

4.0 Water Quality & Pollutant Modeling Assessment

4.1 Water Quality

The primary goal of this watershed plan is to guide efforts to protect and restore surface water quality in Upper South Branch Kishwaukee River watershed. Section 305(b) of the Federal Clean Water Act requires Illinois and all other states to submit to the USEPA a biennial report of the quality of the state's surface and groundwater resources called the *Illinois Integrated Water Quality Report and Section 303(d) List*. These reports must also describe how Illinois waters meet or do not meet water quality standards specific to each "Designated Use" as defined by the Illinois Pollution Control Board (IPCB). When a waterbody is determined to be impaired, Illinois EPA must list potential causes and sources for impairment in the 303(d) impaired waters list. There are seven

"Designated Uses" in Illinois; Illinois EPA has assigned four of these uses to Upper South Branch Kishwaukee River *Aquatic Life*, *Fish Consumption*, *Primary Contact Recreation*, and *Aesthetic Quality*.

According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Upper South Branch Kishwaukee River (IEPA Segment Codes: IL_PQC-02 and IL_PQC-13) are "Fully Supporting" for *Aquatic Life*, "Not Supporting" for *Fish Consumption*, and the upper half of the Kishwaukee is also "Not Supporting" for *Aesthetic Quality*; neither reach was assessed for *Primary Contact Recreation* (Table 28). The sources of impairment are unknown for both segments. Tributaries 6 and 8 have AUID codes, as noted in Table 28, but have not been assessed for designated uses.

Table 28. Illinois EPA Designated Uses and impairments for Upper South Branch Kishwaukee River and tributaries.

Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
South Branch Kishwaukee River: IL_PQC-02 (Reaches 9-16)				
<i>Aquatic Life</i>	Fully Supporting	No	None	N/A
<i>Fish Consumption</i>	Not Supporting	Yes	Mercury, PCBs	Source Unknown
<i>Primary Contact Recreation</i>	Not Assessed	-	-	-
<i>Aesthetic Quality</i>	Fully Supporting	No	None	-
South Branch Kishwaukee River: IL_PQC-13 (Reaches 1-8)				
<i>Aquatic Life</i>	Fully Supporting	No	None	N/A
<i>Fish Consumption</i>	Not Supporting	Yes	Mercury, PCBs	Source Unknown
<i>Primary Contact Recreation</i>	Not Assessed	-	-	-
<i>Aesthetic Quality</i>	Not Supporting	Yes	Bottom Deposits	Source Unknown
Middle Branch South Branch Kishwaukee River: IL_PQCG (Tributary 6)				
Not Assessed				
North Branch South Branch Kishwaukee River: IL_PQCF (Tributary 8)				
Not Assessed				

Source: 2018 Illinois EPA 303(d) list

Water Chemistry Monitoring

Upper South Branch Kishwaukee River

A variety of chemical monitoring stations have been sampled in recent years in an attempt to document the baseline conditions of Upper South Branch Kishwaukee River. Table 29 lists all known chemical/physical water quality monitoring sites in the watershed, including the entities that conducted the sampling, a summary of the dates of sampling and sampled parameters, while Figure 54 depicts the location of each monitoring site where data was collected. In total there were twelve water quality monitoring sites.

Nine monitoring sites were sampled regularly by Northern Illinois University (NIU) during 2018 and 2019 and each was

sampled between six and eleven times over that time period; parameters sampled by NIU under this monitoring program included pH, electrical conductivity (EC), luminescent dissolved oxygen (LDO), turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, and total hardness. Additionally, three of these sites (Broken Bridge, NIU, and Southwest 2), were sampled twice by AES and the Kishwaukee Water Reclamation District (KWRD); parameters sampled by AES/KWRD included pH, biochemical oxygen demand (BOD), total suspended solids (TSS), ammonia, chloride, phosphorus, *E. coli*, nitrite, nitrate, total Kjeldahl nitrogen (TKN), and total nitrogen. Sampling by AES/KWRD occurred twice – once on July 18th (baseline) and again on August 27th, 2019 (after a 1" rain event).

