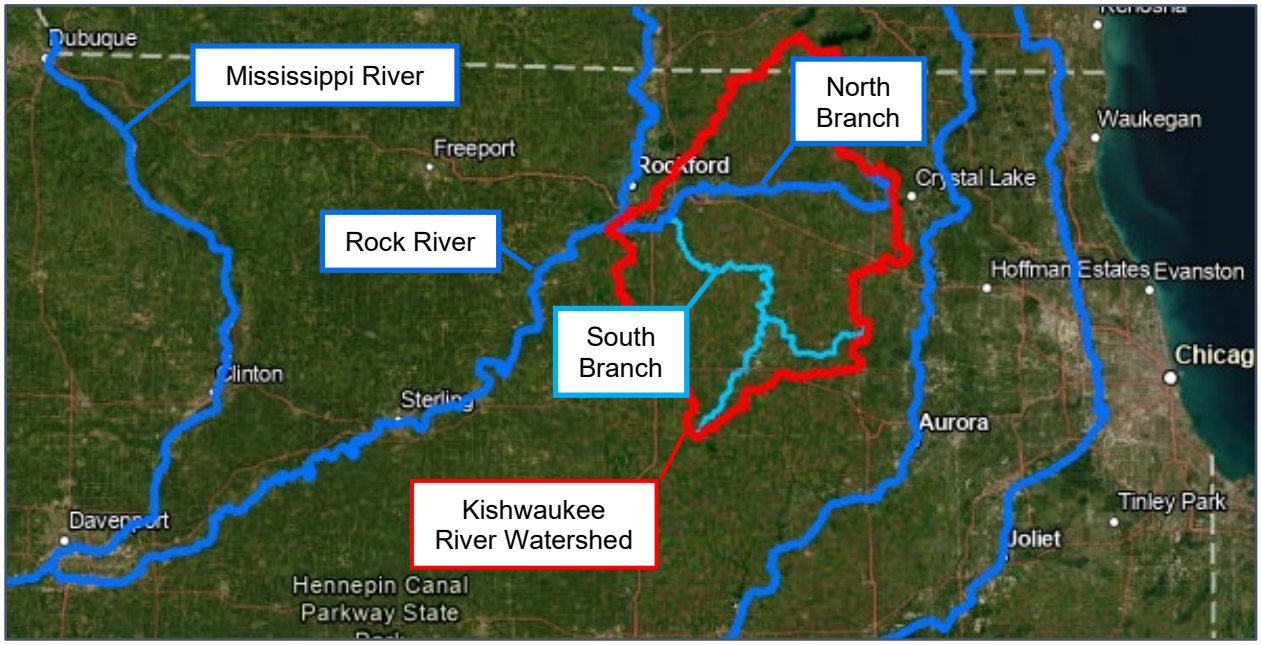
DeKalb / Sycamore
Watershed Planning Area

Nutrient Assessment Reduction Plan

Prepared By:

December 2023

The Kishwaukee Water Reclamation District (KWRD) is a regional sanitary district that provides sanitary sewer and wastewater treatment services to a population of 45,000 within the City of DeKalb, Village of Malta, Northern Illinois University, Kishwaukee College, and unincorporated areas in DeKalb County. KWRD operates an 8.63 MGD wastewater treatment facility (NPDES Permit No. IL0023027). The City of Sycamore's North Sewage Treatment Plant (STP) serves over 18,000 residents. Sycamore's North STP is rated for 4.9 MGD (NPDES Permit No. IL0031291). Both Publicly Owned Treatment Works (POTW's) discharge treated effluent to the South Branch of the Kishwaukee River.



