SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
W239 N1812 ROCKWOOD DRIVE • PO BOX 1607 • WAUKESHA, WI 53187-1607 • TELEPHONE (262) 547-6721

Serving the Counties of: KENOSHA
MILWAUKEE
OZAUKEE
RACINE
WALWORTH
WASHINGTON
WAUKESHA

Staff Memorandum

LAC LA BELLE WATER AND PHOSPHORUS STUDY, WAUKESHA COUNTY, WISCONSIN

April 28, 2026

Lac La Belle (Lake) is a 1,186-acre two-story lake located in the City of Oconomowoc and the Village of Lac La Belle in western Waukesha County. Situated within the Rock River Basin, the Lake is the last lake in a chain of lakes along the Oconomowoc River, which is the primary tributary and outflow for the Lake. Like other lakes in the Rock River Basin, the Lake suffers from excessive total phosphorus concentrations, for which it has been listed on the 303(d) impaired water list since 2020.[1] Due to the multiple impairment listings within the Rock River Basin, a TMDL (Total Maximum Daily Load) study for phosphorus and sediment was developed for the Rock River basin and its tributaries and was approved in 2011. This TMDL establishes phosphorus and sediment load reduction goals for the Oconomowoc River as a reach of the larger Rock River basin.[2] In order to achieve these water quality goals, the City of Oconomowoc (City) has developed the Oconomowoc Watershed Protection Program (OWPP) to build capacity and develop collaborative projects within the watershed.[3] The Lac La Belle Management District (District), the City, and the OWPP are concerned about the Lake's impairment listing and are working to reduce phosphorus loads to Lac La Belle.

To help efficiently focus management planning efforts, the District requested that the Commission develop an updated water and phosphorus budget for Lac La Belle. In response to this, the District executed an agreement with the Southeastern Wisconsin Regional Planning Commission (Commission or SEWRPC) to study the Lake's water and phosphorus sources and contributions and outflow from the Lake. The Commission has previously produced two water quality management plans for the Lake (in 1980 and an update in 2007), both of which also provided information on the Lake's water budget and phosphorus loads.[4,5] This updated study included data collection by City and OWPP staff as well as review of readily available existing data sources regarding water and phosphorus contributions to the Lake. Study findings are summarized in this staff memorandum and are used to identify areas of concern and suggest methods that should help reduce phosphorus loads reaching the Lake.

---

[1] *apps.dnr.wi.gov/water/impairedDetail.aspx?key=11489.*

[2] *USEPA and WDNR*, Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids in the Rock River Basin Columbia, Dane, Dodge, Fond du Lac, Green, Green Lake, Jefferson, Rock, Walworth, Washington, and Waukesha Counties, Wisconsin, *prepared by the CADMUS Group, July 2011*.

[3] *www.oconomowoc-wi.gov/749/Oconomowoc-Watershed-Protection-Program.*

[4] *SEWRPC Community Assistance Planning Report No. 47,* A Water Quality Management Plan for Lac La Belle, Waukesha County, Wisconsin*, 1980*.

[5] *SEWRPC Community Assistance Planning Report No. 47 (2nd Edition),* A Water Quality Management Plan for Lac La Belle, Waukesha County, Wisconsin*, 2007*.

LAKE AND WATERSHED CHARACTERISTICS

The Wisconsin Department of Natural Resources (WDNR) classifies Lac La Belle as a two-story lake, meaning that the Lake should be deep enough to support a layer of deep, cold, and well-oxygenated water. Due to this classification, the Lake has more stringent total phosphorus criteria (at 0.015 mg/l) than other lakes. Cisco (*Coregonus artedi*) is a cold-water fish species that used to be found in great abundance within Lac La Belle in the 1920s,[6] but they have not been observed within the Lake since at least 2013.[7] Although Lac La Belle attains a maximum depth of 45 feet, the Lake is predominantly shallow with a mean depth of only 11 feet (see Map 1).[8] About 38 percent of the lake area has a water depth of less than five feet, 28 percent of the lake area has a water depth between five and 10 feet, 12 percent has a water depth between 10 and 20 feet, and 22 percent has a depth of more than 20 feet. Lac La Belle is 2.6 miles long and 1.2 miles wide at its widest point. The major axis of the Lake lies in a northwesterly-southeasterly direction. The Lake contains two islands connected to the shore by roadways. The shore length is 11.2 miles, and the shoreline development factor is 2.01, indicating that the lake shoreline is irregular and about twice as long as that of a circular lake of the same area. The Lake has a total volume of approximately 12,924 acre-feet. The Lake is impounded by the Lake Labelle dam, which is owned and operated by the City of Oconomowoc (City).[9]

Based on updated mapping by the Commission, Lac La Belle has a 63,100-acre watershed, with 7,255 acres contributing directly to the Lake via either direct runoff or tributaries and the remaining 55,845 acres flowing through the upstream chain of lakes along the Oconomowoc River and into the Lake via the Fowler Lake outlet dam (see Map 2).[10] The Oconomowoc River forms the major inflow to the Lake, entering Lac La Belle on the southeastern shore directly downstream from the Fowler Lake dam spillway and mill race (also known as the "Peacock Dam").[11] In addition to the Oconomowoc River, the Lake receives inflow from Rosenow Creek, Cottonwood Creek (also known as "Golf Course Creek"), and Saeger Creek as well as direct runoff from lands surrounding the Lake. Saeger Creek is an intermittently flowing stream that drains a 436-acre area to the northwest of the Lake primary comprised of wetlands and woodlands but also contains agricultural and residential land uses and a stretch of Hwy 16; a portion of this watershed is within a conservation easement established by the Tall Pines Conservancy.[12] Cottonwood Creek is also an intermittently flowing stream that drains a 1,511-acre area north of the Lake primarily comprised of cultivated agricultural lands and to a lesser extent suburban residential lands and woodlands. The lower portion of the Creek drains and runs through the Club at Lac La Belle golf course before entering the Lake on its northern shore. Rosenow Creek is a perennial stream draining a 3,357-acre area east of the Lake primarily comprised of suburban residential use and cultivated agricultural lands as well as wetlands and woodlands in the northern part of the watershed and along the riparian corridor. Portions of the Oconomowoc Golf Club drain to Rosenow Creek. The remainder of the lake-direct drainage area is 1,951 acres and largely drains fairly dense residential and commercial land uses around the Lake, including portions of the downtown City of Oconomowoc area.

---

[6] *Alvin Robert Cahn, An Ecological Study of Southern Wisconsin Fishes,* Illinois Biological Monographs*, Volume XI, No. 1, January 1927.*

[7] *John Lyons, Jeff Kampa, Tim Parks, & Greg Sass, The Whitefishes of Wisconsin's Inland Lakes: the 2011-2014 Wisconsin Department of Natural Resources Cisco and Lake Whitefish Survey, Fisheries and Aquatic Research Section, Wisconsin Department Natural Resources, February 2015*

[8] *apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=848800&page=facts.*

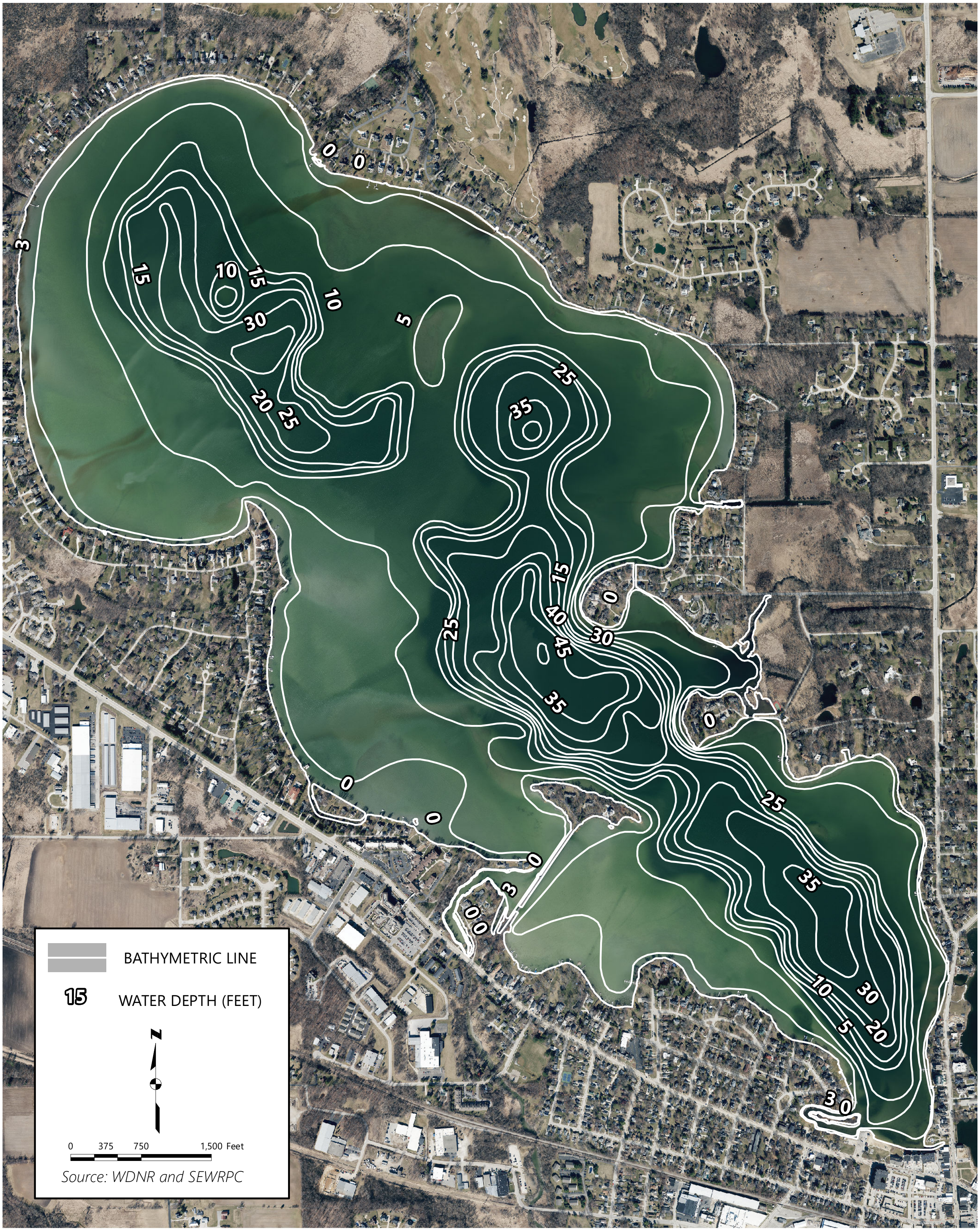
[9] *apps.dnr.wi.gov/dam/Dam/Detail/1570.*