Additionally, AES pulled ten years of historical water quality data (2010-2019) within the watershed and found three additional monitoring locations – IL-02, IL-13, and IL-99 (Table 29). All three sites were monitored by Illinois EPA and had both Intensive Basin and Special Studies conducted; sites IL-02 and IL-99 were sampled in 2011 and 2016, while IL-13 was sampled in 2016. The parameters for the Special Study included total Kjeldahl nitrogen, total phosphorus, ammonia-nitrogen, inorganic nitrogen (NO₂+NO₃), volatile suspended solids, and total suspended solids, while the Intensive Basin studies included analysis of up to 70 parameters including all of the parameters from the Special Study as well as pH, chloride, dissolved oxygen and water temperature.

Table 29. List of chemical/physical surface water quality monitoring sites (2010-2019).

Site ID	Site Name	Sampling Entity	Date Range	Sampled Parameters
BB	Broken Bridge (SP 4)	NIU, AES/ KWRD	May 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, TKN, total nitrogen, E. coli, BOD, TSS, chloride, phosphorus
L	Lagoon (SP 2)	NIU	June 2018 – Mar 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
NIU	Northern Illinois University campus	NIU, AES/ KWRD	June 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, TKN, total nitrogen, E. coli, BOD, TSS, chloride, phosphorus
RH	River Heights Golf Course (SP 14)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
S1	South First Street (SP 15)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
SW1	Southwest 1 (SP18)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
SW2	Southwest 2 (SP 17)	NIU, AES/ KWRD	July 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, TKN, total nitrogen, E. coli, BOD, TSS, chloride, phosphorus
W	Western (SP 16)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
WWTP	WKRD (SP 3)	NIU, KWRD	June 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, BOD, TSS, chloride, phosphorus
IL-02	IL_EPA-PQC-02; 1.5 MI W SYCAMORE	Illinois EPA	2011, 2016	Intensive Basin, Special Study
IL-13	IL_EPA-PQC-13; GURLER RD 2MI SW DE KALB	Illinois EPA	2016	Intensive Basin, Special Study
IL-99	IL_EPA-PQC-99; TAYLOR ST IN DE KALB	Illinois EPA	2011, 2016	Intensive Basin, Special Study

Sampling Abbreviations: EC= electrical conductivity, LDO=luminescent dissolved oxygen, TKN=total Kjeldahl nitrogen, BOD=biochemical oxygen demand, TSS=total suspended solids

