosphorus load occurred during spring runoff:** 100%

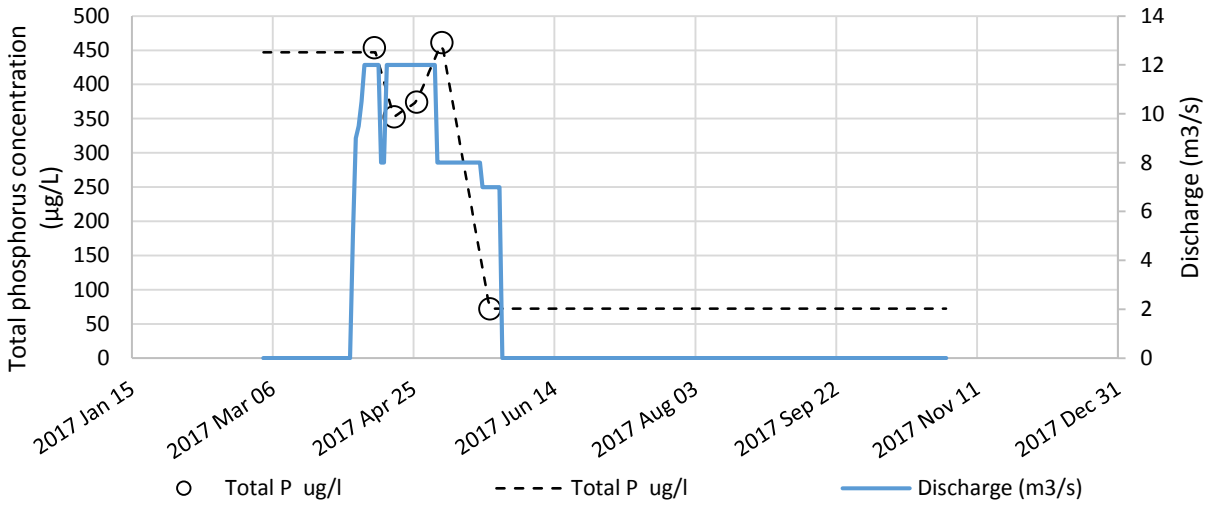

Figure 8. Discharge and total phosphorus concentration over the 2017 sampling season at Pelican Lake.

Pembina River sample sites

Pembina River near Lorne Lake

This reach of the Pembina River drains a largely agricultural area of approximately 573 km^2.

Samples were taken at Water Survey of Canada flow meter 05OA010, above Lorne Lake. In 2017, 12 samples were collected between March 31st and November 12th.

- **Discharge peaked**: March 31st
- **Secondary peak**: April 4th
- **Greatest phosphorus concentration**: 960 µg/L measured on March 29th
- **Total phosphorus load:** 43 tonnes
- **Total water load:** 0.06 km^3
- **Phosphorus export:** 0.75 kg/ha/y
- **Percent water load occurred during spring:** 96%
- **Percent phosphorus load occurred during spring:** 99%