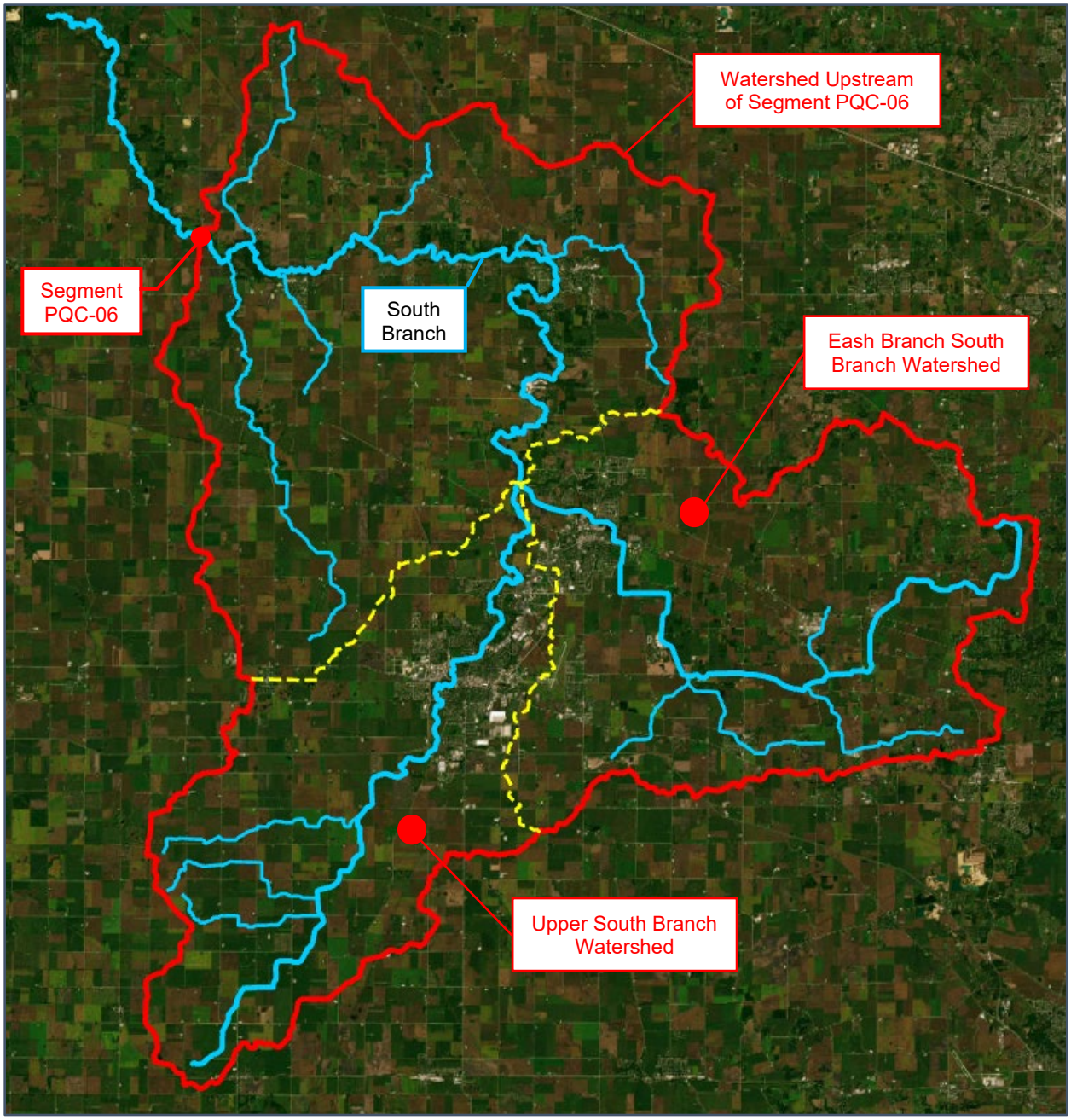
KWRD's most recent NPDES permit, effective October 1, 2019, identified that KWRD's "treatment plant effluent is located upstream of a waterbody or stream segment that has been determined to have a phosphorus related impairment. A phosphorus related impairment means that the downstream waterbody or segment is listed by the Agency as impaired due to dissolved oxygen and/or offensive condition (algae and/or aquatic plant growth) impairments that is related to excessive phosphorus levels." Similarly, Sycamore's NPDES permit stated that the "treatment plant effluent is located upstream of a waterbody or stream segment that has been determined to be at risk of eutrophication due to phosphorus levels in the waterbody."

The Special Conditions of both KWRD and Sycamore's NPDES Permit identify the requirement to develop a Nutrient Assessment Reduction Plan (NARP) for their respective watersheds. The NPDES Permit requires this NARP to meet the following requirements:

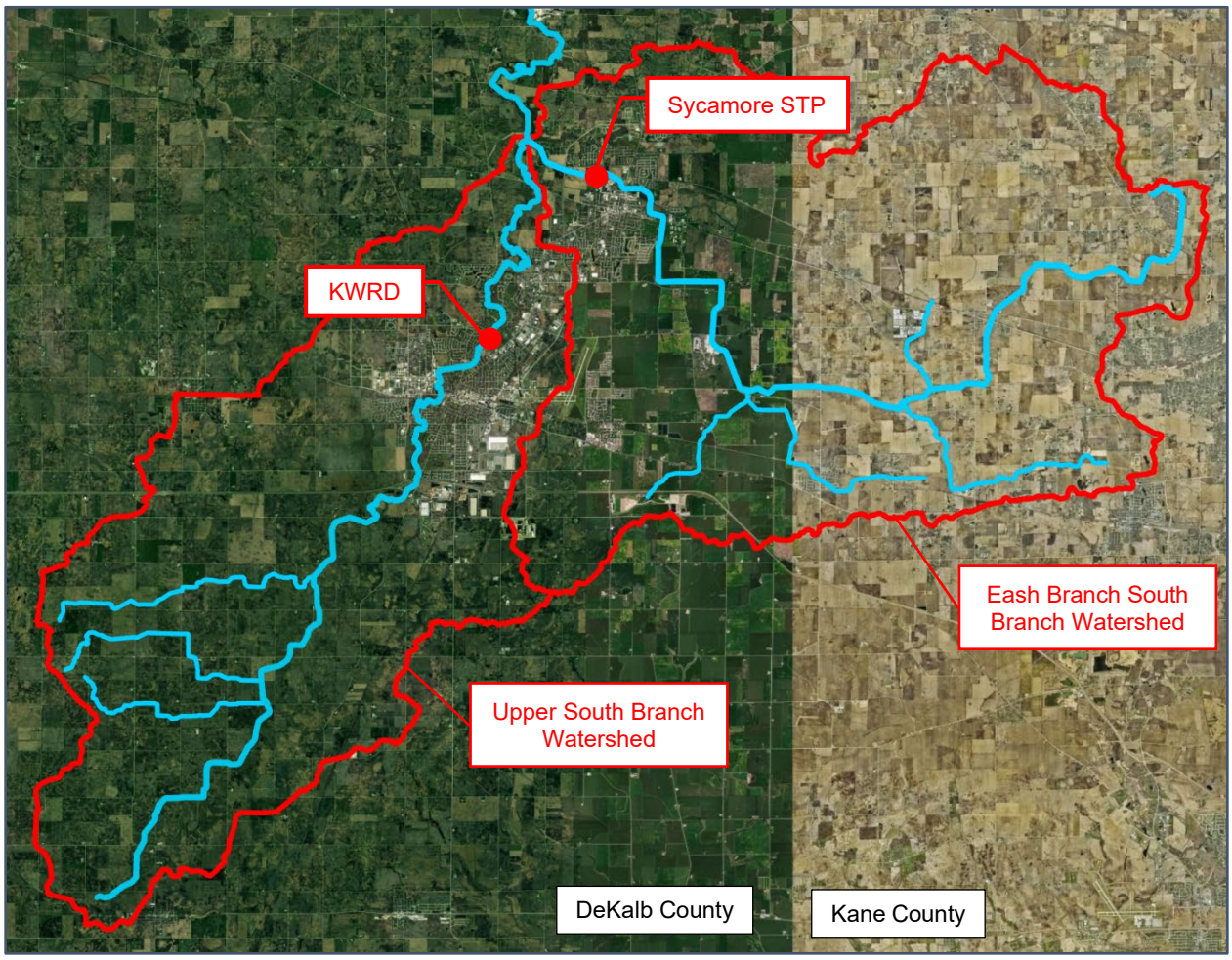
- Work with other stakeholders in the watershed to determine the most cost-effective means to address the phosphorus related impairment/risk of eutrophication.
- Utilize recommendations by the Nutrient Science Advisory Committee in determining target levels of various parameters necessary to address the phosphorus related impairment.
- Identify phosphorus input reductions to remove phosphorus related impairments in the watershed.

