LAKE WINNIPEG COMMUNITY-BASED MONITORING NETWORK

Seine Rat Roseau Watershed District

2019 Regional Report

Assiniboine River; Photo: Paul Mutch

LWF LAKE WINNIPEG FOUNDATION

SEINE-RAT RIVER CONSERVATION DISTRICT

LAKE WINNIPEG COMMUNITY-BASED MONITORING NETWORK: OVERVIEW

The Lake Winnipeg Community-Based Monitoring Network (LWCBMN), coordinated by the Lake Winnipeg Foundation (LWF), mobilizes citizens to collect water samples across Manitoba in order to measure phosphorus concentration. Phosphorus is the nutrient responsible for blue-green algae blooms on Lake Winnipeg. Phosphorus comes from diverse sources across the watershed, including municipal wastewater and agricultural runoff.

Different sub-watersheds contribute different proportions of Lake Winnipeg's total phosphorus load. With the help of a strong network of watershed partners and citizen scientists, this long-term monitoring program is identifying phosphorus hotspots – localized areas that contribute higher amounts of phosphorus to waterways than other areas. Targeting remedial action in hotspots will reduce the amount of phosphorus entering Manitoba's lakes and rivers, and improve the health of Lake Winnipeg.

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 LWCBMN 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 notify partners and citizen scientists across the watershed to ensure frequent sampling during peak flows. Sampling at these stations provides corresponding flow data, allowing LWCBMN 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.

Phosphorus load is the total amount of phosphorus flowing past a sample site over a given period of time, expressed as tonnes per year.

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

LWCBMN in action – 2019

In 2019, in its fourth season, LWCBMN expanded to cover more drainage areas across the province, expanding into the Winnipeg River system and the Souris River system. Over 2,000 samples were collected from 161 sites.

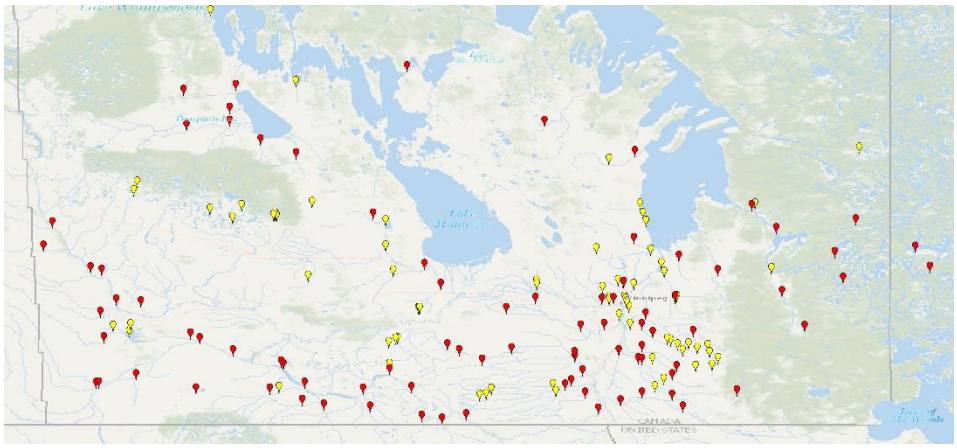


Figure 1. 2019 sampling sites. Sites in red are located at Water Survey of Canada's flow-metered stations. Sites in yellow are located at sampling sites where flow is not measured.

2019 RESULTS: OVERVIEW

Table 1. Overview of findings from 2019 LWCBMN phosphorus monitoring data.

REGION	# years of LWCBMN data	# sampling sites in 2019	# samples collected in 2019	Highest phosphorus export in region (2018)	Highest phosphorus export in region (2019)	Regional lead
East Interlake Watershed District	3	8	112	Icelandic River and Grassmere Creek (0.03 kg/ha/y)	Grassmere Creek Drain near Middlechurch (0.14 kg/ha/y)	Armand Belanger (EIWD)
Seine Rat Roseau Watershed District	4	21	395	Main Drain near Dominion City (0.22 kg/ha/y)	Joubert Creek near St. Pierre-Jolys (2.29 kg/h/y)	Jodi Goerzen and Chris Randall (SRRWD)
Redboine Watershed District	4	14	226	Roseisle Creek near Roseisle (0.12 kg/ha/y)	La Salle River at Elie (0.44 kg/ha/y)	Justin Reid (RWD)
Assiniboine West Watershed District	3	7	148	Bailey's Creek near Oak Lake (0.08 kg/ha/y)	Scissor Creek near McAuley (0.08 kg/ha/y)	Ryan Canart (AWWD)
Pembina Valley Watershed District	3	16	259	Pembina River near Lorne Lake (0.21 kg/ha/y)	Kronsgart Drain near Sewell (1.36 kg/ha/y)	Cliff Greenfield (PVWD) and Jason Vanrobaeys (AAFC)
Souris River Watershed District	2	11	117	Pipestone Creek (0.01 kg/ha/y)	Elgin Creek near Souris (0.44 kg/ha/y)	Dean Brooker and Yasemin Keeler (SRWD)
City of Winnipeg	2	7	142	Omand's Creek (0.03 kg/ha/y)	Sturgeon Creek at St. James Bridge (0.27 kg/ha/y)	LWF
Northeast Red Watershed District	2	7	86	Cooks Creek/Cooks Creek Diversion (0.01 kg/ha/y)	Cooks Creek and Cooks Creek Diversion (0.54 kg/ha/y)	Colin Gluting (NRWD)
Whitemud Watershed District	2	7	55	-	Rat Creek near Macdonald (0.02 kg/ha/y)	Chris Reynolds (WWD)
Intermountain Watershed District	1	7	119	-	Vermillion River near Dauphin (0.07 kg/ha/y)	Jeff Theile and Jody Tucker (IWD)
Winnipeg River System	2	9	205	-	Pine Falls Generating Station (0.85 kg/ha/y)	Manitoba Hydro, Ontario Power Generation
West Interlake Watershed District	1	1	20	-	Fairford River near Fairford (0.00 kg/ha/y, only site)	LWF

The 2019 field season was very different than previous years, with the majority of phosphorus loading occurring during the fall rather than the spring. Fall storms and flooding on the eastern side of the Red River valley resulted in a phosphorus export greater than 2 kg/ha/y at the lower Joubert Creek: one of the greatest phosphorus exports ever reported from rural sub watersheds in Manitoba. These unprecedented wet fall conditions in 2019 highlight changing weather patterns on Manitoba's prairies: short-lived but intense precipitation events are expected to become more frequent and intense with climate change (Prairie Climate Centre, 2017). Data collected by LWCBMN in 2019 improves our understanding of how these changes may affect phosphorus loading in the Lake Winnipeg watershed.

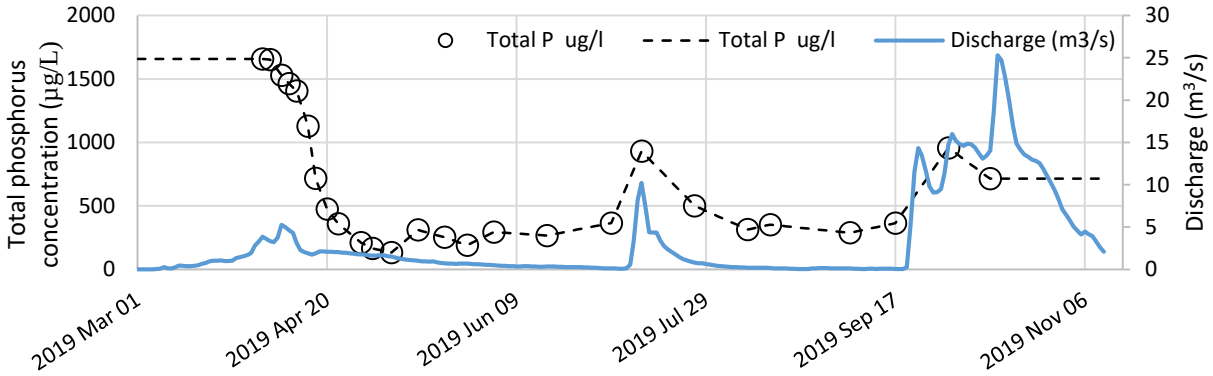


Figure 2. Water discharge and phosphorus concentration for the lower Joubert Creek near St-Pierre-Jolys. In 2019, 70 per cent of the phosphorus load and 73 per cent of the water load occurred during the fall (Sept. 22 to Nov. 11). The high flows in fall 2019 resulted in a phosphorus export of 2.29 kg/ha/y for this sampling site.

SEINE RAT ROSEAU WATERSHED DISTRICT

The Seine Rat Roseau Watershed District (SRRWD) is located east of the Red River, extending almost to Ontario and to the United States. SRRWD consists of three major sub-watersheds: the Seine, Rat and Roseau River watersheds. The primary land use in SRRWD is agriculture, specifically cereal crops and livestock. The Seine River watershed has the most intensively developed hog industry of all watersheds in Manitoba (Seine River Integrated Watershed Management Plan, 2010). In addition to agricultural activities, wastewater treatment plants and lagoons in municipalities throughout SRRWD contribute phosphorus to local waterways. Major municipalities include Steinbach, St-Pierre-Jolys and Lorette.

In partnership with LWCBMN, SRRWD staff and volunteers sampled 21 sites in the SRRWD region, of which 14 were at flow meters. For the sites 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 phosphorus concentration by the volume of water flowing by the sampling site.

SRRWD and volunteers collected samples frequently at all sites, catching the spring runoff period and major rain events throughout the summer and fall. Unlike previous years, most of the water and phosphorus contribution occurred during the fall. Fall rain and flood events resulted in the greatest phosphorus export ever reported through LWCBMN, in the lower Joubert Creek.

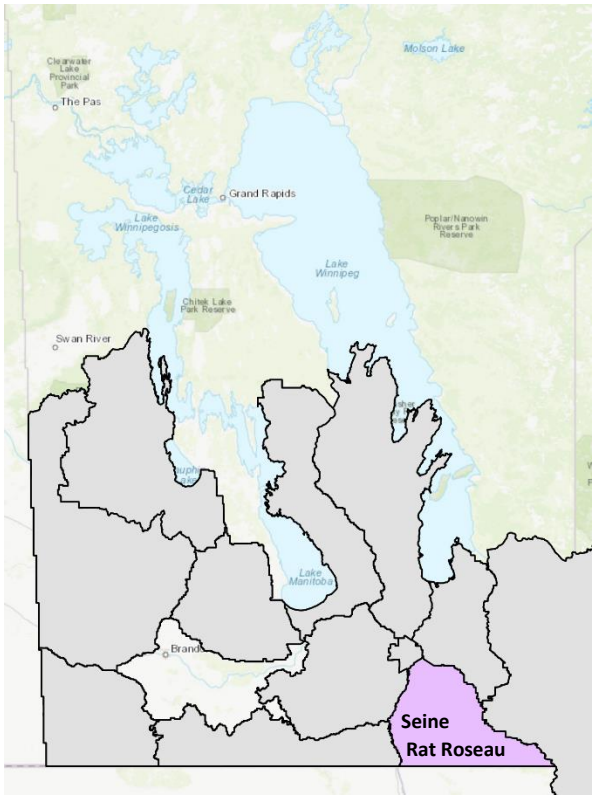


Figure 3. Manitoba's Watershed Districts, highlighting Seine Rat Roseau Watershed District.