[10] *This watershed acreage does not include the 1,186 acres of the Lake surface but does include 3,695 acres of mapped internally draining areas.*

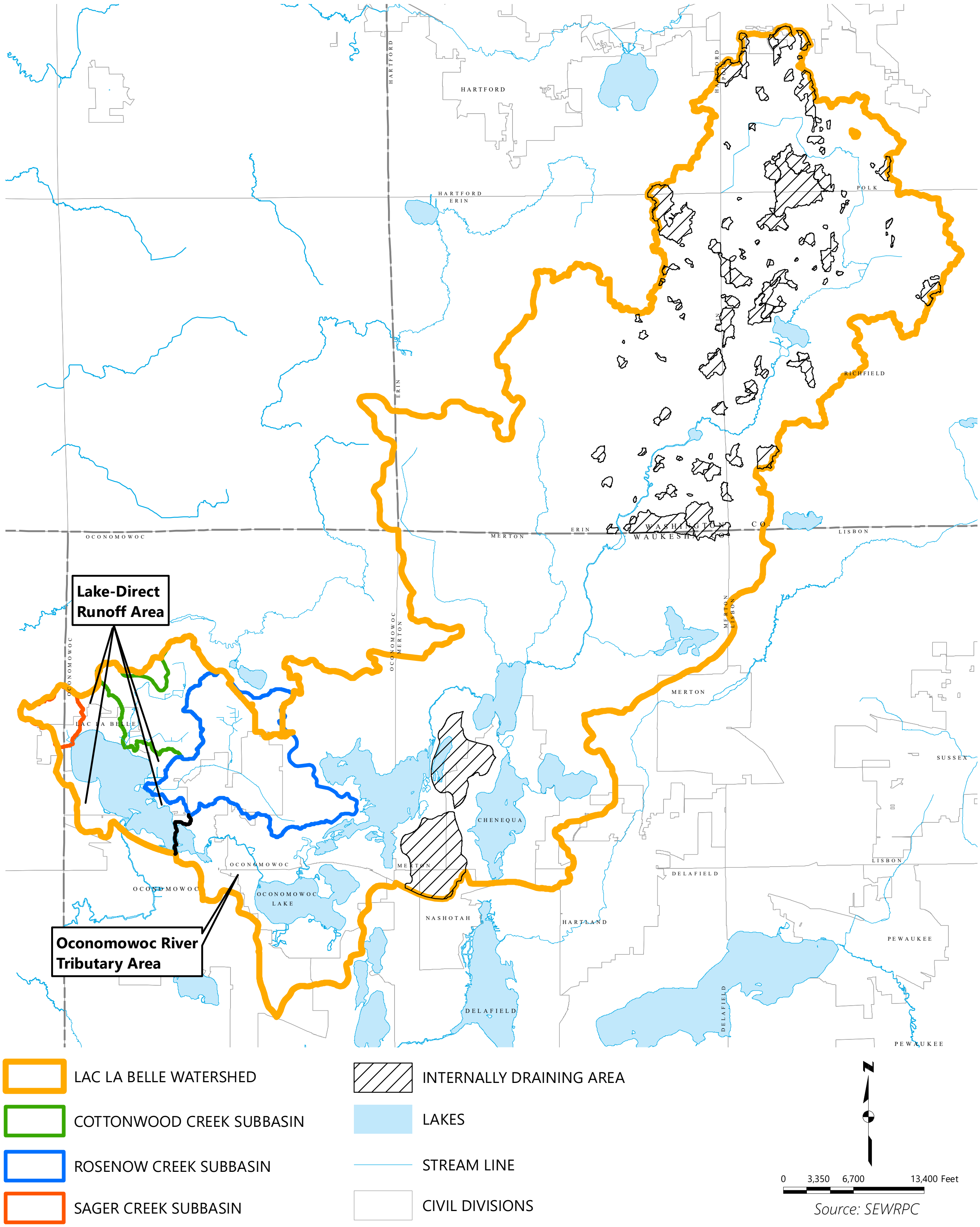
[11] *apps.dnr.wi.gov/dam/Dam/Detail/650.*

[12] *tallpinesconservancy.org/saeger-creek.*

Map 1
Bathymetric Map of Lac La Belle



Map 2
Lac La Belle Watershed and Direct Tributary Subbasins



Source: SEWRPC

WATER CONTRIBUTIONS AND OUTFLOW

Historical Water Budget

The 2007 update to the Lac La Belle water quality plan provided an updated annual water budget using 1931 through 2001 as the period of record.[13] This analysis assumed no net change in lake level. Approximately 37,100 acre-feet of water entered the Lake as surface runoff and approximately 3,000 acre-feet contributed by direct precipitation onto the lake surface. Of this volume, about 2,800 acre-feet were lost to evaporation from the lake surface, approximately 2,500 acre-feet through groundwater outflows, and about 34,800 acre-feet through surface water outflows through the Oconomowoc River, assuming no net change in lake level during this period. For the 1931 through 2001 period, the Oconomowoc River contributed about 92 percent of the known inflow to the Lake with direct precipitation onto the Lake's surface accounting for the balance of about 8 percent of the total inflow. Evaporation from the Lake's surface accounted for about 7 percent of the outflow, groundwater outflows for about 6 percent, and surface outflows via the Oconomowoc River for the balance of about 87 percent.

Groundwater

The water budget presented in the 2007 lake water quality plan estimated that groundwater constituted an annual net outflow of 2,500 acre-feet from the Lake based on groundwater estimates from the original 1976-1977 lake study.[14] These original estimates assumed that groundwater outflows accounted for a 0.4-foot decrease in the Lake level during the study period. As there has been no consistent groundwater elevation monitoring in the area near Lac La Belle since publication of the 2007 plan, the groundwater inflow and outflow to the Lake could not be independently assessed for this study. However, since the completion of that plan, several high-capacity wells have been built in the immediate area to provide water supply for residential and recreational land uses.[15] Based on the predominant flow of groundwater to the southeast, the wells located north of the Lake may reduce groundwater contributions to the Lake while wells to the south may increase groundwater outflow from the Lake (see approximate delineation of groundwatershed of Lac La Belle in Map 3).[16] Consequently, the current net outflow from the Lake to groundwater may exceed the 2,500 acre-feet presented in the 2007 water budget. However, this groundwater outflow may be offset from the increase in annual precipitation rates since the 2007 plan, which could be supplementing shallow groundwater contributions to the Lake. An updated net groundwater flow is presented in "Water Flow Analysis" later in this report.

Evaporation and Precipitation

The water budget presented in the 2007 water quality plan assumed an annual loss of 2,800 acre-feet from the Lake due to evaporation based on regional evaporation rates of approximately 29 inches per year. This water loss constituted 7 percent of the outflow of water from the Lake.[17] In the preparation of this study, Commission staff estimated an annual evaporation rate based on daily evaporation rates measured at the weather station at the Mitchell International Airport in Milwaukee between 1940 and 2024. Although the annual evaporation rate does slightly fluctuate between years, the average annual evaporation rate of 30 inches per year utilized in the 2007 water quality plan is still a reasonable estimate based on these updated calculations. Based on the relatively consistent evaporation rate and lake size, the estimated outflow of 2,800 acre-feet due to evaporation from the 2007 plan is also a reasonable estimate.

The 2007 water budget estimated that direct precipitation to the Lake surface contributed 3,000 acre-feet to the Lake based on an annual precipitation rate of 30.9 inches per year. Based on the 2006-2020 climate normals for the Oconomowoc wastewater treatment facility, Lac La Belle receives an average of 38.7 inches

---

[13] *SEWRPC CAPR 47 (2nd Edition), 2007,* op. cit.