BACKGROUND

The Illinois Integrated Water Quality Report and Section 303(d) List for 2020/22 identified a phosphorus related impairment on Segment PQC-06 of the South Branch of the Kishwaukee River, with the phosphorus related cause of Dissolved Oxygen. KWRD and Sycamore discharge to adjacent segments of the South Branch that come together 25 miles upstream of Segment PQC-06.



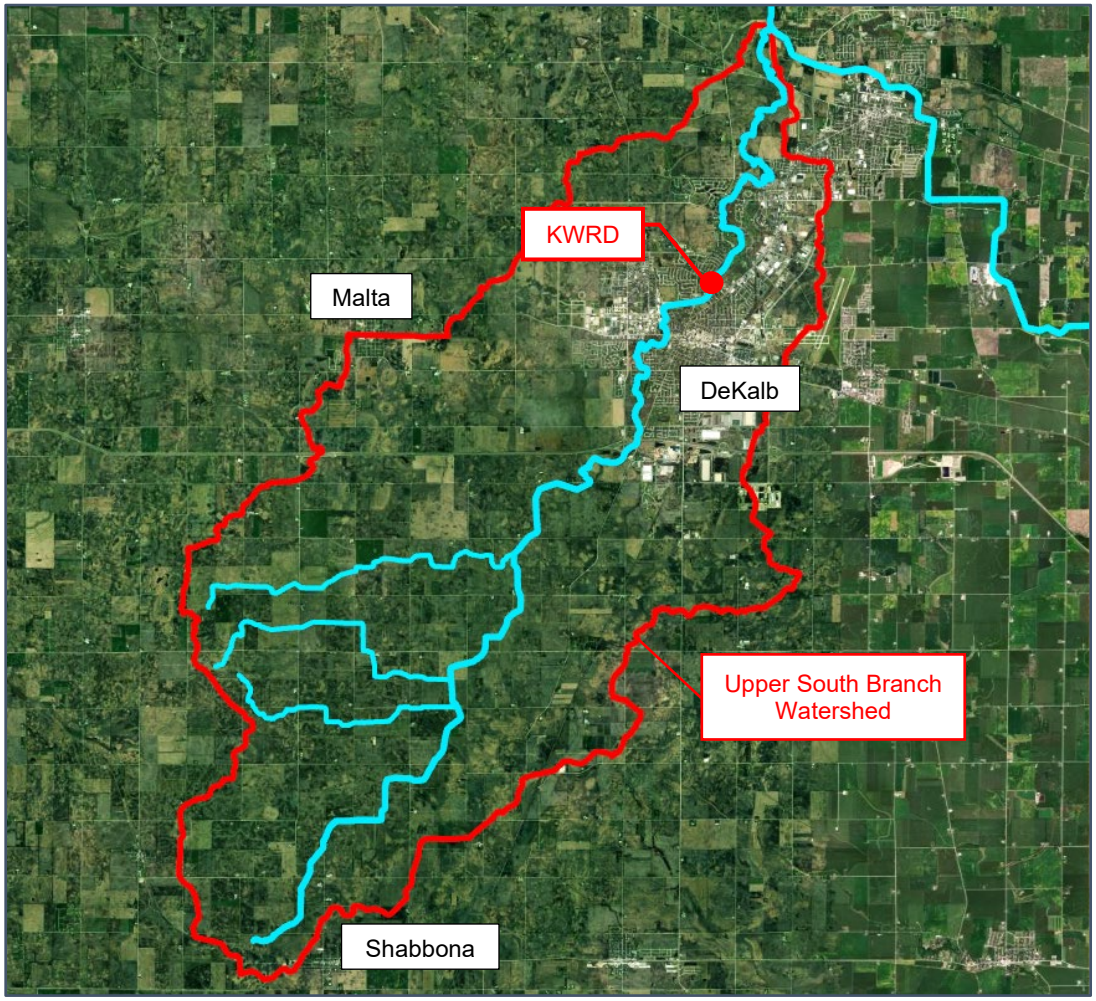
The Kishwaukee Water Reclamation District's treatment facility discharges to the Upper South Branch of the South Branch of the Kishwaukee River and the City of Sycamore discharges to the East Branch of the South Branch.