Table 2. Overview of findings from 2019 Seine Rat Roseau Watershed District sampling sites.

Please note: values with an "*" in this table are incremental phosphorus loads and exports. When multiple sampling sites exist along a waterway, loads can be calculated by subtracting the upstream load from the downstream load, resulting in the amount of phosphorus contributed by the stretch of the waterway between the two sites. Sharing the data this way allows us to break down larger watersheds into smaller drainage areas to more precisely identify phosphorus hotspots.

Sampling station	Total phosphorus load (tonnes/y)	Total phosphorus export (kg/ha/y)
A. Seine River near Ste. Anne	29	0.5
B. Manning Canal near Île-des-Chênes	65	1.35
C. Tourond Creek near Tourond	31	1.49
D. Joubert Creek near Pansy	24	1.14
E. Joubert Creek near St. Pierre-Jolys *	32	2.29
F. Rat River near St. Pierre Jolys *	22	0.33
G. Marsh River near Otterburn	39	0.97
H. Roseau River at Gardenton	82	0.18
I. Vita Drain near Stuartburn	75	1.68
J. Roseau River near Dominion City *	-46	-3.36
K. Main Drain near Dominion City	11	0.48
L. Seine River near Prairie Grove and the Seine River Diversion near Île-des-Chênes*	46	0.91
M. Rat River near Sundown	4	0.1

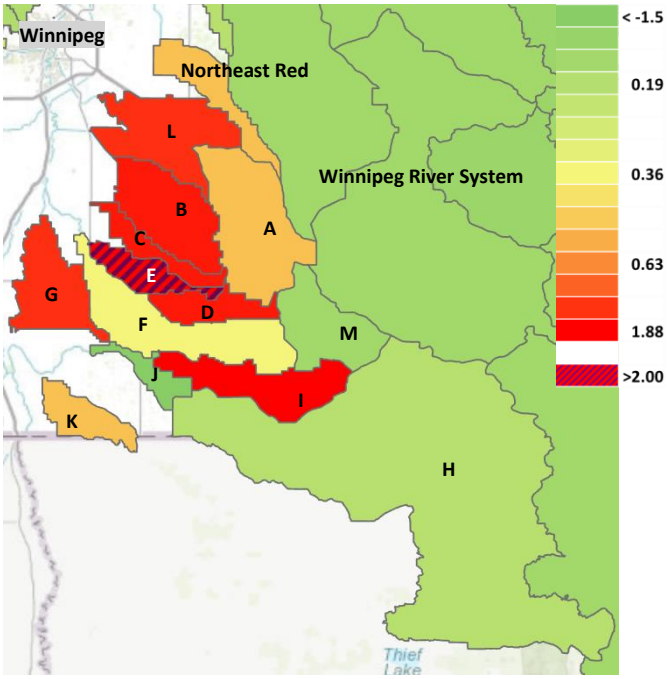


Figure 3. Phosphorus exports (kg/ha/y) for sub-watersheds in the Seine Rat Roseau Watershed District.

2019 RESULTS BY SAMPLING SITE

Seine River sampling sites

Seine River near Ste. Anne

The upper Seine River sampling site drains a largely forested area of approximately 580 km^2. The drainage area includes a portion of Sandilands Provincial Forest.

This sampling site is located at Water Survey of Canada flow meter 05OH007, near Ste. Anne, Man. In 2019, 21 samples were collected between April 2 and Oct. 16.

	2016	2017	2018	2019
Discharge peaked:	March 16	April 1	May 21	Oct. 14
Greatest phosphorus concentration:	643 µg/L* (March 15)	517 µg/L (March 28)	151 µg/L (April 18)	1,334 µg/L (April 7)
Total phosphorus load:	28 tonnes	17 tonnes	2 tonnes	29 tonnes
Total water load:	0.128 km^3	0.073 km^3	0.021 km^3	0.098 km^3
Phosphorus export:	0.48 kg/ha/y ***	0.3 kg/ha/y	0.04 kg/ha/y	0.50 kg/ha/y
Per cent water load in spring:**	66%	64%	14%	20%
Per cent phosphorus load in spring:	82%	85%	19%	20%

*The "µg" symbol is used to express micrograms

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

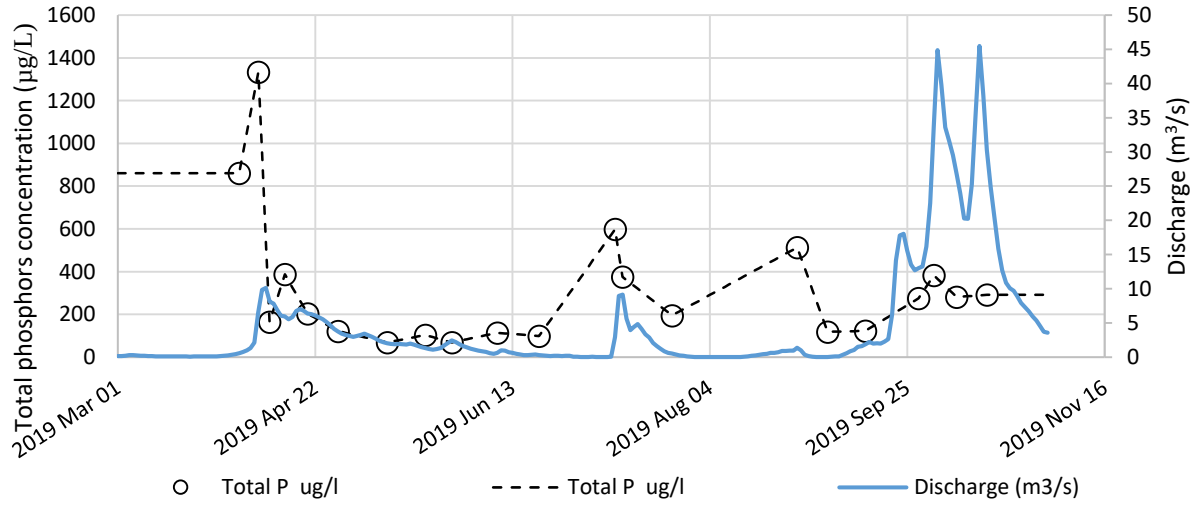


Figure 4. Discharge and total phosphorus concentration over the 2019 sampling season at Seine River near Ste. Anne (Water Survey of Canada Station 05OH007).

***Earlier versions of this report (2017 & 2018) contain an error in the 2016 phosphorus export for the Seine River near Ste. Anne sampling site. The export was reported to be 0.28 kg/ha/y but it was 0.48 kg/ha/y.

Manning Canal near Île-des-Chênes

The Manning Canal is a sub-watershed of the larger Seine River watershed. The Manning Canal drains a largely agricultural area of 481 km^2, which includes dense livestock and crop land as well as the growing city of Steinbach.

This sampling site is located at Water Survey of Canada flow meter 05OE006, near Île-des-Chênes, Man. In 2019, 14 samples were collected between April 1 and Oct. 20.

	2016	2017	2018	2019
Discharge peaked:	March 14	March 30	March 28	Oct. 1
Greatest phosphorus concentration:	1,569 µg/L (March 15)	1,656 µg/L (March 23)	1,642 µg/L (April 27)	1,590 µg/L (April 8)
Total phosphorus load:	53 tonnes	79 tonnes	3 tonnes	65 tonnes
Total water load:	0.059 km^3	0.066 km^3	0.005 km^3	0.063 km^3
Phosphorus export:	1.1 kg/ha/y	1.64 kg/ha/y	0.07 kg/ha/y	1.35 kg/ha/y
Per cent water load in spring:	77%	94%	72%	23%
Per cent phosphorus load in spring:	85%	97%	89%	33%

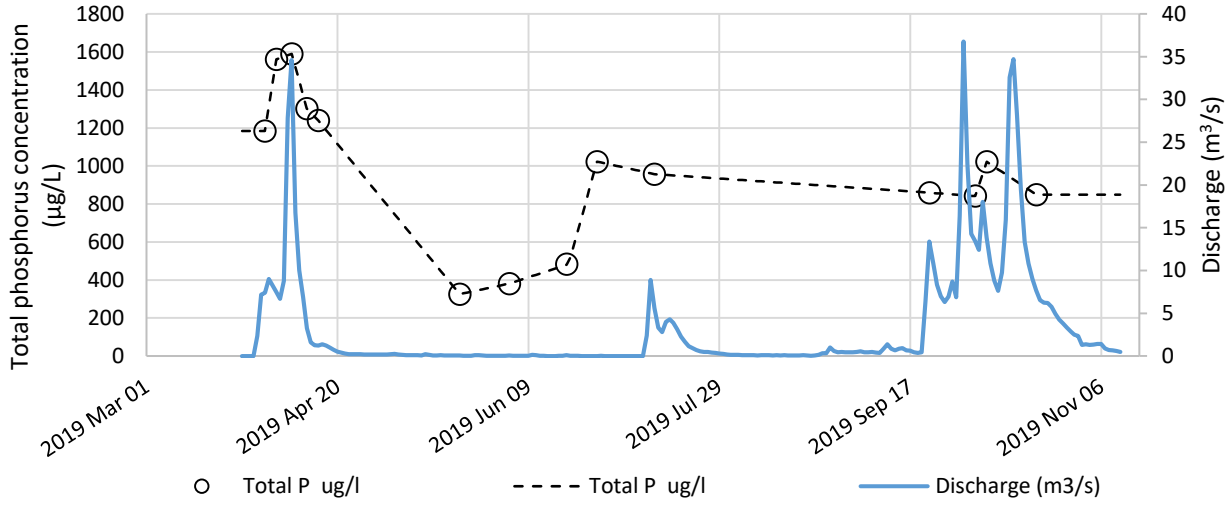


Figure 5. Discharge and total phosphorus concentration over the 2019 sampling season at Manning Canal (Water Survey of Canada Station 05OE006).

Seine River near Prairie Grove and the Seine River Diversion near Île-des-Chênes

Together, the Seine River near Prairie Grove, Man., and the Seine River Diversion sampling sites drain a largely agricultural area of 506 km^2. Water flowing down the Seine River towards Prairie Grove is diverted into the Seine River Diversion when water levels and flows are high. Both sampling sites share a drainage area, therefore, phosphorus and water loads are added together to accurately calculate the phosphorus export for the drainage area.

The Prairie Grove and Diversion sites are located at Water Survey of Canada flow meters 05OH009 and 05OE011, respectively. In 2019, 19 samples were collected at Prairie Grove and 15 samples were collected at the Seine River Diversion between April 2 and Oct. 17.