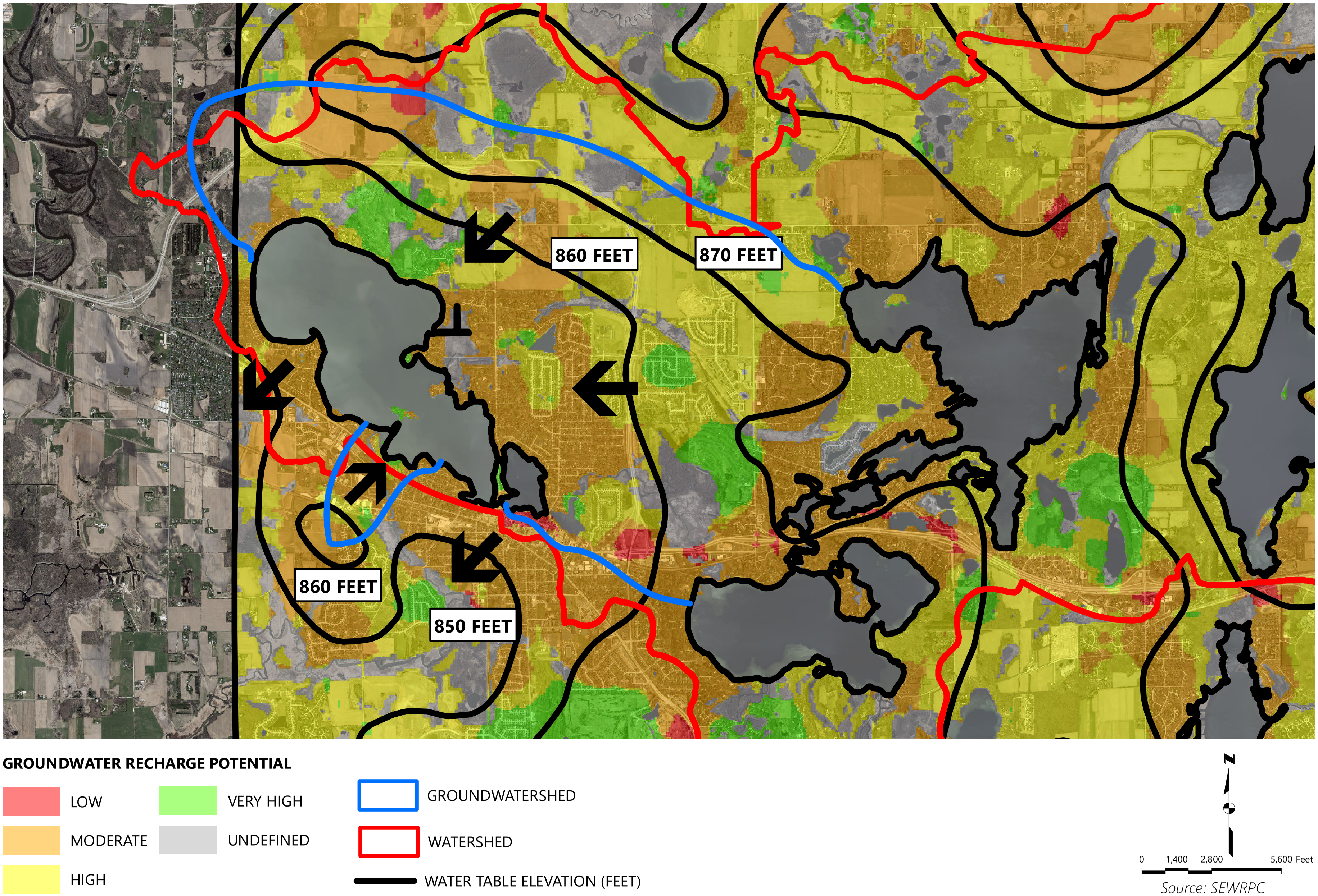
[14] *SEWRPC CAPR 47 (2nd Edition), 2007,* op. cit.

[15] *See the WDNR Water Quantity Data Viewer for more information regarding high-capacity well locations and withdrawals: dnrmaps.wi.gov/H5/?viewer=Water_Use_Viewer.*

[16] *For more information on groundwater in the Lac La Belle area, see the discussion in the 2024 Commission Staff Memorandum,* Identifying Important Areas for Enhancing Water Quality and Quantity on Village of Lac La Belle Property, *February 2024.*

[17] *SEWRPC CAPR 47 (2nd Edition), 2007,* op. cit.

Map 3
Potential Groundwater Recharge, Flow Direction, and Water Table Elevations Surrounding Lac La Belle



Source: SEWRPC

of precipitation per year, which is a substantial increase from the previous estimate.[18] Consequently, the Lake currently receives an estimated 3,828 acre-feet annually from direct precipitation to the Lake surface.

To provide context for analyses in this study, Commission staff compiled daily precipitation data between February 1st, 2024 and March 31st, 2025 collected at the nearby Oconomowoc Wastewater Treatment Facility weather station (see Figure 1). This period coincides with streamflow and total phosphorus monitoring conducted by OWPP discussed later in this report. During this period, the weather station recorded a total of 41 inches of precipitation with precipitation falling on 117 days out of the 425-day period. Daily precipitation was over one inch for twelve of these days, with the highest daily total at 1.7 inches on August 2nd, 2024. Several large rainfall events occurred on or immediately preceding OWPP streamflow and total phosphorus concentrations, resulting in particularly high measurements due to rainfall runoff.

Lake Elevations and Residence Time

The City of Oconomowoc monitored daily lake elevations on Fowler Lake and Lac La Belle between January 2024 and February 2025. As illustrated in Figure 2, the elevations in Fowler Lake ranged between 859.56 and 860.24 feet above mean sea level for differential of 0.68 feet, which corresponds to a change in volume of approximately 66 acre-feet. In Lac La Belle, the elevations ranged between 850.59 and 852.52 feet above mean sea level for a differential of 1.93 feet, which corresponds to a change in volume of approximately 2,289 acre-feet. Due to the large but shallow morphology of the Lake, this change in volume between the lowest and highest elevations constitutes almost 20 percent of the total estimated volume of the Lake. The most rapid increases in lake volume occur immediately following large rainfall events.

Using the estimated annual precipitation rate of 38.74 inches and an evaporation rate of 30 inches across the contributing watershed to Lac La Belle results in a watershed yield of 45,082 acre-feet per year. Combining this watershed yield with the net gain of 900 acre-feet in precipitation minus evaporation from the Lake surface results in 45,982 acre-feet of inflow. Based on the estimated volume of the Lake at 12,924 acre-feet, the Lake residence time is 0.28 years.[19] This residence time is shorter than the 0.32 years estimated in the 2007 water quality plan, which reflects the increase in annual precipitation and stability in annual evaporation rates since the publication of that plan.

Modeled Streamflow

Commission staff utilized the Presto-Lite component of the WDNR Water Explorer (WEx) tool to estimate streamflow for each Lake tributary at the five, fifty, and ninety-five percent flow exceedances as well as for the Lake outflow (see Table 1).[20] As the annual precipitation rates that each tributary receives are similar, the estimated discharge from each tributary scales linearly with the size of the contributing drainage area. Consequently, the estimated Oconomowoc River discharge is over twenty times greater at each flow exceedance than Rosenow Creek, which had the second highest estimated discharge of any tributary. The estimated discharge from Cottonwood Creek and Saeger Creek, the two intermittently flowing streams, were substantially lower and were approaching zero discharge at 95 percent flow exceedance. By subtracting the combined tributary inflow discharge from the estimated Lake outflow discharge, Commission staff could estimate the additional water contributions from lake-direct runoff and direct precipitation on the Lake. These contributions amounted to an equivalent of 4.1 cfs at fifty percent flow exceedance, which would be the second highest inflow (8.3 percent of outflow) from any source following the Oconomowoc River (86.6 percent of outflow).

Commission staff utilized the median streamflow from the flow exceedance curve for the Lac La Belle outflow to estimate annual median outflow from the Lake. The median discharge of 50.6 cfs was converted into an annual outflow of 36,850 acre-feet. This estimate is slightly higher than the 34,800 acre-feet of outflow modeled in the 2007 plan, which corresponds with more water flow through the Lake with increased

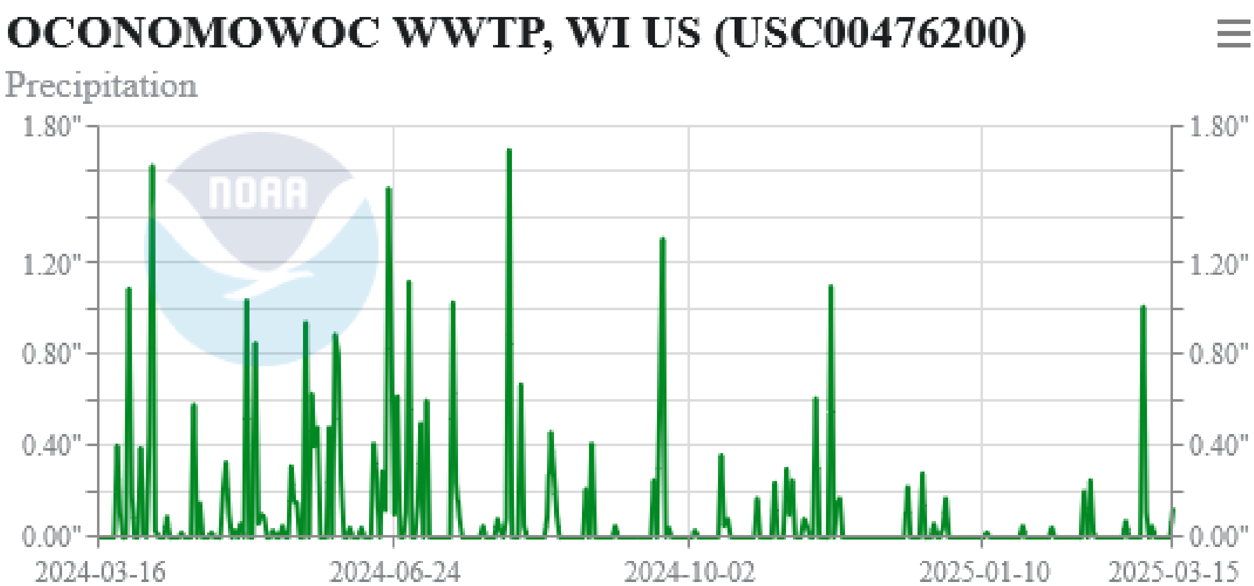
---

[18] *www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-annualseasonal&timeframe=15&station=USC00476200.*