Based on 7-Day, 10-Year Low Flow maps from the Illinois Water Survey, the 7Q10 flow at PQC-06 is 14.2 cubic feet per second (cfs), compared to 7.0 cfs from KWRD's segment and 3.0 cfs from Sycamore's. Based on this information, the flow from the Upper South Branch Kishwaukee River Watershed (KWRD) represents 49.3% of the flow to PQC-06 and the flow from the East Branch South Branch Kishwaukee River Watershed (Sycamore) represents 21.1%.

KWRD – Upper South Branch Watershed

The Upper South Branch Watershed covers approximately 99 square miles and begins as agricultural drain tiles near the Village of Shabbona. The river then flows northeast through farmland until it reaches the City of DeKalb. The Kishwaukee Water Reclamation District treatment plant is on the north side of DeKalb and discharges to Segment PQC-02 of the Upper South Branch of the Kishwaukee River. This Segment is listed on the 303(d) list for impairments non nutrient related impairments of Mercury and PCB's in Fish Consumption.



In October of 2020, the DeKalb County Soil and Water Conservation District facilitated the development of the "Upper South Branch Kishwaukee River Watershed Improvement Plan" utilizing grant funding from the IEPA through Section 319 of the Clean Water Act. The goal of this plan was to give a better understanding and promote improvements to the watershed. The results of the watershed study found that KWRD (as the only wastewater discharger in the watershed) was the highest contributor towards nutrients, as indicated in Table 37 from the watershed plan below:

STEPL Source	N Load (lbs/yr)	% of Total Load	P Load (lbs/yr)	% of Total Load	Sediment (tons/yr)	% of Total Load
Urban	98,634	11.9%	15,964	12.7%	2,334	6.9%
Cropland	231,584	28.0%	47,159	37.4%	17,813	52.7%
Wetland	94	0.0%	38	0.0%	25	0.1%
Septic	7,660	0.9%	3,000	2.4%	0	0.0%
Streambanks	18,411	2.2%	7,088	5.6%	13,538	40.1%
*Wastewater	469,281	56.8%	52,692	41.8%	65	0.2%
Total	825,666	100.0%	125,941	100.0%	33,775	100.0%

In 2018/2019 when the above data was collected, KWRD's wastewater treatment plant was already under construction to build Biological Nutrient Removal (BNR) facilities to be able to meet the upcoming 1.0 mg/L phosphorus limit and improve nitrogen removal. The improvements were brought online in 2020 and the most recent effluent Daily Monitoring Report (DMR) results are shown below in comparison to the 2018/19 results utilized for the watershed plan.

2018 / 2019 Effluent DMR Data

	Flow (MGD)	TN (mg/L)	TP (mg/L)
Oct-18	5.6	24.5	3.152
Nov-18	5.4	25.9	3.06
Dec-18	6.7	16.4	2.35
Jan-19	6.7	19.6	2.181
Feb-19	8.9	12.0	1.6
Mar-19	9.3	17.6	1.7
April-19	6.6	21.7	2.6
May-19	13.2	13.1	1.596
June-19	6.5	22.1	2.4
July-19	3.6	26.7	2.97
Aug-19	3.8	35.3	3.9
Sept-19	7.1	25.3	2.7
Oct-19	8.5	23.4	1.659
AVG =	**7.07**	**21.82**	**2.45**

TOTAL LBS =	**469,455**	**52,752**

2022 / 2023 Effluent DMR Data

	Flow (MGD)	TN (mg/L)	TP (mg/L)
Oct-22	4.4	5.01	0.491
Nov-22	4.2	5.41	0.224
Dec-22	5.1	14.7	0.246
Jan-23	5.7	1.99	0.138
Feb-23	7.1	4.18	0.145
Mar-23	8.0	6.07	0.093
April-23	7.4	7.79	0.102
May-23	4.5	4.23	0.109
June-23	3.5	9.6	0.17
July-23	4.2	4.32	0.19
Aug-23	4.4	10.2	1.608
Sept-23	4.1	14.31	1.268
Oct-23	4.3	12.215	0.245
AVG =	**5.15**	**7.69**	**0.39**