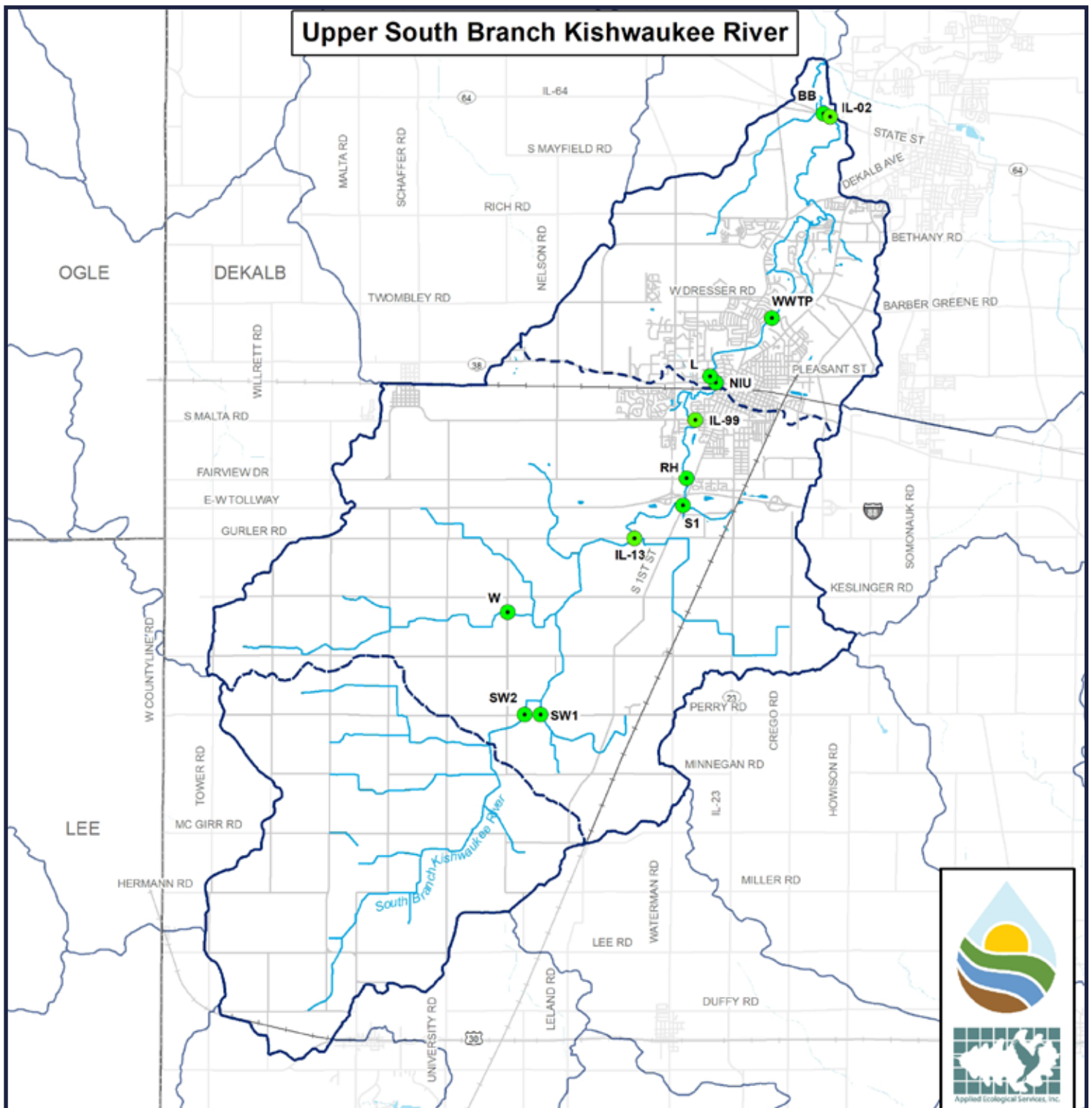


Figure 54: Existing Water Quality Monitoring Locations

0 1 2 4 Miles



- Legend**
- Roads
 - Railroads
 - Streams
 - ▭ Kishwaukee River Watershed
 - - - Kishwaukee River Subwatersheds (HUC12)
 - ▭ Adjacent Watersheds
 - Existing Water Quality Monitoring Locations

AES Project #: 16-1003
 Coordinate System:
 NAD 83 IL State Plane East
 Data Sources:
 DeKalb County



Illinois EPA lists Upper South Branch Kishwaukee River as being impaired for Fish Consumption and the lower half is also impaired for Aesthetic Quality according to the 2018 *Integrated Water Quality Report and Section 303(d) List* (Table 28). Recent water quality data collected within the Upper South Branch Kishwaukee River indicates likely overall impairment from elevated total phosphorus, total nitrogen, and total suspended solids (sediment).

Note: For the Upper South Branch Kishwaukee River watershed, the Broken Bridge (BB) and IL_EPA-PQC-02 (IL-02), as the most downstream water quality monitoring locations in the watershed, are considered the most representative of watershed-wide water quality conditions and are therefore used as the measure of watershed-wide water quality results and summaries.

The full water quality monitoring results performed by both NIU (Table 30) and AES/KWRD (Tables 31-33) depict elevated levels of nitrogen, phosphorus and sediment at multiple locations in the Upper South Branch Kishwaukee River and particularly at the Broken Bridge monitoring location which is the most downstream and fully representative of watershed conditions. The NIU sampling at the Broken Bridge location shows average phosphate at 0.7 ppm; the