[19] *This volume was estimated in the 2007 water quality plan. However, the mapped lake acreage has slightly increased since the publication of that plan meaning that the volume may be slightly higher than this figure. Additionally, both the Fowler Lake and Lac La Belle outlet dams were reconstructed (in 2002 and 2012, respectively) which may also have changed the total lake volume since the 2007 plan.*

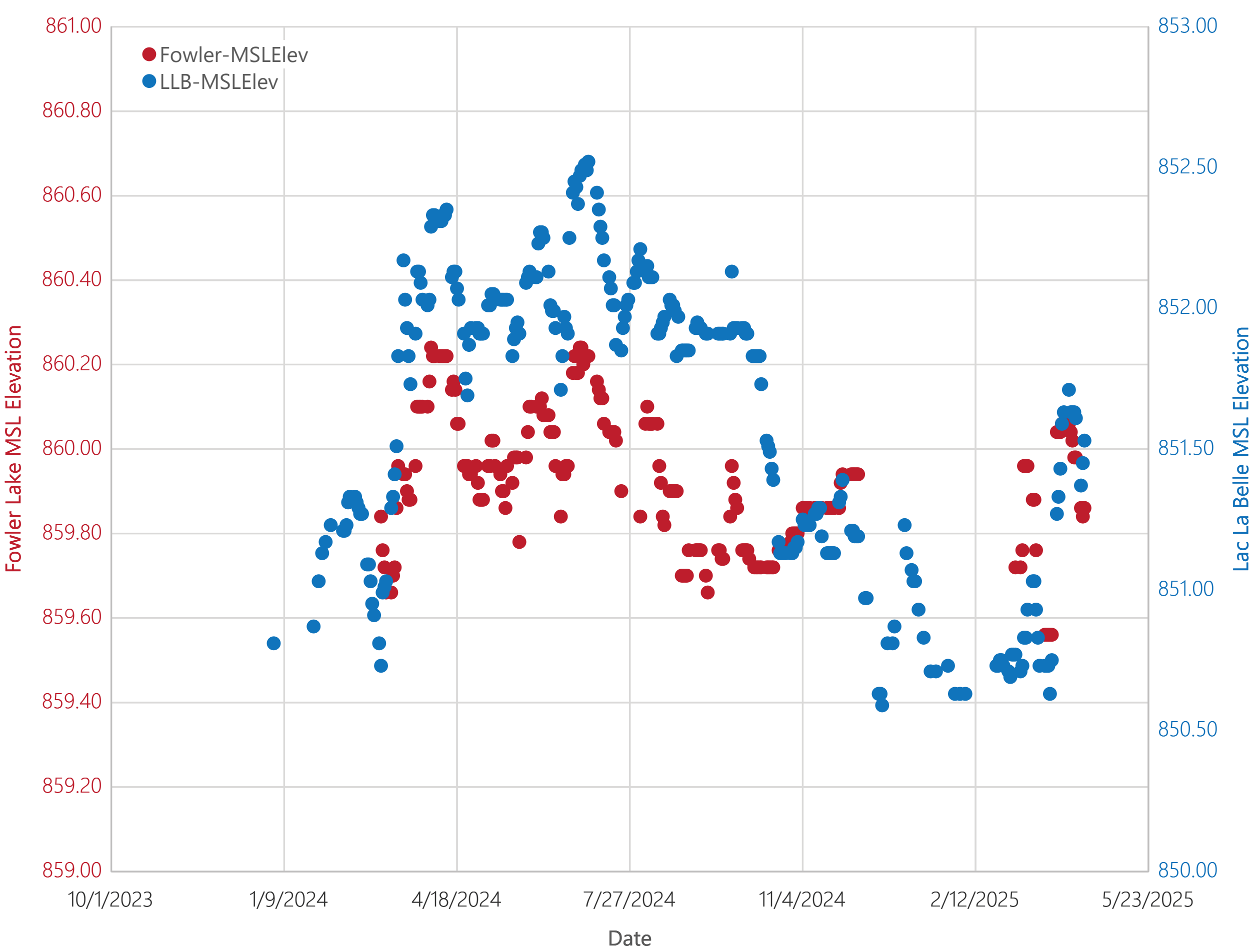
[20] *See the following link for more information on the WDNR Presto-Lite model: dnr.wisconsin.gov/topic/SurfaceWater/PRESTO.html.*

Figure 1
Precipitation Recorded at the Oconomowoc Wastewater Treatment Facility: 03/2024 – 03/2025



Source: NOAA and SEWRPC

Figure 2
Lac La Belle and Fowler Lake Elevations: January 2024 – April 2025



Source: OWPP and SEWRPC

Table 1
Modeled Streamflow and Total Phosphorus Loads from the WDNR Presto-Lite and WiLMS Models

Name	Acres	Discharge (cfs) at Flow Exceedance			Percent of Outflow Discharge (%)			Total Phosphorus (Presto-Lite)			Total Phosphorus (WiLMS)			Predominant Total Phosphorus Source (WiLMS)	Phosphorus per Acre (Presto Avg.)	Phosphorus per Acre (WiLMS Avg.)
		5%	50%	95%	5%	50%	95%	Avg	Low	High	Avg	Low	High			
Cottonwood Creek	1,511	2.58	0.58	0.14	2.0	1.2	1.0	929	476	1,816	742	382	2,071	Agriculture (84.1%)	0.61	0.49
Saeger Creek	436	0.59	0.16	0.04	0.5	0.3	0.3	255	126	514	149	78	394	Agriculture (73.8%)	0.58	0.33
Rosenow Creek	3,357	5.35	1.82	0.48	4.2	3.6	3.3	1,068	542	2,106	1,580	802	4,447	Agriculture (82.7%)	0.32	0.47
Oconomowoc River	55,845	109.00	43.30	12.50	86.5	86.6	86.8	1,943	936	4,034	19,285	9,528	51,513	Agriculture (66.3%)	0.03	0.35
Tributary Inflow[a]	61,149	117.50	45.90	13.20	93.3	91.7	91.4	4,195	2,080	8,470	21,756	10,790	58,425	N/A	0.07	0.36
Lake-Direct Inflow[a]	3,137	8.50	4.10	1.20	6.7	8.3	8.6	5,135	2,674	9,839	738	328	2,146	N/A	1.64	0.24
Lac La Belle Outflow	64,286	126.00	50.00	14.40	100.0	100.0	100.0	9,330	4,754	18,309	22,494	11,118	60,571	Agriculture (67.1%)	0.15	0.35

Note: WiLMS stands for the Wisconsin in-Lake Modeling Suite.

[a] *Tributary Inflow is the sum of the lake tributaries while Lake-Direct Inflow is the remainder of the Lac La Belle outflow from the Tributary Inflow.*

Source: WDNR and SEWRPC

annual precipitation. However, this estimate is likely an underestimate as streamflow is often not normally distributed and is skewed towards higher flows.

Water Flow Analysis

The simplified lake water budget utilized for this analysis is composed of the following equation:

$$\Delta S = P + Q_{in} + G_{in} – E - Q_{out} - G_{out}$$

where ΔS is the change in lake storage, P is the annual precipitation to the lake surface, Q_{in} is the surface water inflow to the Lake, G_{in} is the groundwater inflow, E is the evaporation from the lake, Q_{out} is the surface water outflow, and G_{out} is the groundwater out. Assuming the annual lake storage remains level (as was done in the 2007 plan), this equation can be rearranged as follows:

$$\Delta G = P + Q_{in} – E - Q_{out}$$

where ΔG is the difference in the groundwater inflow minus the groundwater outflow, which is solved by inputting the other water flow components. For the remaining terms, P is 3,828 acre-feet per year, Q_{in} is 45,082 acre-feet per year, E is 2,800 acre-feet per year, and Q_{out} is 36,850 acre-feet per year. Completing the equation results in a net groundwater outflow of 9,260 acre-feet from the Lake each year meaning that the Lake receives much less groundwater than it loses each year. This outflow, which is substantially higher than the 2,500 acre-feet estimated in the 2007 plan, may be an overestimate due to the likely underestimate of Q_{out} by using on the median discharge from the flow exceedance curve. However, as described in the "Groundwater" section above, there have been numerous high-capacity wells installed around the Lake that may be reducing groundwater contributions and increasing exports. Further groundwater monitoring and/or modeling would be required to confirm groundwater flow estimates for the Lake. In addition, more detailed and synchronized flow monitoring of both Fowler Lake and Lac La Belle water levels and development of more accurate stage-discharge relationships for each lake would also help quantify groundwater gains and/or losses.