TOTAL LBS =	**120,533**	**6,060**

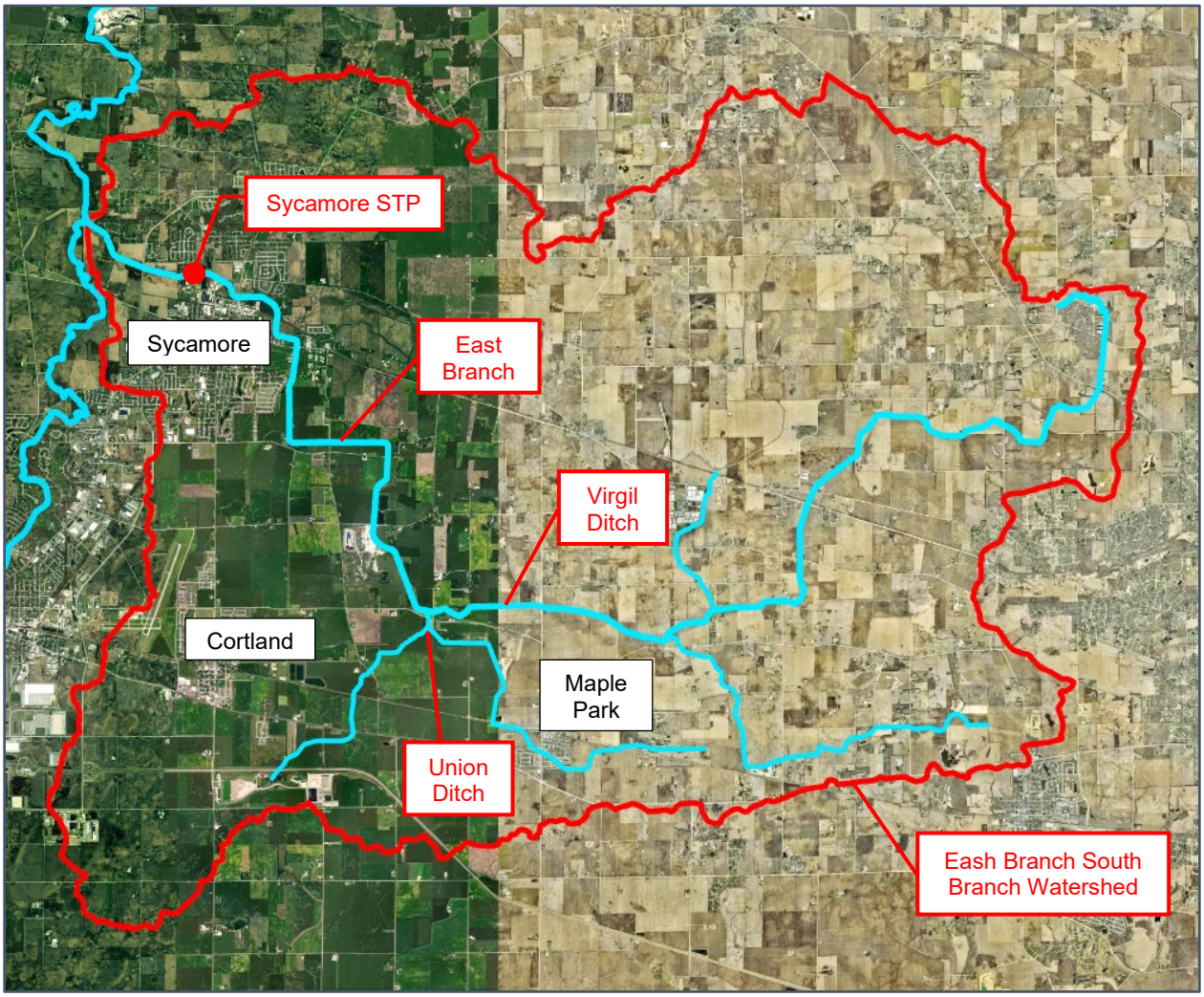
The above data shows a 74.3% reduction in annual Total Nitrogen loading and 88.5% reduction in annual Total Phosphorus loading from KWRD's treatment facility since the sampling for the 303(d) list was performed. Utilizing these values and keeping the other contribution levels the same, Table 39 from the Watershed Plan can be updated as follows:

	Total Nitrogen				Total Phosphorus			
	2019		2023		2019		2023	
	N Load (lbs/yr)	% of Total	N Load (lbs/yr)	% of Total	P Load (lbs/yr)	% of Total	P Load (lbs/yr)	% of Total
Urban	98,634	11.9%	98,634	20.7%	15,964	12.7%	15,964	20.1%
Cropland	231,584	28.0%	231,584	48.6%	47,159	37.4%	47,159	59.5%
Wetland	94	0.0%	94	0.0%	38	0.0%	38	0.0%
Septic	7,660	0.9%	7,660	1.6%	3,000	2.4%	3,000	3.8%
Streambanks	18,411	2.2%	18,411	3.9%	7,088	5.6%	7,088	8.9%
Wastewater	469,281	56.8%	***120,533***	***25.3%***	52,692	41.8%	***6,060***	***7.6%***
Total =	**825,664**		**476,916**		**125,941**		**79,309**	
	Reduction =		**42.2%**		**Reduction =**		**37.0%**	

The impact of KWRD's BNR improvements have drastically reduced the nutrient loading in the Upper South Branch Kishwaukee River Watershed (42.2 / 37.0% reduction in Nitrogen and Phosphorus, respectively). Considering KWRD was the largest single point source upstream of impaired Segment PQC-06, and the largest source of nutrients in this sub-watershed when the impairment was identified, KWRD's BNR improvements were without question the most impactful nutrient reduction measures that could have been completed in Upper South Branch Watershed.