	2018	2019
Incremental total phosphorus load:	2 tonnes	46 tonnes
Incremental water load:	0.004 km^3	0.066 km^3
Phosphorus export:	0.03 kg/ha/y	0.91 kg/ha/y

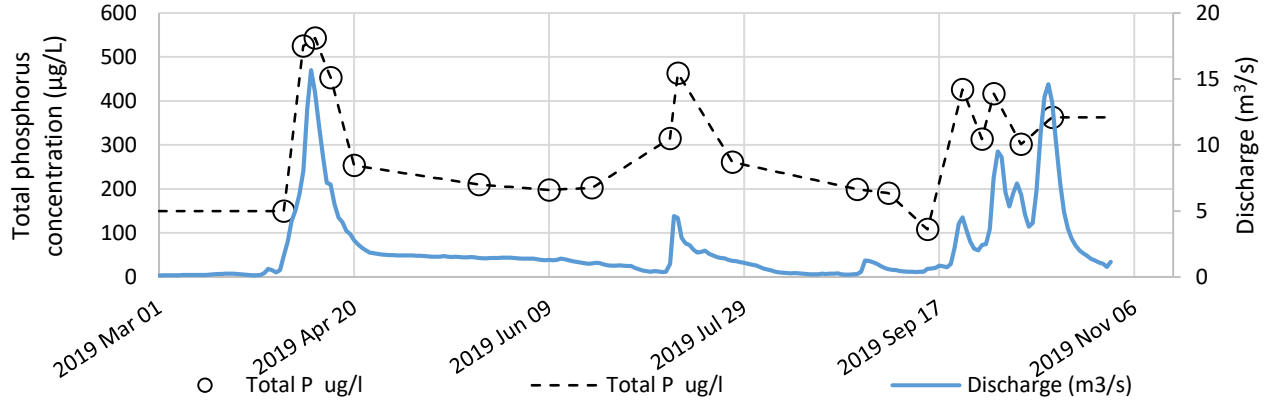


Figure 6. Discharge and total phosphorus concentration over the 2019 sampling season at Seine River near Prairie Grove (Water Survey of Canada Station 05OH009).

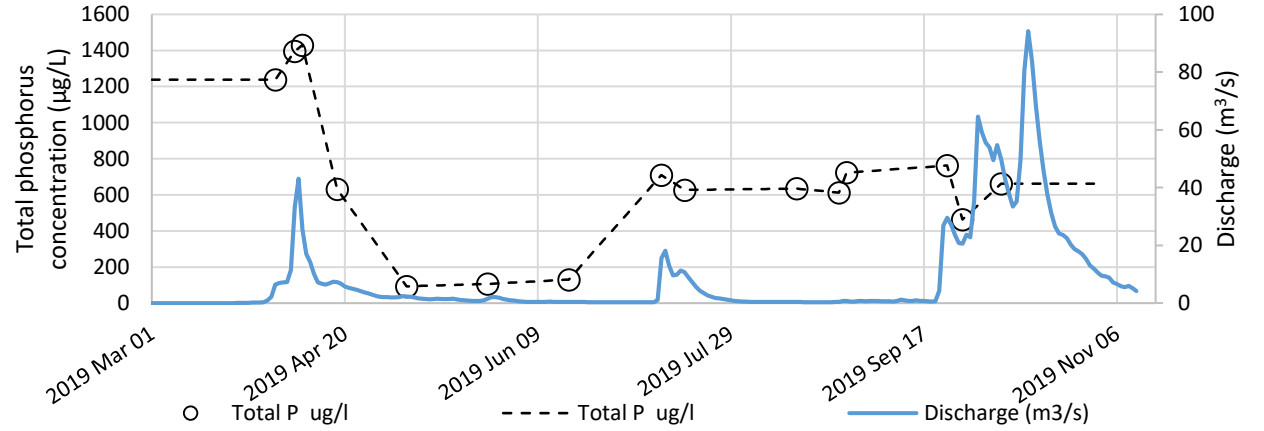


Figure 7. Discharge and total phosphorus concentration over the 2019 sampling season at Seine River Diversion (Water Survey of Canada Station 05OE011).

Tourond Creek sampling sites

Tourond Creek near Tourond

Tourond Creek drains a largely agricultural area of 210 km^2 before flowing into the Red River south of Saint Adolphe, Man.

This sampling site is located at Water Survey of Canada flow meter 05OE009, near Tourond, Man. In 2019, 15 samples were collected between March 23 and Nov. 7.

	2016	2017	2018	2019
Discharge peaked:	March 14	March 31	May 19	Oct. 14
Greatest phosphorus concentration:	1,105 µg/L (March 15)	1,641 µg/L (March 23)	1,145 µg/L (April 16)	1,548 µg/L (April 9)
Total phosphorus load:	13 tonnes	17 tonnes	0.4 tonnes	31 tonnes
Total water load:	0.020 km^3	0.018 km^3	0.001 km^3	0.0031 km^3
Phosphorus export:	0.61 kg/ha/y	0.81 kg/ha/y	0.02 kg/ha/y	1.49 kg/ha/y
Per cent water load in spring:	72%	93%	17%	11%
Per cent phosphorus load in spring:	82%	95%	44%	10%

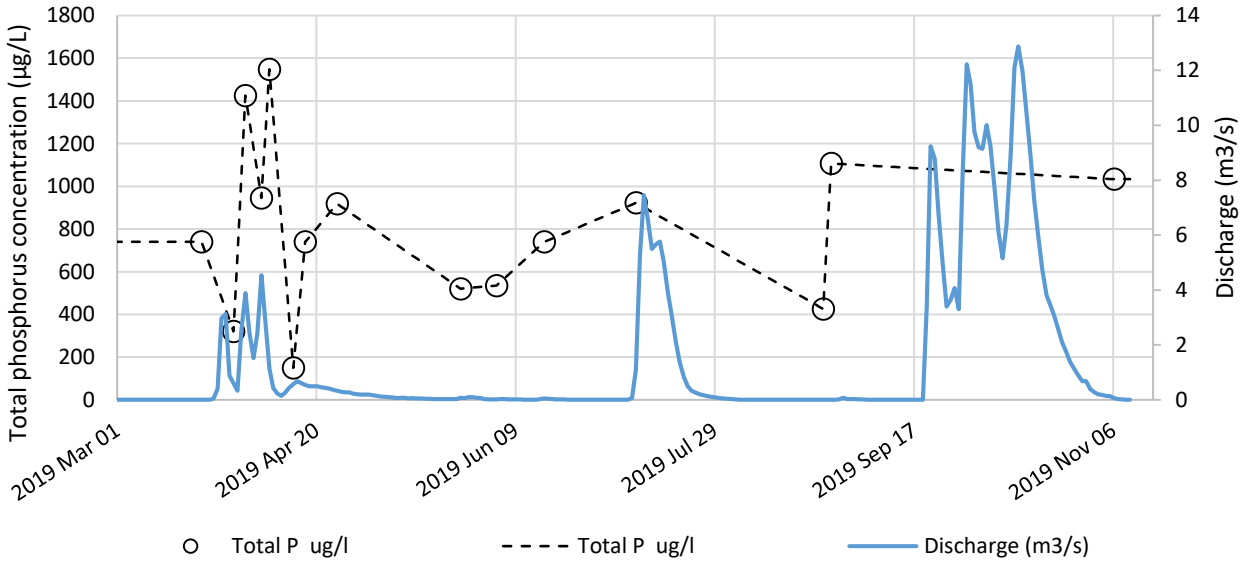


Figure 8. Discharge and total phosphorus concentration over the 2019 sampling season at Tourond Creek (Water Survey of Canada Station 05OE009).

Rat River sampling sites

Joubert Creek near Pansy

This sampling site is the most upstream sampling site on the Joubert Creek, a tributary of the Rat River. The area that drains into this site is 208 km^2, consisting of pasture and forage crop land.

This sampling site is located at Water Survey of Canada flow meter 05OE015, near Pansy, Man. In 2019, 14 samples were collected between March 31 and Sept. 23.

	2017	2018	2019
Discharge peaked:	March 30	April 27	Oct. 14
Greatest phosphorus concentration:	1,957 µg/L (March 23)	4,617 µg/L (April 16)	1,031 µg/L (July 10)
Total phosphorus load:	23 tonnes	1 tonnes	24 tonnes
Total water load:	0.034 km^3	0.001 km^3	0.049 km^3
Phosphorus export:	1.1 kg/ha/y	0.06 kg/ha/y	1.14 kg/ha/y
Per cent water load in spring:	97%	66%	13%
Per cent phosphorus load in spring:	100%	91%	9%

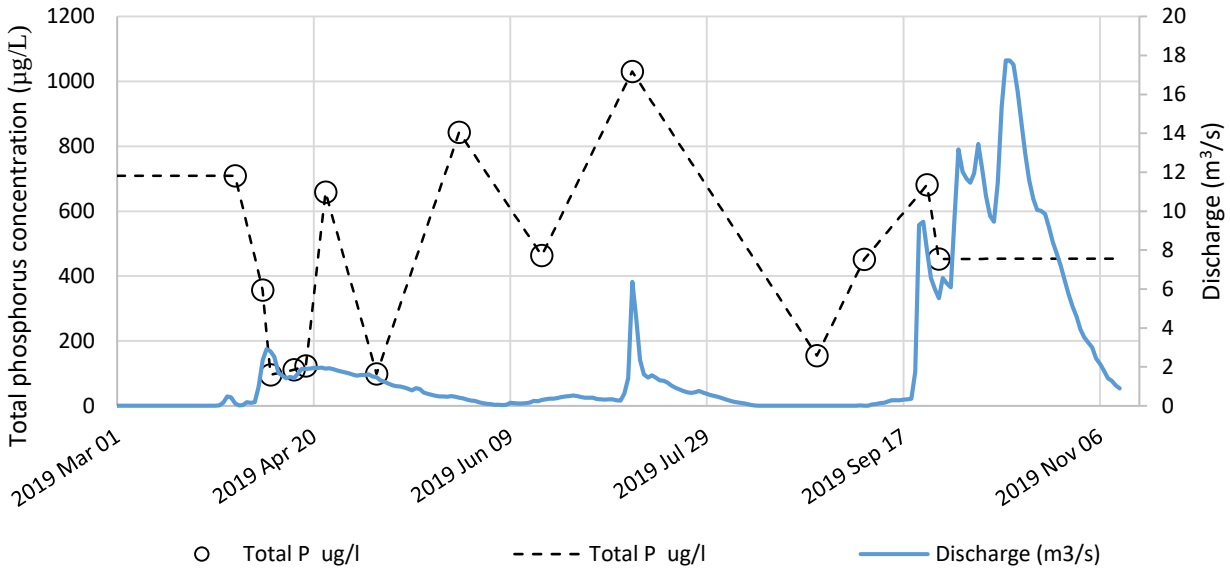


Figure 9. Discharge and total phosphorus concentration over the 2019 sampling season at Joubert Creek near Pansy (Water Survey of Canada Station 05OE015).

Joubert Creek near St-Pierre-Jolys

This is the most downstream sampling site on Joubert Creek, which is located just before Joubert Creek flows into the Rat River. The area that drains into this sample site is 140 km^2 of pasture and forage cropland, as well as a portion of the community of St-Pierre-Jolys, Man.

This sampling site is located at Water Survey of Canada flow meter 05OE007, near St-Pierre-Jolys. In 2019, 26 samples were collected between April 3 and Oct. 10th.