Monitored Streamflow

As there is no streamflow gaging station on the Oconomowoc River, the 2007 water quality plan utilized streamflow measured on the Rock River to estimate the Lake water budget.[21] Commission staff compiled available streamflow data from the United States Geological Survey (USGS) stream gaging stations on the Bark River on Nagawicka Road (USGS 5426067) and the Rock River in Watertown (USGS 5425500), downstream of the confluence between the Oconomowoc and Rock Rivers (see Figure 3).[22,23] In the 2000 water year, the Rock River at Watertown had a median discharge of 427 cubic feet per second (cfs), with a minimum discharge of 47 cfs and a maximum of 3,570 cfs. In comparison, the Rock River at Watertown had a median discharge of 703 cfs between 2015 and 2025, with a minimum discharge of 13.3 cfs and a maximum of 4,560 cfs. Based on this lower discharge, either the 2000 water year represented a drier year than the average conditions in the past decade or the Rock River discharge may have increased with increasing annual precipitation. During the 2015 – 2025 period, the Bark River had a median discharge of 30.2 cfs with a minimum of 4.82 cfs and a maximum of 356 cfs.[24] Both the Bark and Rock Rivers had higher annual discharge during 2016 through 2020 before having lower than normal discharge in 2021 and a return to more normal levels in subsequent years (except for August 2025).

Between February 2025 through March 2025, OWPP staff measured streamflow at several locations around Lac La Belle: on Cottonwood Creek by a bridge in the Club of Lac La Belle golf course, on Rosenow Creek at Blackhawk Drive and near the Burtonwood neighborhood, immediately downstream of the Fowler Lake outlet dam, and immediately downstream of the Lac La Belle outlet dam as well as the auxiliary spillway

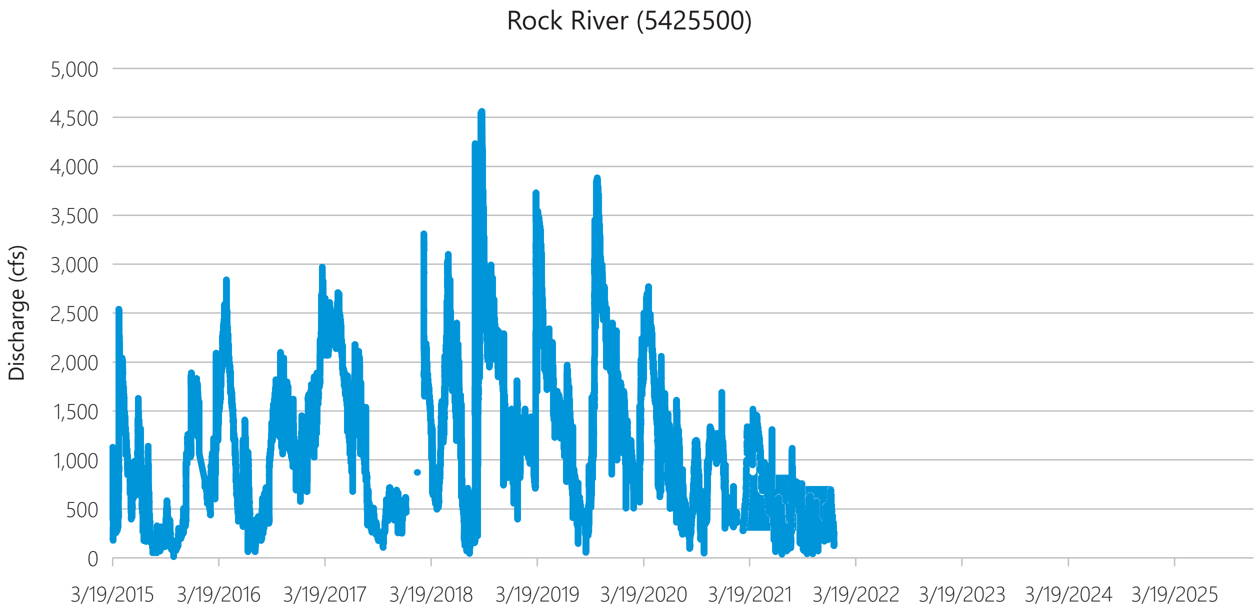
[21] *SEWRPC CAPR 47 (2nd Edition), 2007,* op. cit.

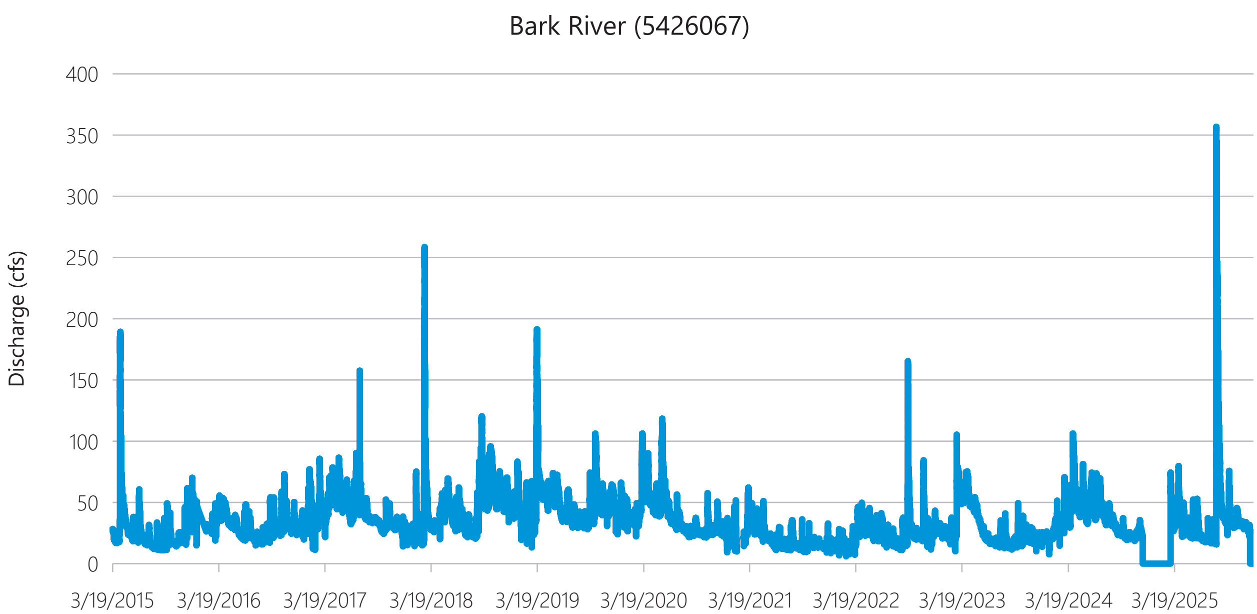
[22] *Previous Commission reports have indicated that the nearby Bark River serves as a suitable proxy for estimating relative discharge in the Oconomowoc River due to the similarities of the watersheds.*

[23] *The 2007 plan also utilized the Rock River in Watertown gage to estimate the water budget for the Lake.*

[24] *The maximum discharge recorded at this site was in August 2025, when many areas of southeastern Wisconsin received nearly the highest precipitation totals ever recorded for a 24-hour period. Before this event, the highest discharge for this site during the time period was 254 cfs in February 2018.*