SYCAMORE – EAST BRANCH OF THE SOUTH BRANCH WATERSHED

The City of Sycamore's Wastewater Treatment Facility discharges to the East Branch of the South Branch (EBSB) of the Kishwaukee River. The EBSB drains approximately 123 square miles and includes the Virgil Ditch, which originates in Kane County and includes the Village of Maple Park, and the Union Ditch, which includes the Town of Cortland. These two ditches converge into the EBSB, which includes the City of Sycamore.



A watershed study was conducted for this watershed in 2014, titled "East Branch of the South Branch Kishwaukee River (Including the Union Ditch and Virgil Ditch Systems) Watershed-Based Plan." At the time, there was no known water quality data available, however, testing performed as part of the watershed study found high (above 0.05 mg/L) levels of Phosphorus (Nitrogen was only found to be in low levels).

Similar to KWRD, the City of Sycamore also recently constructed nutrient removal improvements at their wastewater treatment plant. By 2021, the project was substantially complete with the results shown below:

2018 / 2019 Effluent DMR Data

	Flow (MGD)	TN (mg/L)	TP (mg/L)
Oct-18	3.0	17.1	2.30
Nov-18	2.7	15.2	1.79
Dec-18	3.9	13.6	1.66
Jan-19	3.8	14.1	2.15
Feb-19	5.1	12.9	1.08
Mar-19	4.8	10.2	0.83
April-19	3.5	9.2	0.96
May-19	6.1	11.6	1.11
June-19	3.9	13.4	1.45
July-19	2.2	15.3	2.42
Aug-19	2.5	18.9	2.40
Sept-19	3.9	15.6	1.23
Oct-19	5.7	11.3	1.25
AVG =	**3.9**	**13.7**	**1.59**

TOTAL LBS =	**164,745**	**19,049**

2022 / 2023 Effluent DMR Data

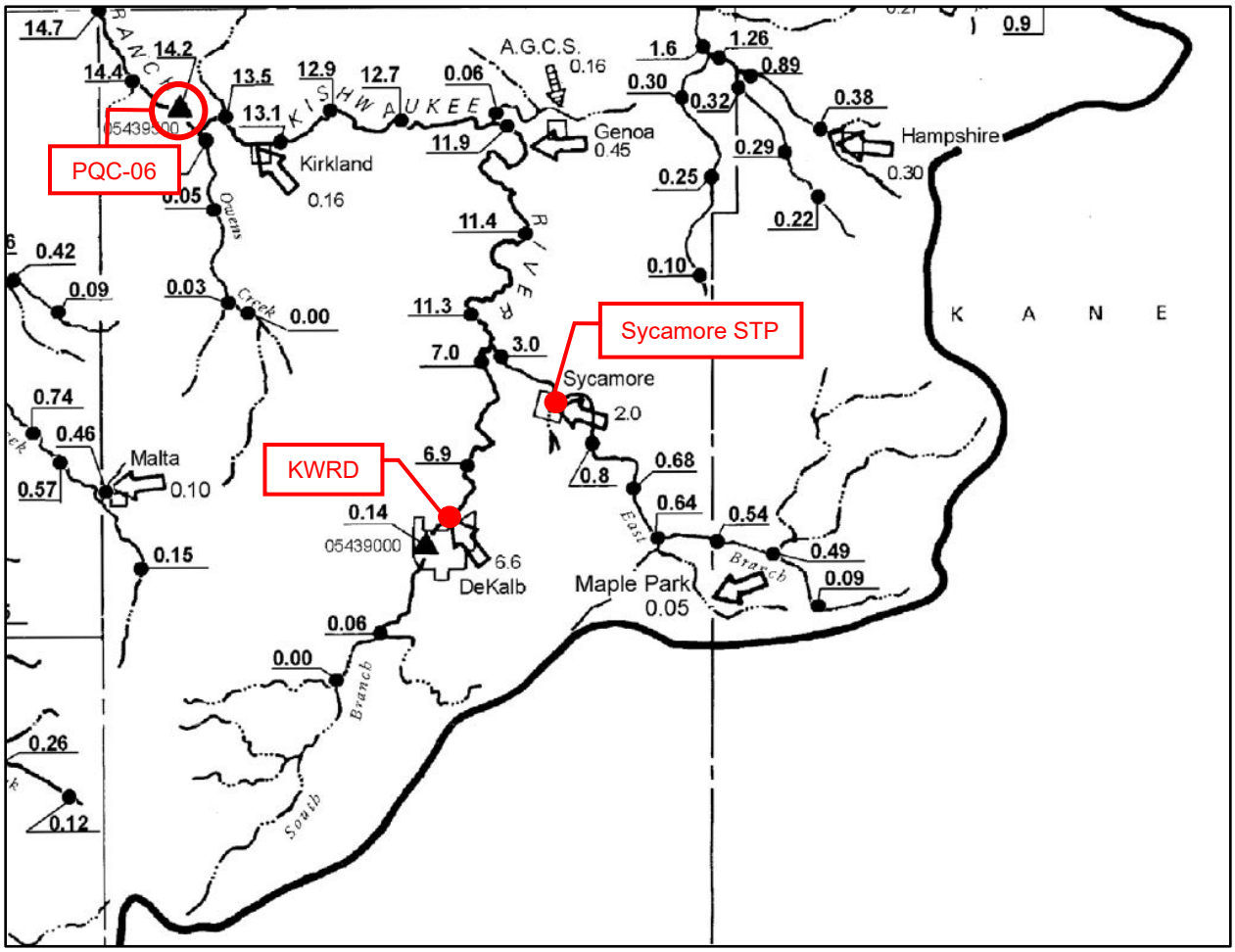
	Flow (MGD)	TN (mg/L)	TP (mg/L)
Oct-22	2.7	3.07	0.439
Nov-22	2.5	3.69	0.693
Dec-22	3.1	4.75	0.59
Jan-23	3.5	4.90	0.555
Feb-23	4.7	4.05	0.705
Mar-23	5.2	4.17	0.61
April-23	5.1	4.56	0.672
May-23	3.0	3.26	0.96
June-23	2.4	3.37	0.856
July-23	2.6	3.81	0.669
Aug-23	2.5	2.81	0.415
Sept-23	2.3	2.81	0.594
Oct-23	2.5	2.80	0.623
AVG =	**3.2**	**3.69**	**0.64**