	2017	2018	2019
Discharge peaked:	March 30	April 24	Oct. 14
Greatest phosphorus concentration:	1,604 µg/L (March 23)	941 µg/L (April 16)	1,658 µg/L (April 3)
Incremental total phosphorus load:	8 tonnes	-0.2 tonnes	32 tonnes
Incremental total water load:	0.010 km^3	0.001 km^3	0.022 km^3
Incremental phosphorus export:	0.57 kg/ha/y	-0.001 kg/ha/y	2.29 kg/ha/y
Per cent water load in spring:	93%	56%	16%
Per cent phosphorus load in spring:	98%	62%	20%

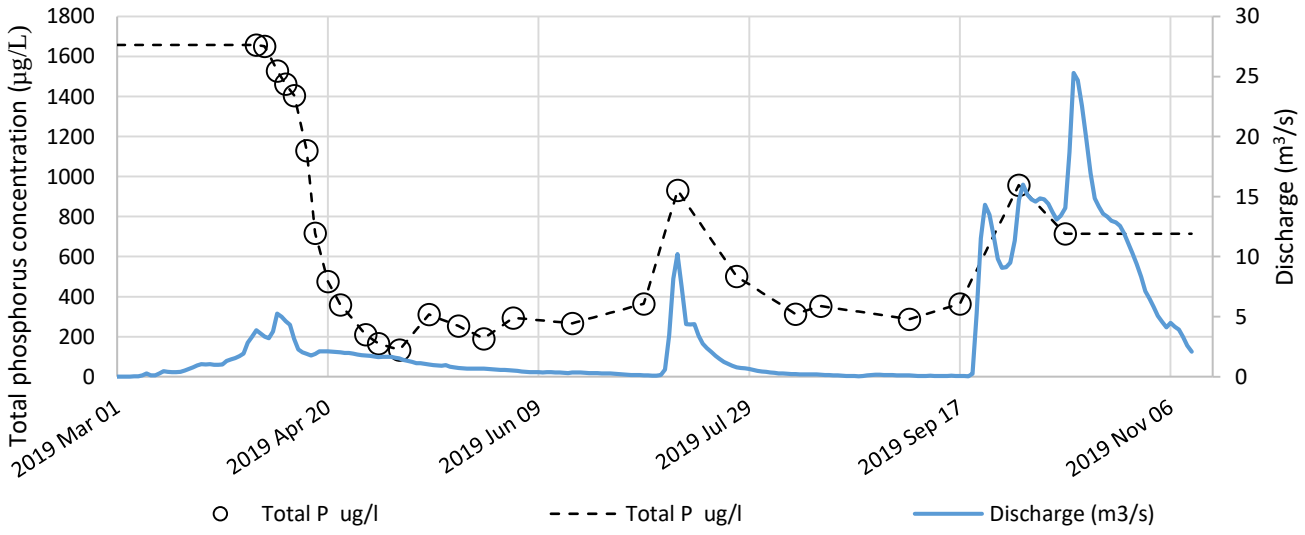


Figure 10. Discharge and total phosphorus concentration over the 2019 sampling season at Joubert Creek near St-Pierre-Jolys (Water Survey of Canada Station 05OE007).

Rat River near St-Pierre-Jolys

The Rat River sampling site is located upstream from where Joubert Creek flows into the Rat River. The area that drains into this stretch of the Rat River is 652 km^2 and includes the community of St-Pierre-Jolys, Man. In 2018, LWCBMN began collecting samples at the Rat River near Sundown sampling site, which reduced the size of the incremental drainage area for this site.

This sampling site is located near Water Survey of Canada flow meter 05OE001, which is slightly downstream from where Joubert Creek flows into the Rat River*. In 2019, 26 samples were collected between March 28 and Oct. 12.

	2017 (1,075 km^2)	2018 (652 km^2)	2019 (652 km^2)
Discharge peaked:	April 5	June 6	Oct. 17
Greatest phosphorus concentration:	415 µg/L (March 23)	569 µg/L (May 23)	1341 µg/L (April 5)
Incremental total phosphorus load:	24 tonnes	1 tonnes	22 tonnes
Incremental total water load:	0.098 km^3	0.001 km^3	0.154 km^3
Incremental phosphorus export:	0.23 kg/ha/y	0.02 kg/ha/y	0.33 kg/ha/y
Per cent water load in spring:	96%	48%	13%
Per cent phosphorus load in spring:	98%	81%	9%

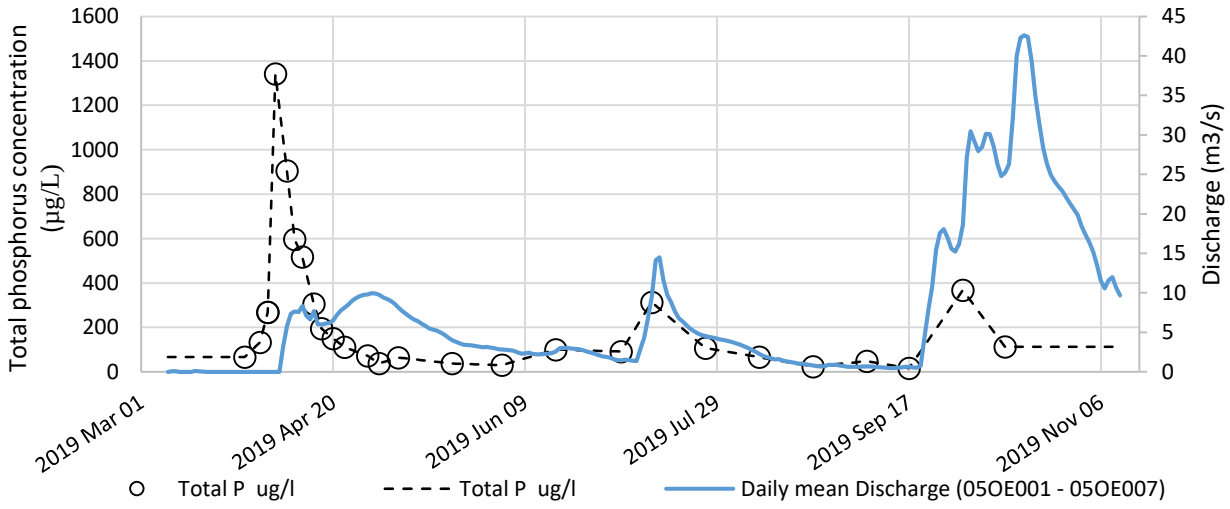


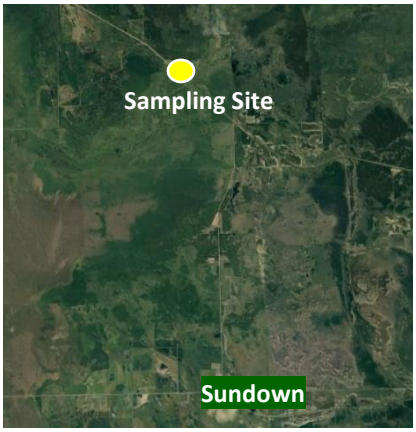
Figure 11. Discharge and total phosphorus concentration over the 2019 sampling season at Rat River (estimated from Water Survey of Canada Stations 05OE001 and 05OE007).

***Discharge for this sample site was estimated by subtracting Joubert Creek near St-Pierre-Jolys discharge (flow meter 05OE007) from the Rat River near Otterburne discharge (flow meter 05OE001). Sites were selected this way to separate the Rat and Joubert drainage areas.**

Rat River near Sundown

This sampling site is the most upstream sampling site on the Rat River. The area that drains into this site is 423 km^2 and drains a largely forested area with some pasture land.

This sampling site is located at Water Survey of Canada flow meter 05OE004, near Sundown, Man. In 2019, 24 samples were collected between April 6 and Oct. 14.



	2018	2019
Discharge peaked:	April 26	Oct. 13
Greatest phosphorus concentration:	142 µg/L (April 20)	144 µg/L (April 9)
Total phosphorus load:	2 tonnes	4 tonnes
Total water load:	0.027 km^3	0.075 km^3
Phosphorus export:	0.04 kg/ha/y	0.10 kg/ha/y
Per cent water load in spring:	59%	31%
Per cent phosphorus load in spring:	87%	36%

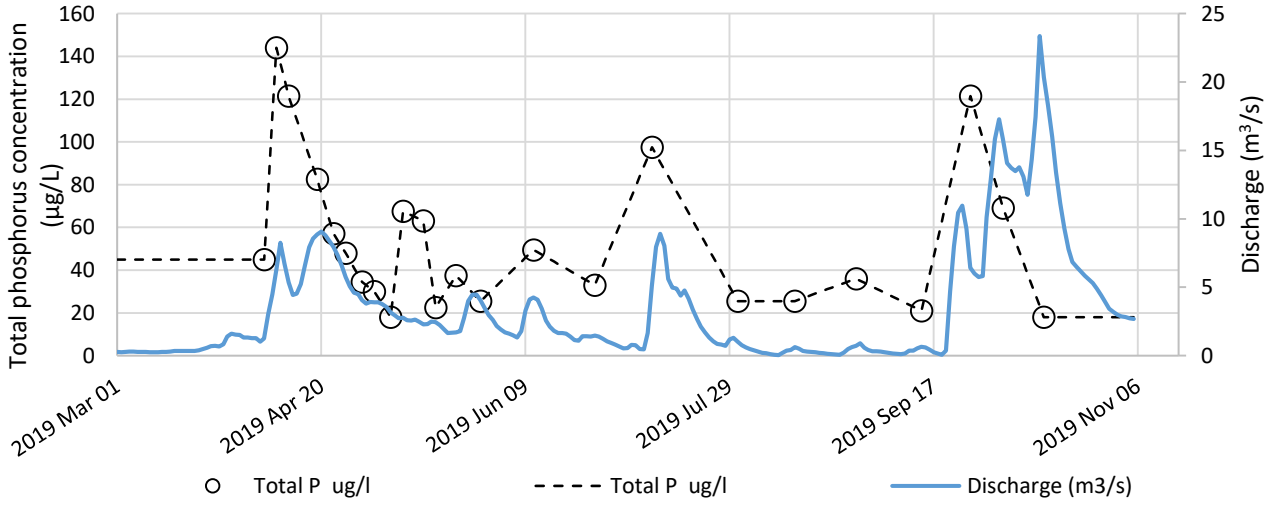


Figure 12. Discharge and total phosphorus concentration over the 2019 sampling season at Rat River near Sundown (Water Survey of Canada Station 05OE004).

Marsh River near Otterburn

The Marsh River sampling site drains an area of approximately 403 km^2, consisting mainly of agricultural land. This sampling site is located directly upstream of where the Marsh River flows into the Rat River.

The sampling site is located at Water Survey of Canada flow meter 05OE010, near Otterburn, Man. In 2019, 17 samples were collected between April 7 and Oct. 19.