phosphate guideline, converted from the phosphorus standard, is 0.222 ppm. The AES/KWRD phosphorus monitoring at Broken Bridge resulted in 0.662 mg/L on July 18th, 2019, 0.569 mg/L on August 27th, 2019, and 0.234 on December 5th, 2019, all well over the phosphorus guideline of 0.0725 mg/L. Nitrogen levels are elevated across the watershed, with NIU's data depicting 18.1 ppm average for inorganic nitrogen (NO₂+NO₃) at Broken Bridge on a guideline of 1.800 ppm, while the AES/KWRD sampling depicted total nitrogen results of 13.6 mg/L, 7.12 mg/L, and 8.07 mg/L for the baseline, rain event, and December samples, respectively, at Broken Bridge on a guideline of 2.461 mg/L. The average turbidity (a measure of the amount of solids or sediment in the water column) at Broken Bridge, as measured by NIU was 31.1 NTU on a guideline of less than 14 NTUs, while AES/KWRD sampling depicted 42 mg/L on July 18th, 20 mg/L on August 27th, and 2 mg/L on December 5th at Broken Bridge on a guideline of less than 19 mg/L. Both turbidity and total suspended solids were elevated at locations across the watershed.

AES also analyzed historical water quality for the Upper South Branch Kishwaukee River available via EPA's WQX/Storet water quality database for the last ten years (2010 through 2019). Average

sample results at IL-02, IL-13, and IL-99 for pH, dissolved oxygen, total suspended solids, chloride, total phosphorus, ammonia, inorganic nitrogen (NO₂+NO₃), total Kjeldahl nitrogen, and total nitrogen (calculated) are reported in Table 30. Site IL-02 is immediately adjacent to the Broken Bridge monitoring location, is the most downstream sample location for this data, and is considered the most representative of watershed conditions. Monitoring results at IL-02 show that phosphorus is above the criteria at 0.8305 mg/L and that both inorganic nitrogen and total nitrogen are above the guideline at 11.3 mg/L and 12.38 mg/L, respectively. This data does not, however, depict total suspended solids above the criteria, although it is just below the threshold with an average of 18 mg/L.

Upper South Branch Kishwaukee River watershed-wide averages for TP, TN, and TSS were calculated by taking all of the individual sample results for these parameters at the Broken Bridge and IL-02 sites and averaging them. The watershed-wide average reading was 0.483 mg/L of total phosphorus, 11.67 mg/L of total nitrogen, and 19.2 mg/L of total suspended solids. These watershed-wide averages will be used in the calculation of watershed-wide reduction targets.

Table 30. NIU water chemistry data (averages) for sites on Upper South Branch Kishwaukee River (2018-2019).

Site ID/ Parameter	Statistical, Numerical, or General Use Guidelines	SW1	SW2	W	S1	RH	L	NIU	WWTP	BB
Average of pH	>6.5 or <9.0*	8.2	8.4	8.2	8.4	8.2	8.2	8.3	7.8	8.0
Average of EC (uS/cm)	<1,667 µmhos/cm	428.9	296.7	354.0	451.0	429.6	456.0	517.0	496.3	522.8
Average of LDO (mg/L)	>5.0 mg/l*	9.8	10.3	10.0	9.8	9.5	9.9	10.4	9.0	9.2
Average of Turbidity (NTU)	<14 NTU**	9.0	8.2	34.6	42.6	13.0	23.5	13.6	10.4	31.1
Average of Ammonia (ppm)	<15 mg/l* (<15.017 ppm)	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.4	0.0
Average of Nitrite (NO ₂) (ppm)	<i>see NO₂+NO₃ below</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.5	0.1
Average of Nitrate (NO ₃) (ppm)	<i>see NO₂+NO₃ below</i>	12.9	16.2	20.5	6.6	15.9	10.2	10.0	18.7	18.0
Average of NO ₂ +NO ₃ (calculated)	1.798 mg/L** (1,800 ppm)	12.9	16.3	20.7	6.7	16.0	10.2	10.0	19.2	18.1
Average of Sulphate (ppm)	N/A	43.8	31.5	55.7	26.3	29.4	21.1	29.1	18.4	29.9
Average of Sulfide (ppm)	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average of Calcium (ppm)/Total Hardness	N/A	240.3	273.0	248.4	212.6	232.0	224.1	267.0	239.6	259.5
Average of Phosphate (ppm)	0.222 ppm (converted from phosphorus standard)**	0.2	0.2	0.2	0.2	0.1	0.2	0.1	1.8	0.7
Average of Total Hardness	N/A	166.7	252.5	221.7	166.7	166.7	137.8	145.0	166.7	253.3

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines

* Illinois EPA General Use Standard

** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)

*** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)

Table 31. AES and KWRD sample results for baseline on 7/18/19.