TOTAL LBS =	**36,353**	**6,344**

The above data shows an annual 77.9% reduction in Total Nitrogen loading and 66.7% reduction in Total Phosphorus loading from Sycamore's treatment facility compared to when sampling for the 303(d) list was performed.

DeKalb/Sycamore Watershed Impacts

The 7-Day 10-Year Low Flow Map, shown below, is generally considered to be base flow. The discharge from KWRD is indicated to be 6.6 cubic feet per second (cfs), the discharge from Sycamore is 2.0 cfs, and the Segment PQC-06 flow is 14.2 cfs. Therefore, it can be estimated that KWRD represents 46.5% of the flow on this segment and Sycamore represents 14.1%, for a combined total of 60.6% of the flow.



Assuming proportional loadings for the downstream areas, the impact of KWRD's and Sycamore's Nitrogen and Phosphorus removal improvements on Segment PQC-06 can be estimated as follows:

	Total Nitrogen				Total Phosphorus			
	2019 lbs/yr	2023 lbs/yr	Discharge Reduction	PQC-06 Reduction	2019 lbs/yr	2023 lbs/yr	Discharge Reduction	PQC-06 Reduction
KWRD	469,455	120,533	74.3%	**34.5%**	52,752	6,060	88.5%	**41.1%**
Sycamore	164,745	36,353	77.9%	**11.0%**	19,049	6,344	66.7%	**9.4%**
Combined	634,200	156,886	75.3%	**45.6%**	71,801	12,404	82.7%	**50.1%**

The Illinois EPA worked with the Nutrient Science Advisory Committee and other work groups to develop the Illinois Nutrient Loss Reduction Strategy (NLRS) in 2015. The ultimate goal of the Illinois Nutrient Loss Reduction Strategy is a 45% reduction in both Nitrogen and Phosphorus Loading, with the intermediate goal of a 25% Phosphorus reduction and 15% Nitrogen reduction by 2025. Based on the above analysis, it can be concluded that the DeKalb/Sycamore Watershed Planning Area has not only far exceeded the 2025 intermediate goal of 25% Phosphorus / 15% Nitrogen reduction but has also achieved the ultimate goal of 45% reduction in both nutrients.

ADDITIONAL NUTRIENT REDUCTION INITIATIVES

Additional measures are being considered or already implemented in the DeKalb/Sycamore Watershed to reduce nutrient loading including regionalization of wastewater treatment and conversion of turf grass to deep-rooted Native Plantings and Constructed Wetlands.

Wastewater Regionalization

The Kishwaukee Water Reclamation District and City of Sycamore are the only known wastewater treatment facilities with a NARP requirement in the DeKalb-Sycamore Watershed Planning Area. However, there are several other point sources that contribute towards the nutrient loading on the South Branch of the Kishwaukee River. Additional wastewater point sources in the DeKalb/Sycamore watershed include the Town of Cortland, Village of Maple Park and DeKalb Packing Company. Based on the USEPA's Enforcement and Compliance History Online (ECHO), phosphorus discharges from these facilities can be found in the table below:

	Cortland STP NPDES: IL0079065			Maple Park STP NPDES: IL0070131			DeKalb Packing NPDES: IL0049832		
	Flow (MGD)	TP (mg/L)	TP (lbs)	Flow (MGD)	TP* (mg/L)	TP (lbs)	Flow (MGD)	TP (mg/L)	TP (lbs)
Oct-22	0.193	2.4	120	0.101	2.0	52	0.011	6.38	18
Nov-22	0.523	1.6	209	0.127	2.0	64	0	-	-
Dec-22	0.397	1.6	164	0.150	2.0	78	0.017	5.54	24
Jan-23	0.397	2.1	216	0.148	2.0	77	0	-	-
Feb-23	0.542	2	253	0.195	2.0	91	0	-	-
Mar-23	0.600	2	289	0.156	2.0	81	0	-	-
April-23	0.446	1.8	201	0.220	2.0	110	0	-	-
May-23	0.272	2.6	183	0.157	2.0	81	0.017	6.9	30
June-23	0.206	2.2	113	0.155	2.0	78	0	-	-
July-23	0.022	3	17	0.153	2.0	79	0	-	-
Aug-23	0	-	-	0.167	2.0	86	0	-	-
Sept-23	0.001	2.5	1	0.125	2.0	63	0.012	7.15	21
		TOTAL	**1,766**		**TOTAL**	**938**		**TOTAL**	**93**