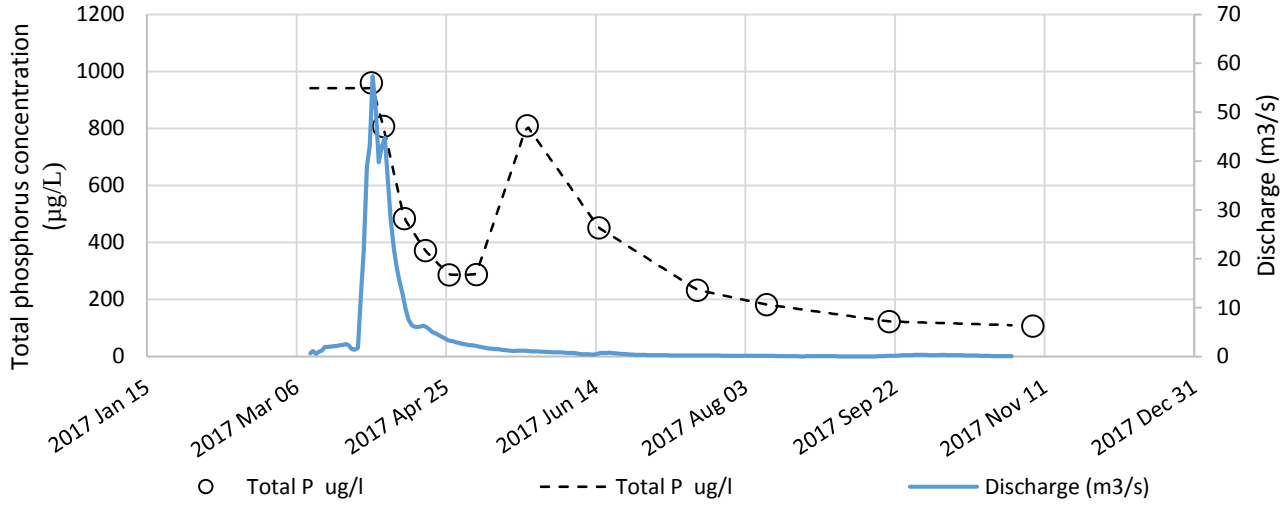

Figure 9. Discharge and total phosphorus concentration over the 2017 sampling season at Pembina River near Lorne Lake (Water Survey of Canada Station 05OA010).

Pembina River near Crystal Creek

This stretch of the Pembina River drains a largely agricultural area of 4480 km^2.

Samples were taken at Water Survey of Canada flow meter 05OB010, below Crystal Creek. In 2017, 11 samples were collected between March 24th and September 20th.

- **Discharge peaked**: April 2nd
- **Greatest phosphorus concentration**: 897 µg/L measured on March 31st
- **Total phosphorus load:** 25 tonnes
- **Total water load:** 0.117 km^2
- **Phosphorus export:** 0.18 kg/ha/y
- **Percent water load occurred during spring runoff:** 90%
- **Percent phosphorus load occurred during spring runoff:** 96%

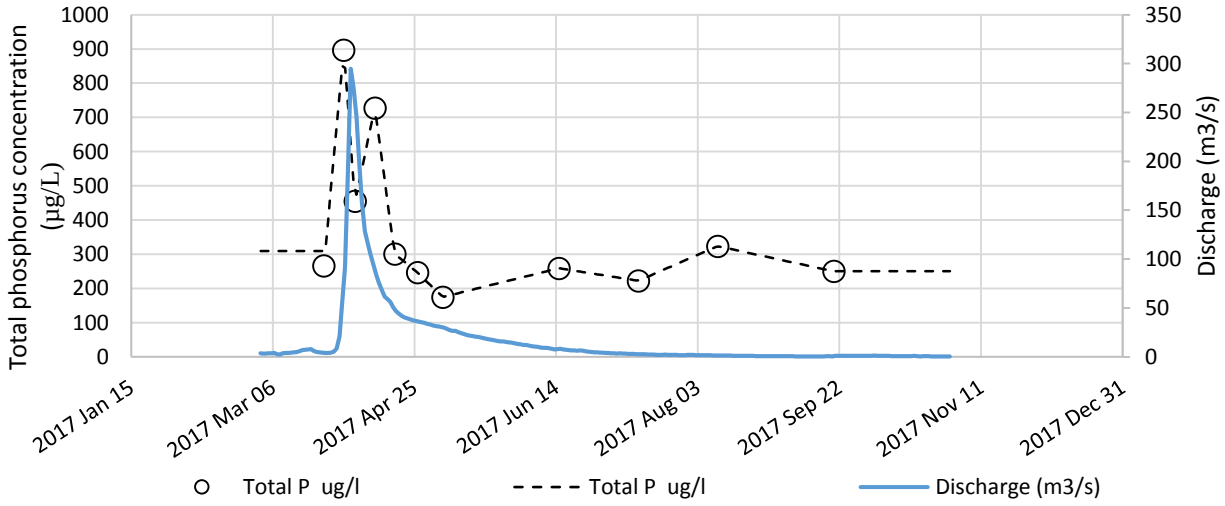

Figure 10. Discharge and total phosphorus concentration over the 2017 sampling season at Pembina River near Crystal Creek (Water Survey of Canada Station 05OB010).

Pembina River near La Rivière

The drainage area for this stretch of the Pembina River is 850 km^2. This stretch of the Pembina River includes Swan Lake, which has previously been reported to sequester, rather than export, phosphorus[1]. This is likely the case for 2017, resulting in a negative export coefficient for this stretch of the Pembina River.

Samples were taken at Water Survey of Canada flow meter 05OB001, near La Rivière. In 2017, 12 samples were collected between March 31st and September 20th.