Figure 3
USGS Discharge for Rock River at Watertown and Bark River: 2015-2025

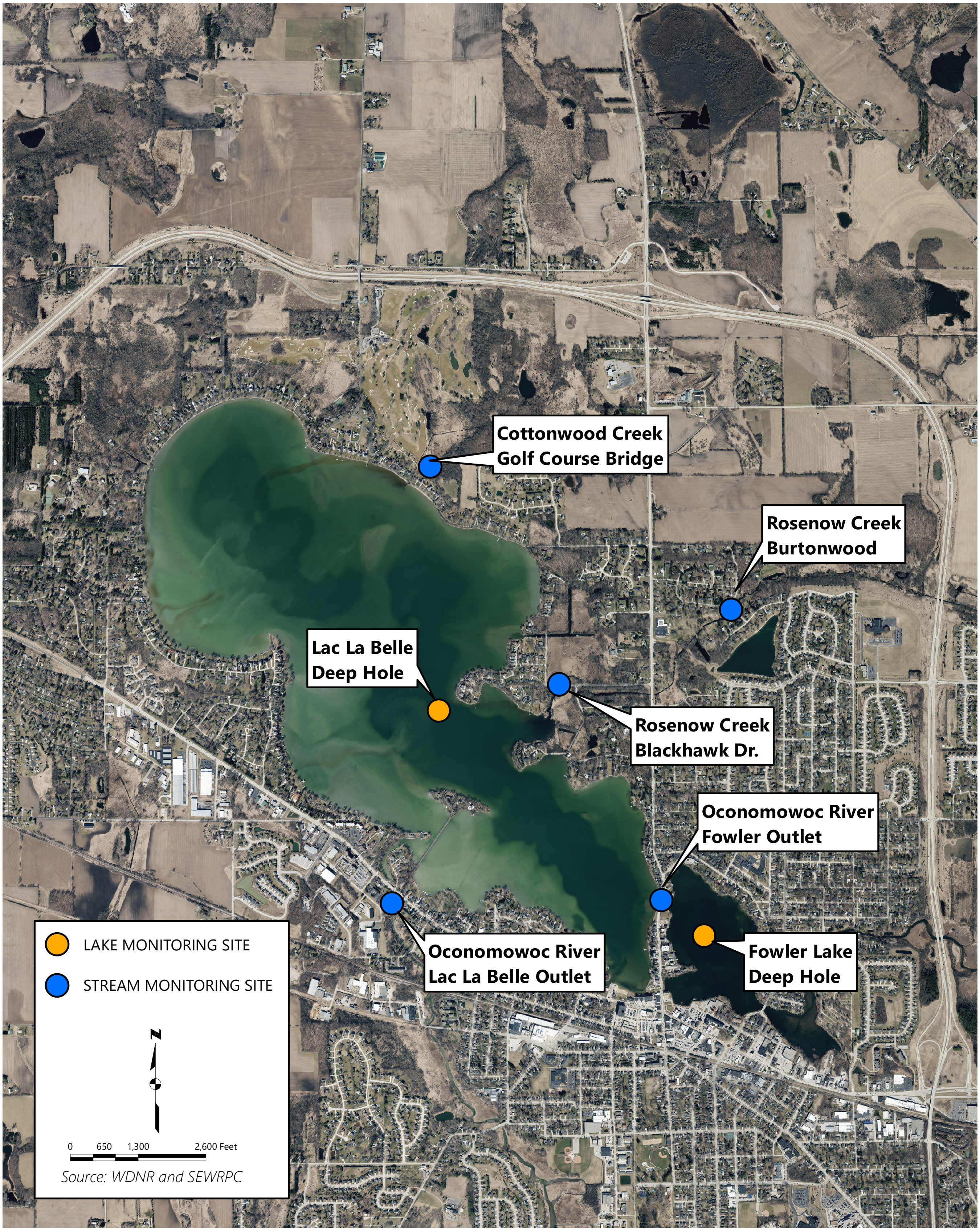




Source: USGS and SEWRPC

(when flowing) (see Map 4). Several of these monitoring locations were near culverts or bridges and/or may have been affected by backwater effects from downstream waterbodies; consequently, these sites may not represent uniform, free-flowing reaches of the streams that would be typically targeted for streamflow measurements. Streamflow was measured using cross-sections of the stream at each monitoring location, where the stream width was divided into cells of typically equal width (e.g., 15 cells with a width of 0.4 feet for Rosenow Creek) and the water depth and velocity were measured in each cell. The OWPP measurement notes state that for waters shallower than 0.8 meters (2.62 feet) velocity was a single measurement made at a depth of 60 percent of the total water depth for that cell. In waters deeper than 0.8 meters, two velocity measurements were made: one at 20 percent and another at 80 percent of the total water depth for that cell. The original streamflow methodology utilized resulted in an overestimation of streamflow in part due to calculating a streamflow for an additional cell beyond what was measured in the field. Additionally, measurements were made against each stream bank, where the water depth and velocity are typically low

Map 4
Total Phosphorus Monitoring Near Lac La Belle: 2024-2025



unless the bank is near vertical or undercut. Following the initial summer of data collection, Commission staff discussed the streamflow methodology with OWPP staff and provided guidance on how to calculate streamflow to be more in line with methodology recommended by the United States Geological Survey.[25] Commission staff used these modified calculations in the preparation of this staff memorandum report.

Across the four streams monitored, the Oconomowoc River immediately downstream of Fowler Lake had the highest median streamflow (61.2 cfs), followed by the Oconomowoc downstream of Lac La Belle (60.5 cfs), and then Rosenow Creek (5.3 cfs) and Cottonwood Creek (1.2 cfs) (see Table 2). The recorded streamflow values are largely within with the modeled flow exceedances discussed in the previous section and confirm measurements and modeling in previous studies of the Lake's tributaries.[26] Some of the highest streamflow measurements at the Oconomowoc River sites exceeded the discharge modeled at the five percent flow exceedance (109 and 126 cfs for Oconomowoc downstream of Fowler Lake and Lac La Belle, respectively). The highest streamflow measurements across most of the monitoring sites were recorded on June 26th, 2024, with a streamflow of 165 cfs at the Oconomowoc River downstream of Fowler Lake as the highest streamflow during the study period. This streamflow measurement immediately followed a nine-day period where 4.16 inches of precipitation was recorded at the weather station at the Oconomowoc wastewater treatment facility, including a 0.62-inch event the previous day (see Figure 1). Lac La Belle elevations also increased from 851.71 to 852.43 feet during this period.

There were several instances (e.g., on June 5th, June 26th, and July 11th in 2024) where streamflow in the Oconomowoc River upstream of Lac La Belle exceeded streamflow downstream of Lac La Belle. Typically, it would be expected that streamflow is higher downstream on a stream than upstream, particularly when there are additional water contributions from other tributaries. However, these periods may reflect an increase in the amount of water stored in the Lake (see Figure 2), loss to groundwater, decreased streamflow downstream of Lac La Belle due to backwatering effects from high water levels in the Rock River, or from over/under-estimation of streamflow at either of the monitoring sites.

PHOSPHORUS CONCENTRATIONS AND LOADS

Historical Phosphorus Loads

The 2007 water quality plan presented total phosphorus loads to Lac La Belle based on measured data in a 1976-1977 study by tributary as well as by sector based on 2000 land use.[27] The 1976-1977 study estimated a total phosphorus load of 4,197 pounds with approximately 61 percent contributed by the Oconomowoc River, 22 percent directly contributed to the Lake surface via deposition, 13 percent from Rosenow Creek, and the remaining four percent contributed by the other tributaries (Cottonwood and Saeger Creeks) and lake-direct runoff combined. This estimate did not include any phosphorus loading from groundwater. Based on the 2000 land use, an annual total phosphorus load of between 3,055 pounds and 11,800 pounds per year was estimated to be contributed to Lac La Belle, with 3,055 pounds assumed to be more representative based on observed lake total phosphorus concentrations. Agricultural land uses were the predominant phosphorus loading source, constituting 67 percent of the total load, followed by high-density urban uses (14 percent), and low-density urban uses (10 percent). The remaining nine percent of the modeled phosphorus load was split amongst natural and recreational land uses.

The 2007 plan also included a forecast of 2020 phosphorus loads based on planned land use at that time. For the 2020 land use, the total phosphorus load increased to 3,277 pounds with urban land uses constituting a higher proportion of the total load (40 percent) than in the 2000 land use. This increase was based on the continued urbanization of the Lac La Belle watershed as well as assumptions about the use of phosphorus-based fertilizers on residential lands. While the urban land uses in the watershed have increased since 2000, the use of phosphorus-containing fertilizers on residential lawns was banned in Wisconsin in 2010. Consequently, the amount of phosphorus load from residential lands may have been overestimated in this study.

---

[25] *United States Geological Survey,* Measurement and Computation of Streamflow: Volume 1. Measurement of Stage Discharge*, Geological Survey Water-Supply Paper 2175, 1982.*

[26] *SEWRPC CAPR 47 (2nd Edition), 2007,* op. cit.

[27] Ibid.

Table 2

Monitored Total Phosphorus Concentrations, Streamflow, and Phosphorus Loads: February 2024 – March 2025

	Total Phosphorus (mg/l)			Streamflow (cfs)				Total Phosphorus Load (pounds)		
Stream	Mean	Minimum	Maximum	Mean	Median	Minimum	Maximum	Total	Minimum	Maximum
Cottonwood Creek	0.160	0.013[a]	0.600	2.0	1.20	0.3	8.3	23.8	0.03	9.3
Oconomowoc at Lac La Belle Dam	0.018	0.013[a]	0.070	66.9	60.50	5.6	123.4	137.5	0.61	26.5
Oconomowoc at Fowler Dam	0.016	0.013[a]	0.030	76.3	61.20	0.0	165.0	79.2	0.00	18.4
Rosenow Creek	0.054	0.013[a]	0.115	7.0	5.31	2.1	16.3	29.5	0.33	10.6

[a] *0.013 mg/l was the concentration assigned to any sample identified as being below the limit of detection by the Oconomowoc Wastewater Treatment laboratory.*

Source: OWPP and SEWRPC

Modeled Phosphorus Loads

Commission staff utilized the Presto-Lite and Wisconsin in-Lake Modeling Suite (WiLMS) components of the WDNR WEx tool to model phosphorus loads from tributaries around the Lake using land use data (see Table 1).[28,29] Based on the 2018 Wiscland 2.0 land cover data, agricultural land uses (cultivated crops and pasture) comprised 36.3 percent of the total watershed, woodlands comprised 30.1 percent, urban land uses comprised 17.7 percent, while wetlands and open water comprised the remaining 15.9 percent.[30] Using Presto-Lite output, the Oconomowoc River (draining through the Fowler Lake outlet dam) had the highest total phosphorus loads of any subbasin to Lac La Belle, followed by Rosenow Creek, Cottonwood Creek, and Saeger Creek. The total modeled tributary phosphorus loading to the Lake was 4,195 pounds per year. On a per acre basis, Cottonwood Creek had the highest phosphorus loading per acre (0.61 pounds per acre) followed by Saeger and Rosenow Creeks while the Oconomowoc River had a substantially lower phosphorus load per acre.