	2017	2018	2019
Discharge peaked:	April 1	April 22	Oct. 16
Greatest phosphorus concentration:	699 µg/L (March 30)	518 µg/L (May 15)	1,103 µg/L (July 15)
Total phosphorus load:	16 tonnes	1 tonne	39 tonnes
Total water load:	0.047 km^3	0.003 km^3	0.060 km^3
Phosphorus export:	0.41 kg/ha/y	0.03 kg/ha/y	0.97 kg/ha/y *
Per cent water load in spring:	99%	98%	28%
Per cent phosphorus load in spring:	99%	100%	21%

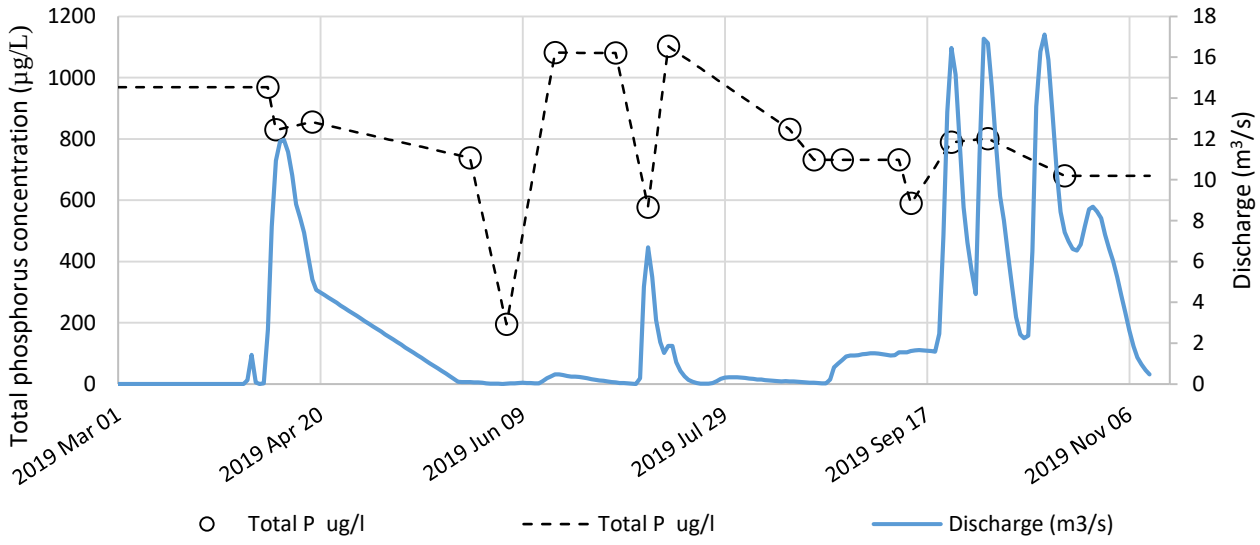
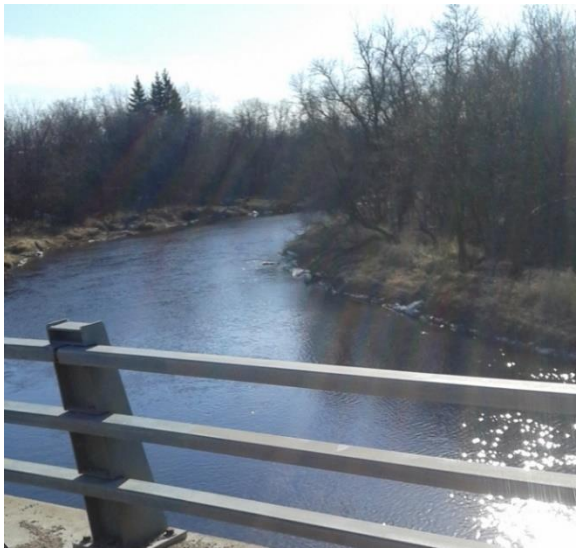


Figure 13. Discharge and total phosphorus concentration over the 2019 sampling season at Marsh River near Otterburn (estimated from Water Survey of Canada Station 05OE010).

***In fall 2019, water levels on the lower Roseau River near the outlet of the Red River were extremely high. During these events, water from the Roseau River and back-flooding from the Red River can cross drainage boundaries and run into the Marsh River watershed. This can result in an inflated phosphorus export for the Marsh River, as it is actually receiving water from parts of the Roseau and Red Rivers and not only water from the Marsh River watershed.**

Roseau River sampling sites

Roseau River near Gardenton



This sampling site is the most upstream sampling site on the Roseau River. The majority of this 4,440 km^2 drainage area is located in Minnesota and Ontario. This drainage area is not densely populated and is largely forested.

This sampling site is located at Water Survey of Canada flow meter 05OD004, near Gardenton, Man. In 2019, 21 samples were collected between April 18 and Oct. 17.

	2017	2018	2019
Discharge peaked:	April 15	April 22	Oct. 14
Greatest phosphorus concentration:	157 µg/L (March 31)	202 µg/L (April 18)	384 µg/L (April 10)
Total phosphorus load:	46 tonnes	19 tonnes	80 tonnes
Total water load:	0.439 km^3	0.168 km^3	0.702 km^3
Phosphorus export:	0.10 kg/ha/y	0.04 kg/ha/y	0.18 kg/ha/y
Per cent water load in spring:	74%	69%	24%
Per cent phosphorus load in spring:	68%	80%	35%

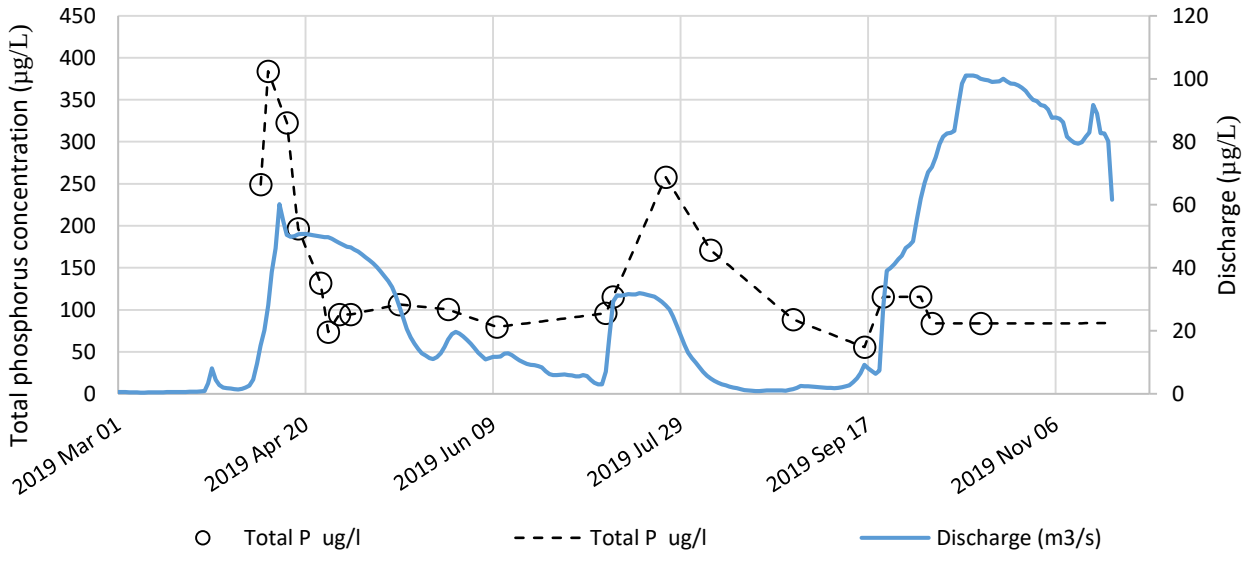


Figure 14. Discharge and total phosphorus concentration over the 2019 sampling season at Roseau River near Gardenton (Water Survey of Canada Station 05OD004).

Vita Drain near Stuartburn

This sampling site is located directly upstream from where the Vita Drain flows into the Roseau River. This 442 km^2 area drains largely forested land, with some agriculture and the community of Vita, Man.

This sampling site is located at Water Survey of Canada flow meter 05OD034, near Stuartburn, Man. In 2019, 21 samples were collected between April 1 and Oct. 17.

	2017	2018	2019
Discharge peaked:	March 29	June 16	Oct. 16
Greatest phosphorus concentration:	98 µg/L (March 31)	106 µg/L (April 18)	278 µg/L (April 1)
Total phosphorus load:	2 tonnes	0.1 tonnes	75 tonnes
Total water load:	0.043 km^3	0.004 km^3	0.060 km^3
Phosphorus export:	0.05 kg/ha/y	0 kg/ha/y	1.68 kg/ha/y
Per cent water load in spring:	93%	35%	17%
Per cent phosphorus load in spring:	94%	32%	24%

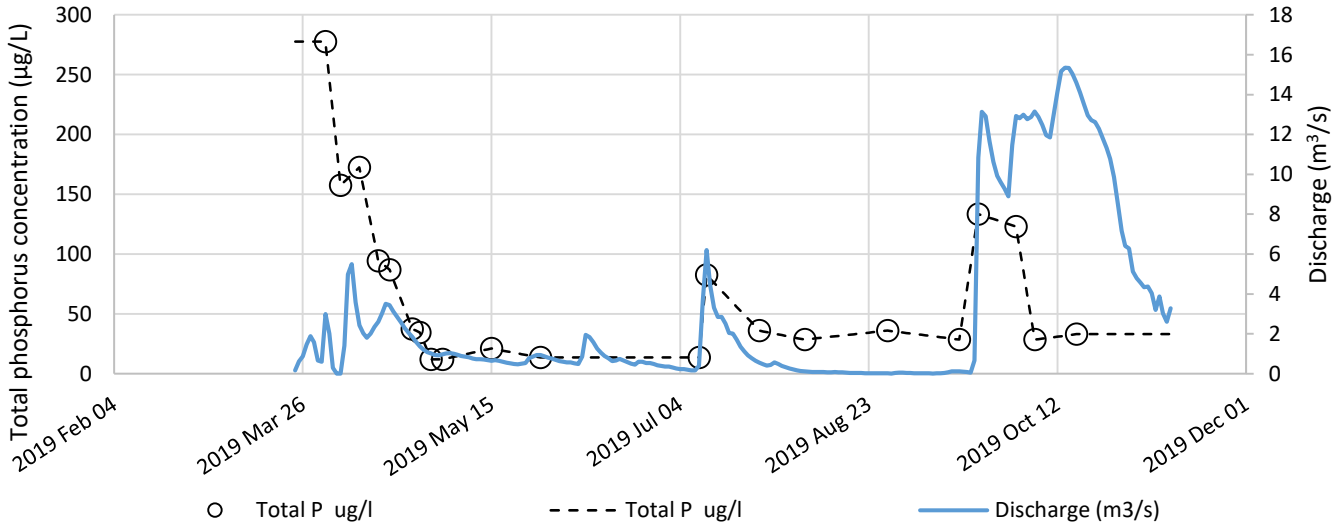


Figure 15. Discharge and total phosphorus concentration over the 2019 sampling season at Vita Drain near Stuartburn (Water Survey of Canada Station 05OD034).

Roseau River near Dominion City

This downstream stretch of the Roseau River drains a 137 km^2 largely forested area and the community of Stuartburn, Man.

This sampling site is located at Water Survey of Canada flow meter 05OD001, near Dominion City, Man. In 2019, 16 samples were collected between April 6 and Oct. 4.