Site ID/ Parameter	Statistical, Numerical, or General Use Guidelines	SW2	NIU	WWTP Upstream	WWTP Downstream	BB
pH	>6.5 or <9.0*	7.56	7.86	7.84	7.82	7.78
BOD (mg/L)	N/A	1	7.1	15.5	7.2	6.3
TSS (mg/L)	<19 mg/l***	11	127	180	184	42
Chloride (mg/L)	<500 mg/l*	24.8	32.3	40.2	42.3	80.4
Phosphorus (mg/L)	<0.0725 mg/l**	0.035	0.25	0.341	0.518	0.662
Ammonia (mg/L)	<i>see TN below</i>	ND	0.19	0.18	0.342	0.36
Nitrite (mg/L)	<i>see TN below</i>	0.0389	0.0408	-	-	0.209
Nitrate (mg/L)	<i>see TN below</i>	9.82	5.08	-	-	7.73
Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	ND	2.85	-	-	5.83
Total Nitrogen (TN) (mg/L) calculated	<2.461 mg/l**	9.82	7.92	-	-	13.6
<i>E. coli</i> (MPN/ 100mL)	<235 MPN/100mL*	320	>1000	-	-	>1000

Table 32. AES and KWRD sample results after 1" rain event on 8/27/19.

Site ID/ Parameter	Statistical, Numerical, or General Use Guidelines	SW2	NIU	WWTP Upstream	WWTP Downstream	BB
pH	>6.5 or <9.0*	7.5	7.58	7.37	7.55	7.43
BOD (mg/L)	N/A	2.7	3.8	4	5.5	5.5
TSS (mg/L)	<19 mg/l***	8	40	14	14	20
Chloride (mg/L)	<500 mg/l*	26.5	87	110	228	186
Phosphorus (mg/L)	<0.0725 mg/l**	0.067	0.18	0.157	1.03	0.569
Ammonia (mg/L)	<i>see TN below</i>	ND	ND	0.111	0.653	0.15
Nitrite (mg/L)	<i>see TN below</i>	0.183	0.0443	-	-	0.12
Nitrate (mg/L)	<i>see TN below</i>	4.78	ND	-	-	2.66
Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	1.7	2.05	-	-	4.46
Total Nitrogen (TN) (mg/L) calculated	<2.461 mg/l**	6.48	2.05	-	-	7.12
<i>E. coli</i> (MPN/ 100mL)	<235 MPN/100mL*	248.9	1553.1	-	-	1986.3

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines

* Illinois EPA General Use Standard

** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)

*** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)

Table 33. AES and KWRD sample results on 12/5/19.

Site ID/ Parameter	Statistical, Numerical, or General Use Guidelines	SW2	NIU	WWTP Upstream	WWTP Downstream	BB
pH	>6.5 or <9.0*	7.45	7.54	7.98	7.36	7.52
BOD (mg/L)	N/A	1.2	1.2	-	-	1.8
TSS (mg/L)	<19 mg/l***	7	6	-	-	2
Chloride (mg/L)	<500 mg/l*	0	36.5	26.5	47.9	53.6
Phosphorus (mg/L)	<0.0725 mg/l**	0.042	0.052	0.076	0.117	0.234
Ammonia (mg/L)	<i>see TN below</i>	0.11	ND	-	-	0.23
Nitrite (mg/L)	<i>see TN below</i>	ND	ND	-	-	0.103
Nitrate (mg/L)	<i>see TN below</i>	6.65	6.15	-	-	6.46
Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	ND	ND	-	-	1.6
Total Nitrogen (TN) (mg/L) calculated	<2.461 mg/l**	6.65	6.15	-	-	8.07
<i>E. coli</i> (MPN/ 100mL)	<235 MPN/100mL*	19.9	35	-	-	1553

Table 34. Illinois EPA water chemistry data (averages) for sites on Upper South Branch Kishwaukee River (2011-2016).