- **Discharge peaked**: April 5th
- **Secondary peak**: April 17th
- **Greatest phosphorus concentration**: 662 µg/L measured on March 31st
- **Total phosphorus load:** -13 tonnes
- **Total water load:** 0.079 km^3
- **Phosphorus export:** -0.15 kg/ha/y
- **Percent water load occurred during spring:** 86%
- **Percent phosphorus load occurred during spring:** 90%

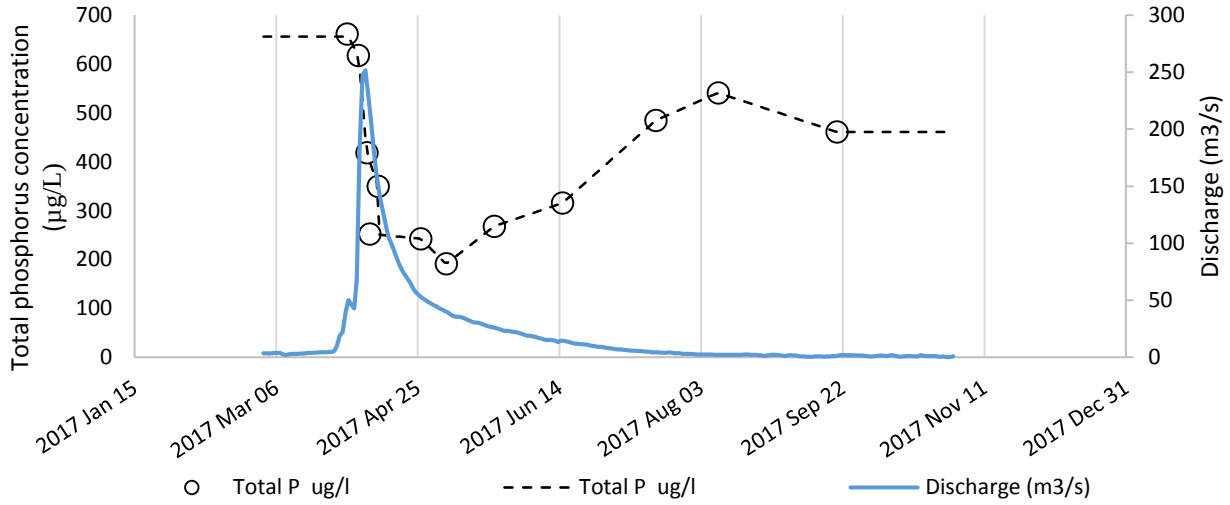

Figure 11. Discharge and total phosphorus concentration over the 2017 sampling season at Pembina River near La Rivière (Water Survey of Canada Station 05OB001).

[1]Donald et al. (2015). Nutrient Sequestration in the Lake Winnipeg watershed. *Journal of Great Lakes Research*. 41, 630-642.

Pembina River near Windygates

This reach of the Pembina River drains a largely agricultural area of approximately 932 km^2.

Samples were taken at Water Survey of Canada flow meter 05OB007, near Windygates. In 2017, 13 samples were collected between March 26th and June 16th.

- **Discharge peaked**: April 8th
- **Greatest phosphorus concentration**: 1329 µg/L measured on March 31st
- **Total phosphorus load:** 162 tonnes
- **Total water load:** 0.058 km^3
- **Phosphorus export:** 1.88 kg/ha/y*
- **Percent water load occurred during spring:** 89%
- **Percent phosphorus load occurred during spring:** 94%