The WiLMS total phosphorus output was relatively similar to the Presto-Lite output for each tributary except for the Oconomowoc River, where the output was ten times higher (19,285 pounds for WiLMS compared to 1,943 pounds for Presto-Lite). For the WiLMS total loads, the highest loading tributaries were the Oconomowoc River followed by Rosenow Creek (less than ten times the modeled Oconomowoc load) and then Cottonwood Creek, the direct lake runoff, and finally Saeger Creek. The total modeled tributary phosphorus loading to the Lake using WiLMS was 21,756 pounds, which is largely attributed to the Oconomowoc River. In order of phosphorus loading per acre, Cottonwood Creek again had the highest followed by Rosenow Creek while the other tributaries and direct runoff were all similar. Agricultural land uses were the predominant total phosphorus sources to each tributary and to the Lac La Belle outflow based on WiLMS model output.

Phosphorus Monitoring

The following section will briefly describe total phosphorus monitoring conducted on Lac La Belle and its tributaries.

Lac La Belle and Fowler

Commission staff compiled available total phosphorus data collected on Lac La Belle and Fowler Lake since 2015 for this study. Due to the participation of the District and the City in the WDNR Citizen Lake Monitoring Program, each Lake has been routinely monitored throughout this period. Each summer (typically June, July, and August) three or four total phosphorus samples have been collected in the Lake surface water (epilimnion) at the deep hole site. Across this period, Lac La Belle has a median total phosphorus concentration of 0.017 mg/l, which is 0.002 mg/l above the WDNR total phosphorus criteria for two-story lakes (see Figure 4).[31] Fowler Lake has a median concentration of 0.0145 mg/l, which is 0.005 mg/l below its WDNR phosphorus criteria as another two-story lake.

Tributaries

The OWPP measured total phosphorus concentrations at the same locations used for streamflow monitoring (as discussed in a previous section). During each sampling event, one water grab sample was collected and analyzed at the City of Oconomowoc wastewater treatment facility laboratory (total of 52 total phosphorus measurements collected between February 2024 and March 2025). Many of the total phosphorus measurements, particularly those in the Oconomowoc River sites, were below the laboratory limit of detection of 0.026 mg/l; the concentrations for these samples were considered as one-half the limit of detection (0.013 mg/l) for this study.

---

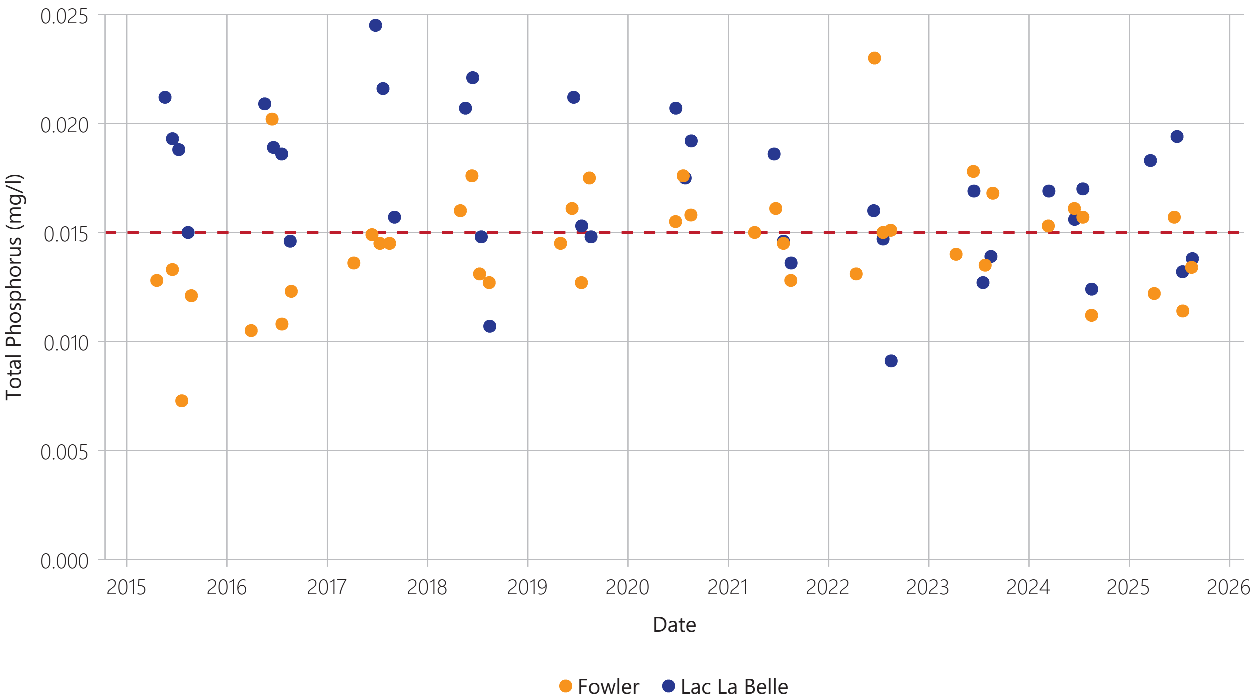
[28] *For more information on the Preso-Lite model, see dnr.wisconsin.gov/topic/SurfaceWater/PRESTO.html.*

[29] *Panuska, John C. and R.A. Lilly,* Phosphorus Loadings from Wisconsin Watersheds: Recommended Export Coefficients for Agricultural and Forested Watersheds*, WDNR Research Management Findings. No. 38, 1995.*

[30] *This watershed land use evaluation included the 1,186-acres of the Lake itself, which is classified as open water.*

[31] *Wisconsin Department of Natural Resources,* Wisconsin Consolidated Assessment and Listing Methodology (WisCALM)*, 2024.*

Figure 4
Total Phosphorus Concentrations in Lac La Belle and Fowler Lake: 2015-2025



Note: Red line indicates total phosphorus criteria for two-story lakes.

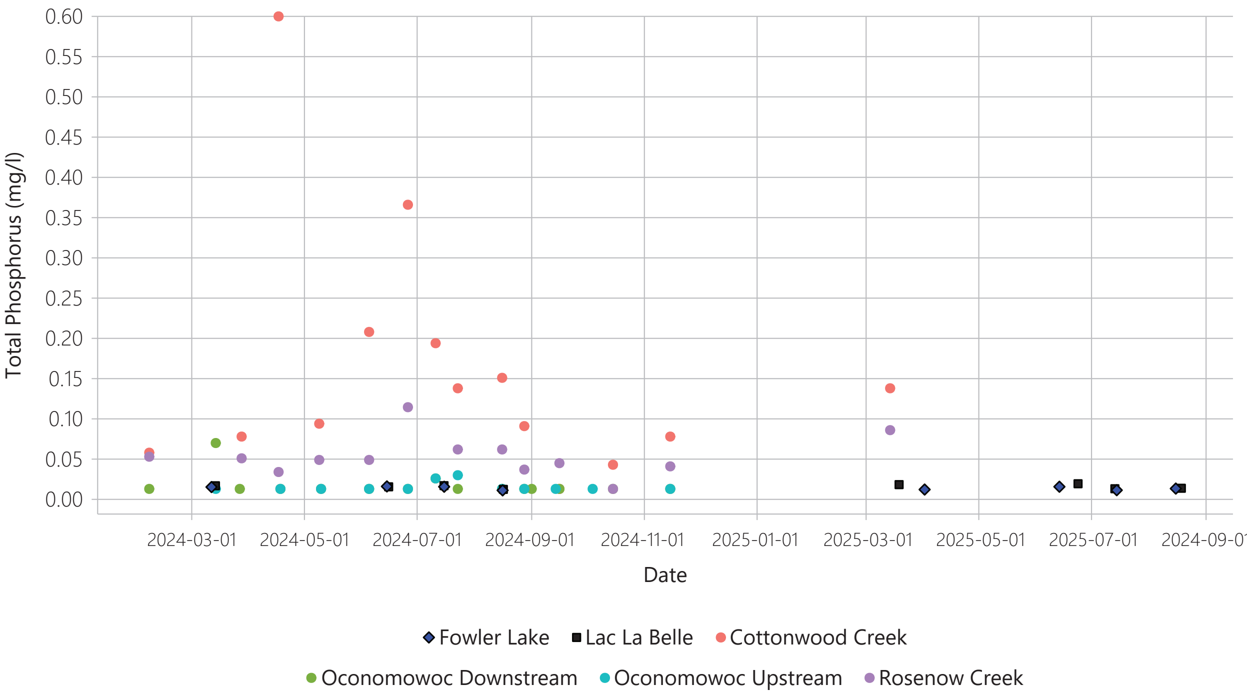
Source: OWPP and SEWRPC

Mean total phosphorus concentrations were highest in Cottonwood Creek (0.16 mg/l, which exceeds the WDNR 0.075 mg/l criteria for stream phosphorus concentrations), followed by Rosenow Creek (0.05 mg/l), and then the two Oconomowoc River sites (0.018 mg/l downstream of Lac La Belle and 0.016 mg/l downstream of Fowler Lake) (see Table 2). Although the concentrations for the Oconomowoc sites are highly influenced by the limit of detection treatment, the resulting mean concentrations are near the concentrations independently sampled and analyzed in Lac La Belle and Fowler Lake which would be expected given that these sites are essentially outflow of lake water (see Figure 5). These lower total phosphorus concentrations reflect the effect that lakes can have on stream total phosphorus by essentially acting as settling ponds for sediment and sediment-bound phosphorus (as previously documented for other lakes in the Oconomowoc River watershed).[32]