	2017	2018	2019
Discharge peaked:	April 1	April 22	Oct.15
Greatest phosphorus concentration:	194 µg/L (March 31)	124 µg/L (April 26)	407 µg/L (April 9)
Incremental total phosphorus load:	4 tonnes	1 tonne	-46 tonnes
Incremental water load:	0.025 km^3	0.024 km^3	0.076
Incremental phosphorus export:	0.29 kg/ha/y	0.07 kg/ha/y	-3.36 kg/ha/y
Per cent water load in spring:	70%	97%	20%
Per cent phosphorus load in spring:	71%	98%	27%

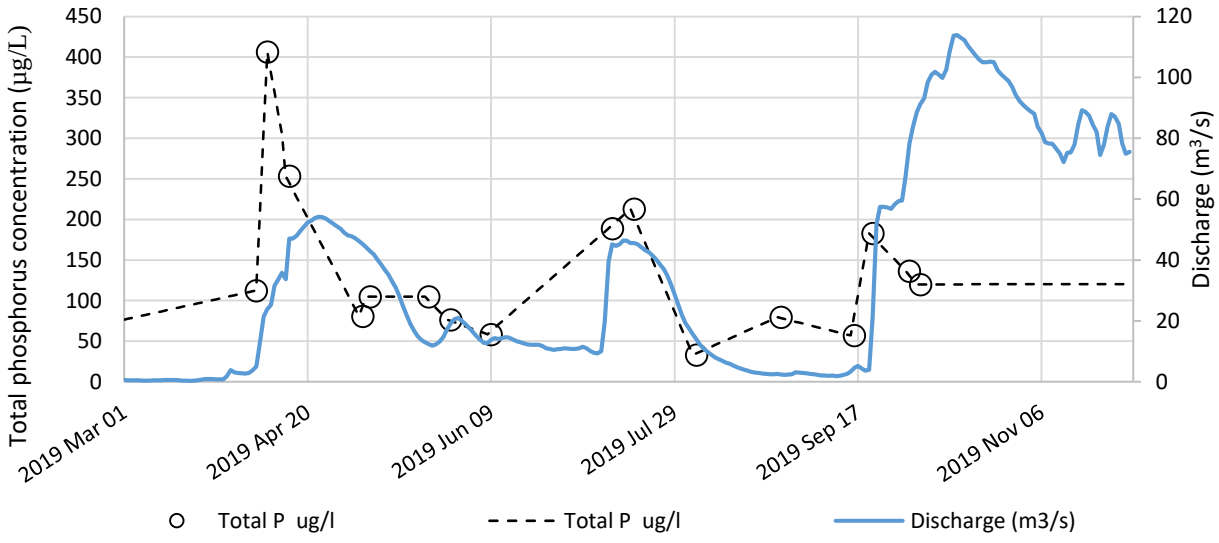
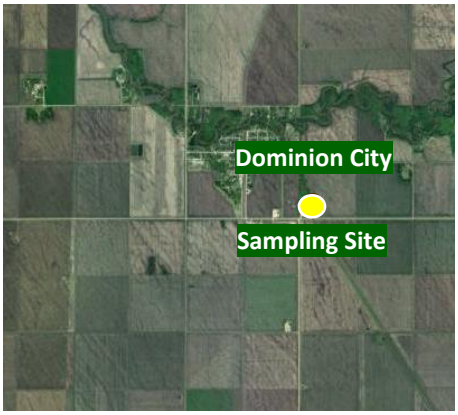


Figure 16. Discharge and total phosphorus concentration over the 2019 sampling season at Roseau River near Dominion City (Water Survey of Canada Station 05OD001).

Main Drain near Dominion City

The drainage area for this sampling site is 225 km^2. The majority of this drainage area is located in Manitoba, with a small portion extending into the United States. This sampling site drains a more densely agricultural area than the other sampling sites in the Roseau River watershed.

This sampling site is located at Water Survey of Canada flow meter 05OD028, near Dominion City, Man. In 2019, 19 samples were collected between April 7 and Oct. 17.



	2017	2018	2019
Discharge peaked:	March 31	April 19	Oct. 15
Greatest phosphorus concentration:	372 µg/L (March 31)	498 µg/L (April 18)	929 µg/L (April 18)
Total phosphorus load:	8 tonnes	5 tonnes	11 tonnes
Total water load:	0.022 km^3	0.011 km^3	0.025 km^3
Phosphorus export:	0.36 kg/ha/y	0.22 kg/ha/y	0.48 kg/ha/y
Per cent water load in spring:	100%	100%	41%
Per cent phosphorus load in spring:	100%	100%	32%

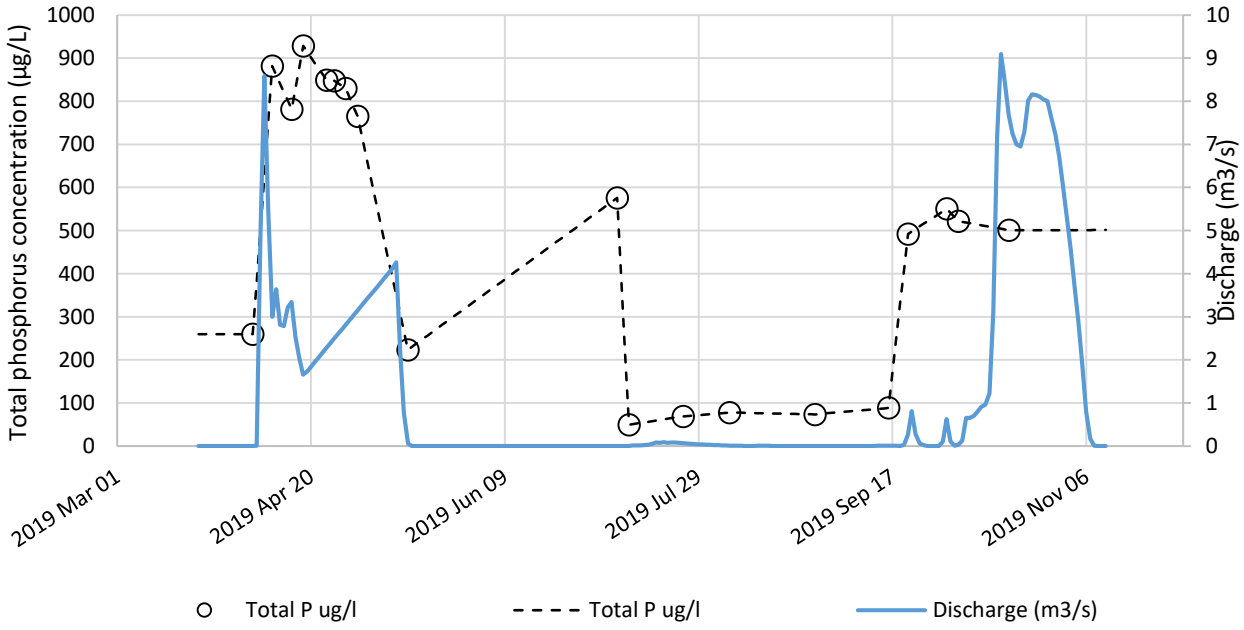


Figure 17. Discharge and total phosphorus concentration over the 2019 sampling season at Main Drain near Dominion City (Water Survey of Canada Station 05OD028).

Sampling sites without flow data

Seine River at Marchand

The Seine River at Marchand, Man. sampling site drains the headwaters of the Seine River watershed, which mainly includes drained low-lying land and cattle pasture.

This sampling site is located near Marchand. In 2019, 20 samples were collected between April 2 and Oct. 9. We cannot calculate phosphorus loads and exports because flow is not measured at this sampling site.

- **2017 greatest phosphorus concentration**: 750 µg/L measured on March 28
- **2018 greatest phosphorus concentration**: 209 µg/L measured on April 27
- **2019 greatest phosphorus concentration:** 1529 µg/L measured on April 8

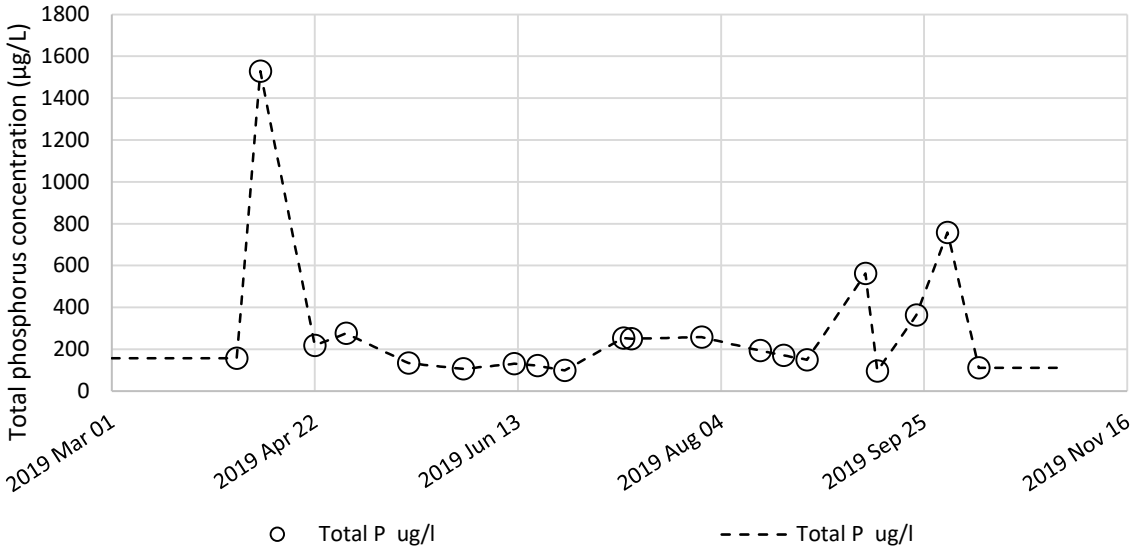


Figure 18. Total phosphorus concentration over the 2019 sampling season at Seine River at Marchand.

Hope Creek near La Broquerie

The Hope Creek sampling site drains dense forage crops and pastures that are spread with hog manure. This sampling site drains recently cleared forest and drained wetlands.

This sampling site is located near La Broquerie, Man. In 2019, 10 samples were collected between April 7 and Sept. 16. We cannot calculate phosphorus loads and exports because flow is not measured at this sampling site.

- **2018 greatest phosphorus concentration**: 237 µg/L on Aug. 4
- **2019 greatest phosphorus concentration**: 1,023 µg/L on April 7

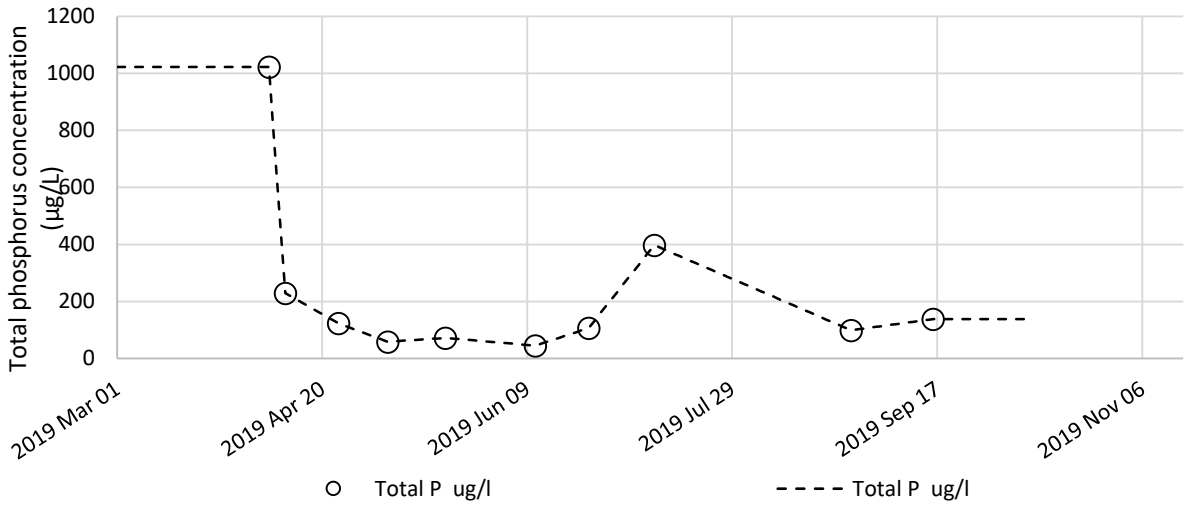


Figure 19. Total phosphorus concentration over the 2019 sampling season at Hope Creek near La Broquerie.