*ECHO data not available, estimated value

Total Phosphorus lbs / yr = 2,797

If the discharges from these facilities were to remove phosphorus to the levels of KWRD or Sycamore and meet the ultimate 2035 phosphorus limit of 0.5 mg/l. The results would be as follows:

	Cortland STP NPDES: IL0079065			Maple Park STP NPDES: IL0070131			DeKalb Packing NPDES: IL0049832		
	Flow (MGD)	TP (mg/L)	TP (lbs)	Flow (MGD)	TP (mg/L)	TP (lbs)	Flow (MGD)	TP (mg/L)	TP (lbs)
Oct-22	0.193	0.5	25	0.101	0.5	13	0.011	0.5	1
Nov-22	0.523	0.5	65	0.127	0.5	16	0	-	-
Dec-22	0.397	0.5	51	0.150	0.5	19	0.017	0.5	2
Jan-23	0.397	0.5	51	0.148	0.5	19	0	-	-
Feb-23	0.542	0.5	63	0.195	0.5	23	0	-	-
Mar-23	0.600	0.5	72	0.156	0.5	20	0	-	-
April-23	0.446	0.5	56	0.220	0.5	28	0	-	-
May-23	0.272	0.5	35	0.157	0.5	20	0.017	0.5	2
June-23	0.206	0.5	26	0.155	0.5	19	0	-	-
July-23	0.022	0.5	3	0.153	0.5	20	0	-	-
Aug-23	0	-	-	0.167	0.5	22	0	-	-
Sept-23	0.001	0.5	0	0.125	0.5	16	0.012	0.5	2
		TOTAL	**448**		**TOTAL**	**235**		**TOTAL**	**7**

Total Phosphorus lbs / yr =	**690**

The table above shows the phosphorus loading could be reduced by an additional 2,100 lbs if these facilities also provided phosphorus removal. It is understood that implementing phosphorus removal at wastewater treatment facilities can be expensive, especially for smaller facilities. KWRD has made efforts to contact these communities to ensure they are aware regionalization of wastewater treatment is a viable option to be considered.

DeKalb Packing is a small slaughterhouse that KWRD is already working on preliminary investigations to have their discharge routed to KWRD's system. Both the Town of Cortland and Village of Maple Park operate wastewater treatment facilities that could be pumped to a regional wastewater utility, like KWRD, that already has phosphorus removal capabilities if additional phosphorus removal is necessary.

Native Plantings and Constructed Wetlands

In addition to point source initiatives, KWRD has also worked with the DeKalb County Soil and Water Conservation District, DeKalb Park District, the City of DeKalb, and DeKalb School District to convert open areas of turf grass to native plantings. Native plantings have a deeper root structure that helps to absorb nutrients from stormwater runoff better than traditional turf grass. To date, nearly 30 acres of open space in the DeKalb community have been converted to native habitats.

Similarly, the City of Sycamore has utilized native plantings to help reduce nutrient loading as well as create habitats for birds and wildlife. As part of the City of Sycamore's most recent plant expansion (substantial completion in 2021), a wetland was constructed to provide secondary treatment for the WWTP effluent as well as allow additional treatment of disinfected excess flow during peak flow events. This wetland is downstream of the treatment facility's discharge and therefore provides additional nutrient removal that is not included in Sycamore's effluent reporting.

CONCLUSION

The Special Conditions of both KWRD and Sycamore's NPDES Permit identify the following items to be addressed in the Nutrient Assessment Reduction Plan (NARP):

- Work with other stakeholders in the watershed to determine the most cost-effective means to address the phosphorus related impairment/risk of eutrophication.

  - ***KWRD and Sycamore have both been involved in the development of watershed studies and implemented nutrient removal at their respective wastewater treatment plants***.

- Utilize recommendations by the Nutrient Science Advisory Committee in determining target levels of various parameters necessary to address the phosphorus related impairment.

  - ***The impact of KWRD's and Sycamore's nutrient removal facilities have met the Nutrient Loss Reduction Strategy's goal of 45% removal of Nitrogen and Phosphorus***.

- Identify phosphorus input reductions to remove phosphorus related impairments in the watershed.

  - ***KWRD and Sycamore's nutrient removal efforts are the most impactful reductions that could have been made in the watershed***.

The Segment PQC-06 impairment was identified on the 303(d) list utilizing sampling from 2018, before both KWRD and Sycamore implemented nutrient removal facilities at their respective treatment facilities. Sampling for the 2024 303(d) list was done in 2021 and will be re-assessed in early 2024. It is our expectation that the updated sampling will show a significant improvement/reduction to the nutrient loading in this segment. Our suspicion is these reductions may enable this segment to be removed from the 303(d) impairment list.

If a nutrient related impairment is still identified for Segment PQC-06, further investigations of the watershed planning area downstream of the DeKalb/Sycamore Watershed should become a priority. There are at least three (3) sewage treatment facilities downstream of the DeKalb/Sycamore planning area but upstream of Segment PQC-06. These facilities do not currently have nutrient removal abilities, or NARP's requirements, but could be involved in a regional wastewater treatment approach.

REFERENCES

DeKalb County Soil and Water Conservation District. *East Branch South Branch Kishwaukee River Watershed Plan – Including the Union Ditch and Virgil Ditch Systems.* Spring 2018. https://dekalbcountywatersheds-il.org/east-branch-kish-plan#3a50fb96-77fc-4565-8f13-29f964484f55

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