In comparison, Cottonwood and Rosenow Creek had fairly high total phosphorus concentrations, particularly following large rainfall events as observed in the April 17th, 2024, sampling event for Cottonwood Creek (0.6 mg/l on day of a 0.5-inch rainfall) and the June 26th, 2024, sampling events for Cottonwood and Rosenow Creeks (0.37 and 0.11 mg/l, respectively, following the aforementioned 4.16 inches of rain in the preceding nine days). Twelve of the fourteen (86 percent) of the samples collected in Cottonwood Creek exceeded the 0.075 mg/l criteria for stream total phosphorus, which indicates that the stream could be listed as impaired for total phosphorus on the 303(d) impaired waters list. In addition to the monitoring described above, the OWPP also collected total phosphorus concentrations at upstream sites from both Rosenow and Cottonwood Creeks as part of a larger monitoring strategy across the Oconomowoc River watershed. The upstream total phosphorus concentrations for the Rosenow Creek site (collected at the Nature Hill Nature Center bridge and at Burtonwood Drive) were generally close to each other and to the concentrations measured at the Blackhawk Drive site. These similar concentrations likely reflect the close spatial proximity of these sites and the lack of any major water or phosphorus sources between them. For Cottonwood Creek, the upstream sites were as follows: a drain tile input from the Club at Lac La Belle golf course, the Creek crossing at Lang Road, and the Creek crossing at Hwy 67. These upstream sites differed much more substantially from each other than the Rosenow sites, with the largest difference at 0.48 mg/l

[32] *SEWRPC Memorandum Report No. 258,* Upper Oconomowoc River and Nutrient Study, *2021.*

Figure 5
Total Phosphorus Concentrations of Lac La Belle Tributaries and Outlet



Note: Total phosphorus concentrations below the limit of detection were set at half the limit of detection (0.013 mg/l).

Source: OWPP and SEWRPC

for the June 26th, 2024 measurement, which also followed the largest rainfall event captured during the study period. For these measurements, the Lang Road site was typically higher than the other upstream sites although there were a few events where the golf course tile drain or the Hwy 67 site exceeded Lang Road. Concentrations at Lang Road typically also exceeded the downstream Cottonwood Creek site, which may reflect dilution of in-stream total phosphorus from additional water contributions.

Commission staff used the modified streamflow calculations and the adjusted total phosphorus concentrations to calculate total phosphorus loads from the OWPP measurements. The same caveats and considerations previously discussed for these measurements would also apply to these load calculations and the measurement error may be compounded as the phosphorus loads are the product of streamflow and concentration. Across all sampling events, the Oconomowoc River downstream of Lac La Belle had the highest total phosphorus loads (137.5 pounds), followed by the Oconomowoc River downstream of Fowler Lake (79.2 pounds), and then Rosenow and Cottonwood Creeks significantly behind the River sites (29.5 and 23.8 pounds, respectively). These findings are consistent with modeled results and previous studies indicating that the Oconomowoc River is the predominant source and outflow of phosphorus from Lac La Belle. However, when calculated as the monitored loading rate per acre, Cottonwood and Rosenow Creeks have five to nearly ten times higher loading per acre (0.014 and 0.011 pounds per acre, respectively) than the Oconomowoc River upstream or downstream of Lac La Belle (0.0014 and 0.0022 pounds per acre, respectively). These monitored loading rates are far lower than the modeled rates because the monitored rates are only calculated over the sampling events while the modeled rates are an annual rate. The relative ordering of the streams by phosphorus loading rate approximately match modeled loading rates.

SUMMARY AND RECOMMENDATIONS

The following section summarizes major findings from this study:

- Updated mapping by the Commission indicates that Lac La Belle has a slightly increased surface area and a slightly smaller watershed than reported in previous studies. There are substantial acres of internally draining areas within the watershed that do not contribute surface runoff or phosphorus loading to the Lake.

- Modeled water flow estimates indicate that the water budget for the Lake remains largely as reported in previous studies, although the contributions from direct precipitation and from the Lake tributaries have increased with long-term increases in annual precipitation and losses to groundwater have also substantially increased. These increased inflows have resulted in a slightly shorter residence time for the Lake than reported in previous studies. The Oconomowoc River remains the most significant inflow and outflow of water from the Lake.

- Modeled total phosphorus loads from the watershed were similar to loads reported in a 1976-1977 study of the Lake but exceeded those reported in a 2007 study. Agricultural land uses were the predominant sources in the previous study and that finding was consistent with modeling conducted for this study. The Oconomowoc River was modeled as the highest annual total phosphorus loading source, but Cottonwood, Saeger, and Rosenow Creek had substantially higher phosphorus loading per acre depending on the model used. Consequently, these watersheds may provide a greater benefit for phosphorus reduction efforts on a per acre basis.

- Lake total phosphorus monitoring indicates that both Lac La Belle and Fowler Lakes have had generally stable concentrations since 2015, with higher concentrations in Lac La Belle than Fowler.

- Although the analysis was limited by technical challenges, the monitored streamflow and total phosphorus concentrations are generally consistent with the modeling results in indicating that although the Oconomowoc River is the largest total phosphorus source, the other lake-direct tributaries have a greater phosphorus load on a per acre basis.

Based on these findings, Commission staff recommend the following:

- The District and other lake stakeholders should stay abreast of developments that could impact pollutant loading and water flows to and from the Lake. These developments may include land development within the lake-direct runoff area, groundwater withdrawal from planned high-capacity wells near the Lake,[33] and expansion of agricultural animal operations into Concentration Animal Feeding Operations (CAFOs).[34]

- Continue and consider expanding lake water quality monitoring through the Citizen Lake Monitoring Program as these efforts will help lake managers track progress in water quality conditions as best management practices are implemented.

    - The 2007 lake management plan estimated that the phosphorus contributed from internal loading was fairly minimal; however, this estimate used data collected in the 1970s. Based on the lake morphometry and the current dissolved oxygen conditions, Commission staff think that the internal loading contributions are likely still minimal. However, these conditions could be reexamined using new data if total phosphorus samples are collected at the lake surface and near the bottom during spring turnover and mid-summer.

[33] *Current and proposed high-capacity well locations can be viewed on the WDNR Water Quantity Viewer: dnrmaps.wi.gov/H5/?Viewer=Water_Use_Viewer.*

[34] *Animal operations that have applied for the necessary WDNR permits to become CAFOs can be viewed on the following webpage: dnr.wisconsin.gov/topic/CAFO/RecentPermits.html. At this time of report publication, there are no existing or proposed CAFOs within the Oconomowoc River watershed.*

    - Water clarity should be routinely monitored in the southeastern portion of the Lake as it is at the deep hole and northwestern sites. Total phosphorus and chlorophyll-a could also be considered to be more routinely collected at all three sites to establish how conditions vary across the Lake.

- Improve lake level monitoring by installing an automated continuous water level monitor at an accessible, permanent location within the Lake (e.g., attached to permanent pier). These sensors can be programmed to measure water depth continuously at hourly to daily increments for years. If the sensor is connected to a wireless or cellular network, the real-time lake level information could be used to inform dam management and shared on the District website. As with the streamflow gage, this lake level gage could be installed in partnership with the USGS.

- Enhance streamflow monitoring by utilizing automated continuous water level monitors in combination with established stage-discharge relationships (a "rating curve"). These relationships would need to be individually established for each tributary. The District could collaborate with the United States Geological Survey (USGS) and other lake districts along the Oconomowoc River to install and operate a gage for the River as there are currently no USGS gages within the watershed.[35]

    - For the Oconomowoc River at Fowler Lake dam, information regarding the dam configuration (e.g., dimensions, elevations, alternate outlets and spillways) should be collected in order to develop a rating curve for the dam. With this information, the water level over the dam collected by an automated sensor could be converted into discharge.

    - For Cottonwood, Rosenow, and Saeger Creeks, streamflow monitoring across the distribution of flow rates (baseflow, moderate, and high flows) should be continued in each stream. Flow monitoring should be combined with water level monitoring in order to establish a site-specific rating curve for each stream. With a rating curve, water levels monitored continuously by an automated sensor could then be converted into streamflow.

- Continue tributary water quality monitoring efforts in conjunction with streamflow monitoring to assess how conditions change, particularly following implementation of best management practices upstream in each subbasin.

- Continue to support the Oconomowoc Watershed Protection Program in their efforts to implement best management practices that reduce phosphorus from agricultural lands in the Lake watershed. For Lac La Belle, these phosphorus reduction efforts should be focused on the Cottonwood, Rosenow, and Saeger Creek subbasins as these subbasins provide a higher phosphorus load per acre than the Oconomowoc River tributary area. The second highest focus for phosphorus reduction efforts should be the lake-direct runoff areas around the Lake followed by lands tributary to the Oconomowoc River between Fowler and Oconomowoc Lakes. The lowest priority areas for Lac La Belle should be lands tributary to the Oconomowoc River upstream of Oconomowoc Lake.

[35] *The USGS maintains a network of streamflow gages across the country, which are funded through by local, state, and federal partners. Per recent discussions with USGS staff, each gage costs between $15,000 and $20,000 to install and then approximately $14,000 per year to operate and maintain. Current streamflow information from gages across the country can be viewed via the USGS National Water Dashboard: dashboard.waterdata.usgs.gov/app/nwd/en/?region=lower48&aoi=default.*