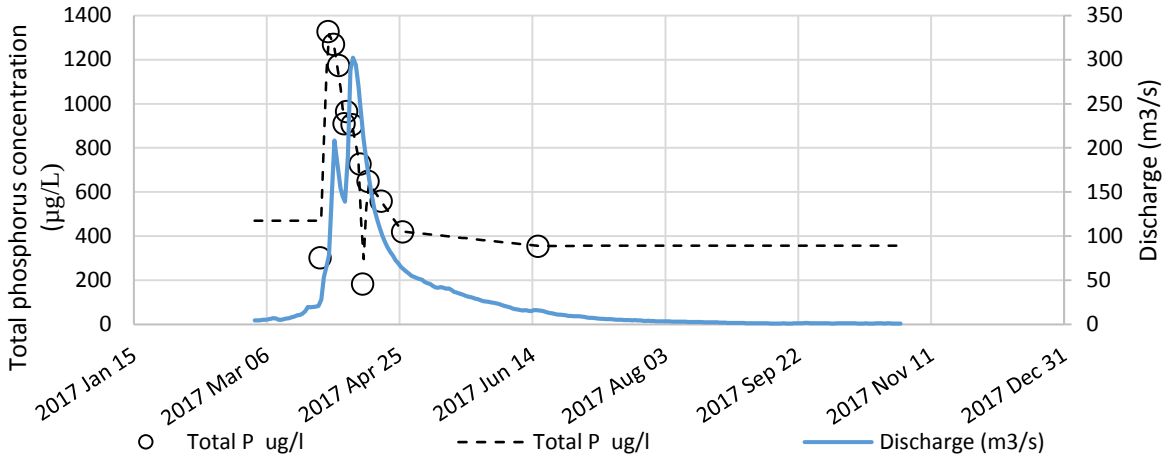

Figure 12. Discharge and total phosphorus concentration over the 2017 sampling season at Pembina River near Windygates (Water Survey of Canada Station 05OB007).

*** 1.88 kg/ha/y is a relatively high phosphorus export for this region. We recommend that no conclusions be drawn until we have additional data from this sample site.**

Sample site without flow data

Bone Lake Outlet

The Bone Lake outlet sample site drains an area of 407 km^2.

Samples were taken at Water Survey of Canada water level meter 05OA019. In 2017, 11 samples were collected between March 31st and September 19th. Because flow is not measured at this site, we cannot calculate phosphorus loads and exports.

- **Water level peaked**: April 4th
- **Greatest phosphorus concentration**: 702 µg/L measured on April 4th

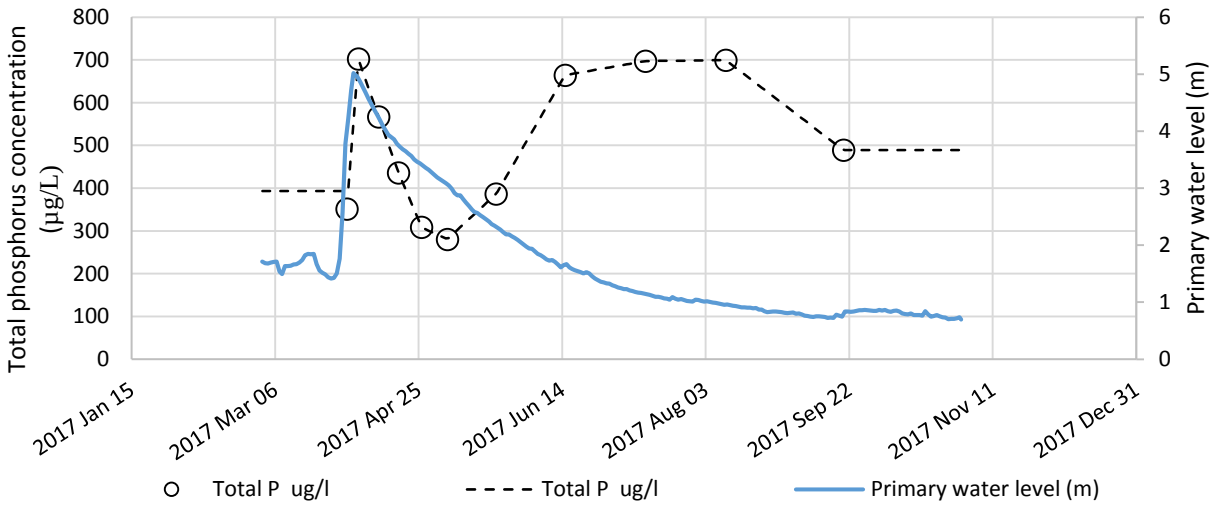

Figure 13. Water level and total phosphorus concentration over the 2017 sampling season at Bone Lake (Water Survey of Canada Station 05OA019).

INTERESTED IN SAMPLING WITH LWCBMN?

LWCBMN provides hands-on opportunities for citizens to get involved in water sampling activities. We are looking for volunteers to sample at Water Survey of Canada stations in 2018. You can find a map of potential sites here.

If you are interested in sampling, please contact the LWCBMN co-ordinator at cbm@lakewinnipegfoundation.org. Together, we can choose a sample site near where you live, work or commute and begin collecting valuable information to measure phosphorus loading to local waterways.

THANK YOU TO OUR 2017 FUNDERS

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