City of Steinbach sampling sites

Located in the Manning Canal drainage area, Steinbach, Man. the third largest city in Manitoba, is home to 15,829 residents (Statistics Canada, 2016 Census). Urban areas like Steinbach can contribute to phosphorus loads through wastewater effluent and urban runoff, as impervious surfaces such as roads, parking lots and sidewalks do not retain water.

Volunteers collected samples at two sites upstream and two sites downstream of Steinbach. Upstream 2 and Downstream 2 are on the mainstem that receives water from Steinbach and its wastewater lagoons. Upstream 1 and Downstream 1 are on a tributary to the mainstem that flows directly through the city and into the mainstem. The Downstream 1 sampling site is located slightly downstream from the city proper, while Downstream 2 is located downstream of Steinbach's wastewater lagoons, enabling wastewater contributions to be assessed.

Based on the data currently available, it is not possible to determine how much Steinbach is contributing to the phosphorus load of the Manning Canal drainage area due to the lack of discharge data for these three sites. In other words, we cannot calculate phosphorus loads and exports because flow is not measured. In 2019, LWCBMN installed water level meters at all four sampling sites, the first step towards enabling us to calculate phosphorus loads and exports. In 2020, LWCBMN will begin collecting flow data at these sites to establish a discharge curve, based on the relationship between flow and water level. Once the curve is established, we can use water level data to retroactively calculate the flow at these sites for 2019.

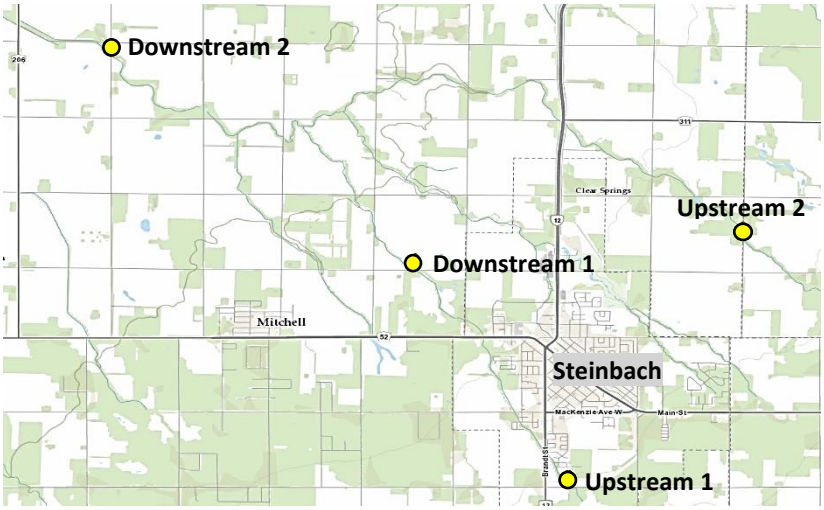


Figure 20. Map of sampling sites upstream and downstream of the City of Steinbach.

Steinbach - Downstream 2

This sampling site is located in the Manning Canal watershed. It is the most downstream of the Steinbach sites, and receives water from Steinbach and the Steinbach wastewater lagoons.

In 2019, 15 samples were collected between March 27 and Oct. 29. Water level meters were installed on July 19 and removed on Nov. 6.

- **2018 greatest phosphorus concentration:** 1,287 µg/L on April 15
- **2019 greatest phosphorus concentration:** 1,649 µg/L on April 6

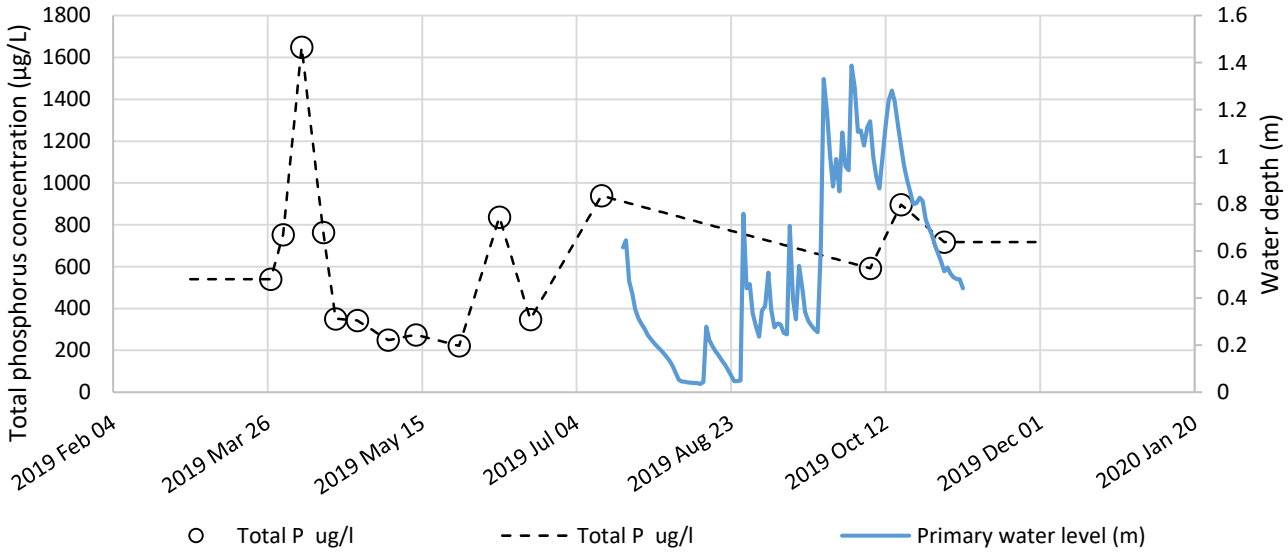


Figure 21. Total phosphorus concentration and water depth over the 2019 sampling season at Steinbach Downstream 2.

Steinbach – Upstream 2

This sampling site is located in the Manning Canal watershed, situated upstream of the Steinbach wastewater lagoons and the Steinbach Downstream 2 sampling site.

In 2019, 26 samples were collected between March 27 and Nov. 1. Water level meters were installed on Aug. 17 and removed Nov. 6.

- **2019 greatest phosphorus concentration**: 1,443 µg/L on April 6

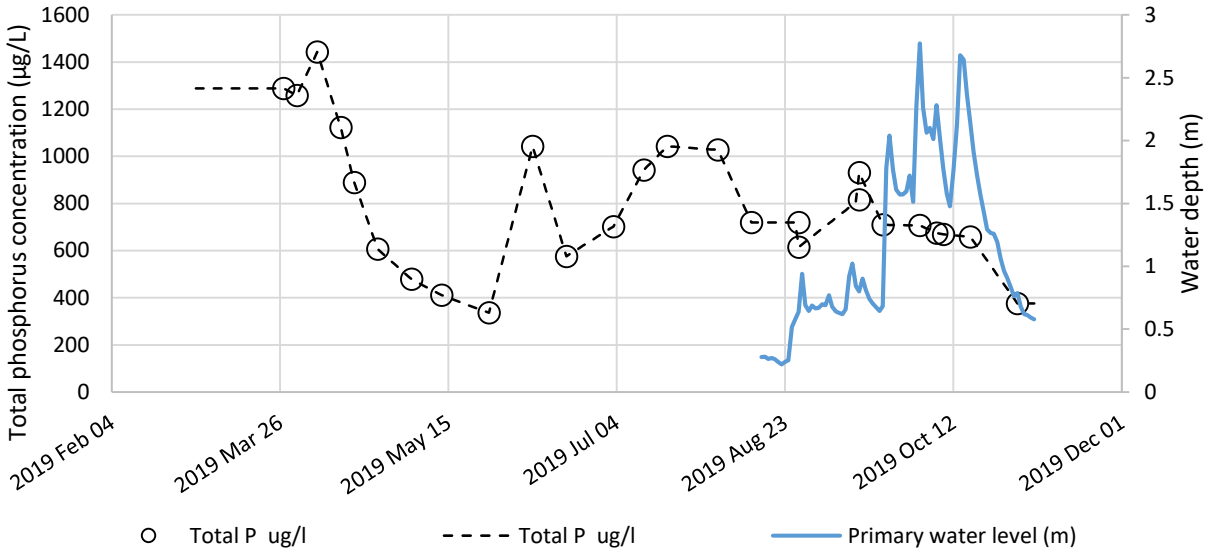


Figure 22. Total phosphorus concentrations and water depth over the 2019 sampling season Steinbach Upstream 2.

Steinbach – Downstream 1

This sampling site is located in the Manning Canal watershed, directly downstream of Steinbach. This sampling site is on a tributary that flows through the city.

In 2019, 22 samples were collected between March 27 and Oct. 17. Water level meters were installed on Aug. 4 and removed on Nov. 6.

- **2018 greatest phosphorus concentration:** 618 µg/L on May 18
- **2019 greatest phosphorus concentration:** 1,242 µg/L on July 19

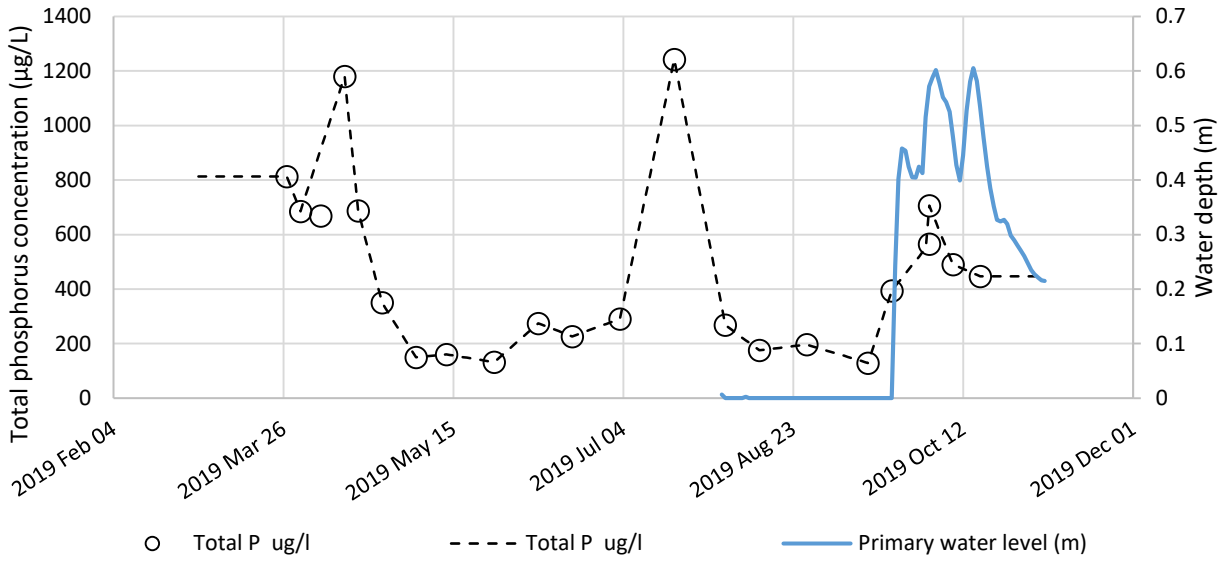


Figure 23. Total phosphorus concentrations and water depth over the 2019 sampling season at Steinbach Downstream 1.

Steinbach – Upstream 1

This sampling site is located in the Manning Canal watershed, directly upstream of Steinbach. It is situated on a tributary that flows through the city.

In 2019, 10 samples were collected between April 6 and Oct. 8. Water level meters were installed on July 11 and removed on Nov. 5.

- **2018 greatest phosphorus concentration:** 1,287 µg/L on April 15
- **2019 greatest phosphorus concentration:** 2,175 µg/L on April 6

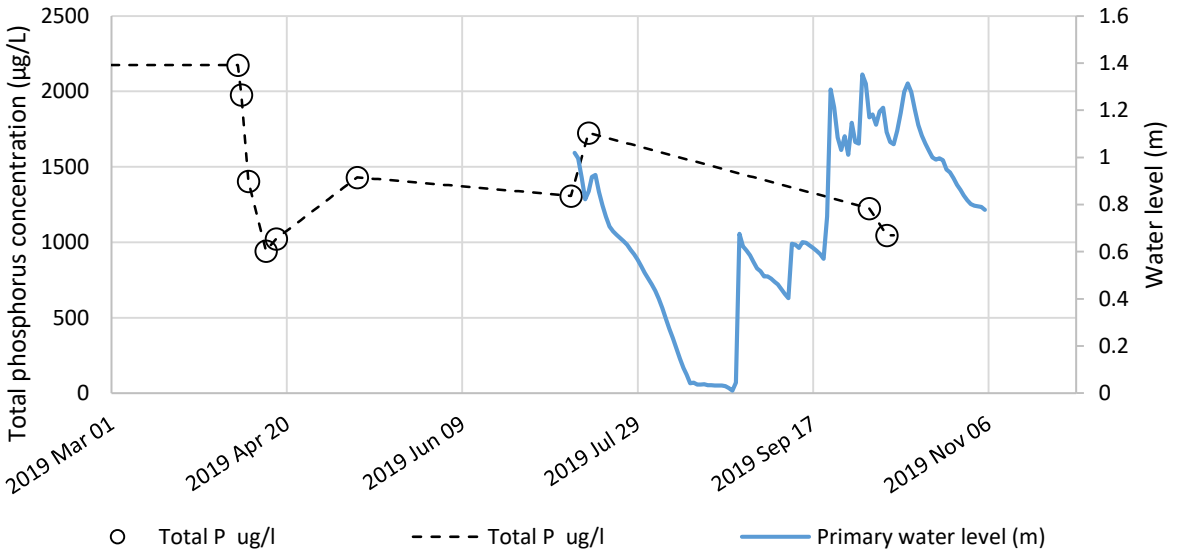


Figure 24. Total phosphorus concentration and water level over the 2019 sampling season at Steinbach Upstream 1.

DeSallaberry Retention Project

The DeSallaberry Retention Project is built on crown land in the Rat River watershed. Water levels at this sampling site are being managed by the International Institute for Sustainable Development (IISD) in partnership with the SRRWD to enhance wetland benefits.

In 2019, 20 samples were collected between April 8 and Nov. 19 at the inlet sampling site; and 13 samples were collected between April 16 and Nov. 19 at the outlet sampling site.

We do not have flow data for this site at this time so phosphorus retention in the system could not be assessed. It is worth noting that phosphorus concentrations are generally higher in water leaving the site, compared to water entering the site. Flow data is critical to understanding the impacts of this change.

- **2019 greatest phosphorus concentration at inlet:** 543 µg/L on April 8
- **2019 greatest phosphorus concentration at outlet:** 795 µg/L on July 17

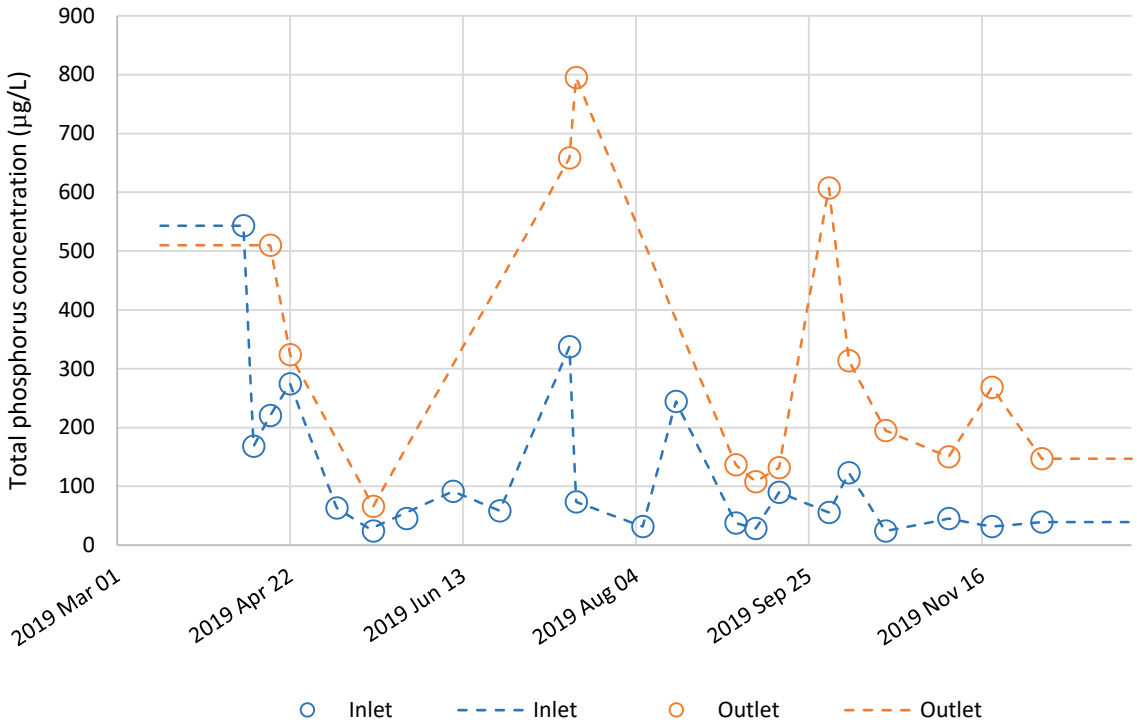


Figure 25. Total phosphorus concentration over the 2019 sampling season at DeSallaberry Inlet and Outlet.

Omega Retention Project

The Omega Retention Project was built in 2018 and is located within the Manning Canal hotspot in the SRRWD. The primary goal of the retention project is to reduce peak water flows. The structure is capable of holding 38 acre/feet of water.

In 2019, three samples were collected between April 8 and April 23 at both the inlet and outlet sampling sites.

We do not have flow data for this site at this time so phosphorus retention in the system could not be assessed.

- **2019 greatest phosphorus concentration at inlet:** 704 µg/L on April 8
- **2019 greatest phosphorus concentration at outlet:** 458 µg/L on April 8

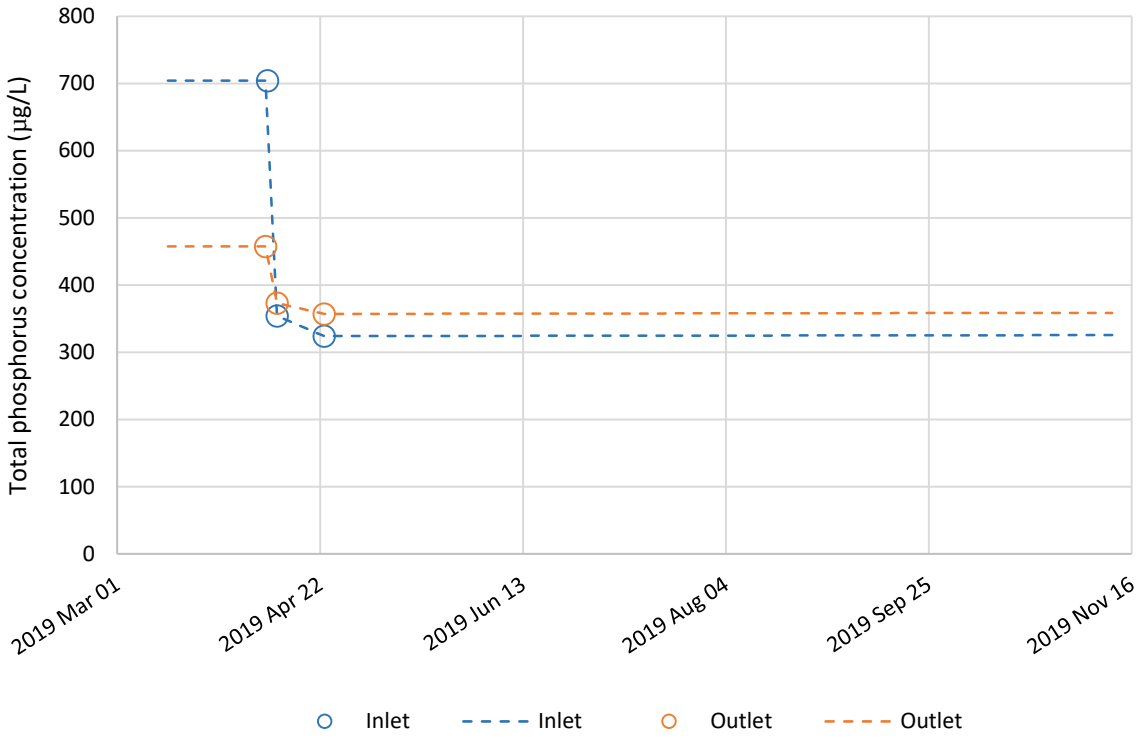


Figure 26. Total phosphorus concentration over the 2019 sampling season at Omega Retention Project Inlet and Outlet.

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LWCBMN is a collaborative initiative delivered in partnership with Manitoba's watershed districts, LWF's science advisors and volunteer citizen scientists.

MONITORING OUR WATERWAYS

To reduce phosphorus loading, we need to know how, when and from where phosphorus is reaching Lake Winnipeg. The Lake Winnipeg Community-Based Monitoring Network (LWCBMN) is a long-term phosphorus monitoring program that engages citizen volunteers to collect water samples across Manitoba using scientific protocols. Because citizen scientists live, work or commute near their sampling sites, they can sample frequently in response to weather events and water conditions, generating critical data to inform research and policy.

The Lake Winnipeg Foundation (LWF) advocates for change and coordinates action to improve the health of Lake Winnipeg. LWF's flagship initiative, the Lake Winnipeg Health Plan, is a set of eight evidence-based actions to reduce phosphorus loading. By addressing the root causes of potentially harmful algae blooms, the plan provides a blueprint for cost-effective decision-making and long-term, adaptive freshwater management.