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	IL-13	IL-99	IL-02
Average of pH	>6.5 or <9.0*	7.9	7.8	7.9
Average of Dissolved Oxygen (mg/L)	>5.0 mg/l*	10.4	7.8	8.9
Average of TSS (mg/L)	<19 mg/l***	12	10	18
Average of Chloride (mg/L)	<500 mg/l*	41.5	38.7	119
Average of Phosphorus (mg/L)	<0.0725 mg/l**	0.0688	0.086	0.8305
Average of Ammonia (mg/L)	<i>see TN below</i>	0.01	ND	0.01
Average of NO ₂ +NO ₃	1.798 mg/L**	15.7	7.5	11.3
Average of Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	0.7	0.7	1.07
Average of Total Nitrogen (TN) (mg/L), calculated	<2.461 mg/l**	16.41	8.20	12.38

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines

* Illinois EPA General Use Standard

** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)

*** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)

Noteworthy- Numeric Water Quality Standards

USEPA expects states to establish *numeric* water quality standards for nutrients (phosphorus and nitrogen) in lakes and streams. Currently, Illinois EPA has a numeric phosphorus standard for lakes and is working on developing nutrient criteria for streams. To date, Illinois EPA has not developed *numeric* standards for turbidity/total suspended solids (TSS) in streams. *Numeric* criteria have been proposed by USEPA (USEPA, 2000) for nutrients based on a reference stream method for the Corn Belt and Northern Great Plains Ecoregion (Ecoregion VI) which includes Upper South Branch Kishwaukee River watershed. The values presented in this document generally represent nutrient levels that protect against adverse effects of nutrient over enrichment. The USGS has published a document outlining recommended *numeric* criteria for sediment in streams for Ecoregion VI (USGS, 2006). These criteria are used in this report to assess the quality of Upper South Branch Kishwaukee River and tributaries to develop pollution reduction targets and measure future successes, even though Illinois EPA has not adopted these criteria as standards.

Illinois EPA and others have developed *statistical* guidelines for various pollutants other than nutrients and suspended sediment. Illinois also provides General Use water quality standards that apply to almost all waters and are intended to protect aquatic life, wildlife, agriculture, primary contact, secondary contact, and most industrial uses. *Statistical* guidelines and General Use water quality guidelines are also used in this report as a means to measure impairment and to determine pollutant reduction needs in Upper South Branch Kishwaukee River watershed.

Biological Monitoring

No biological monitoring data could be found for the watershed within the last ten years.

Wastewater Treatment Plant

There is one National Pollution Discharge Elimination System (NPDES) permitted wastewater treatment plant (WWTP) discharge to Upper South Branch Kishwaukee River. Kishwaukee Water Reclamation District (KWRD) discharges under NPDES Permit No. IL0023027 and is located near downtown DeKalb. Under its permit, KWRD is required to stay within established discharge rates for chlorine residual, biological oxygen demand, fecal coliform, ammonia

nitrogen, suspended solids, pH, and dissolved oxygen. The plant is only required to monitor total nitrogen as it is not regulated. For the purposes of this plan, KWRD provided one years' worth (October 2018 - October 2019) of monitoring data for fecal coliform, total nitrogen, total phosphorus, and total suspended solids, and the average water quality value for each parameter over that time period is depicted in Table 35, below. This data is also important for generating nutrient loading as discussed in Section 4.2. These levels are well within typical levels for WWTP effluent based on literature (IEPA, 2009). It is important to note that as a *permitted* point source, KWRD does an excellent

job of staying within its permitted discharge limits and has recently upgraded its entire facility. From late 2017 through 2019, KWRD systematically replaced its aging plant "with a modern, more efficient, treatment facility designed to meet current regulatory requirements, easily accommodate future growth and regulatory changes, and allow for the District's current facility to be re-tasked to better handle wet weather events (KWRD, 2019)."

Load limits computed based on a design average flow (DAF) of 8.63 MGD.

Table 35. KWRD NPDES permit requirements and effluent water quality average for October 2018- October 2019.

Parameter	NPDES Requirements	Average Monitoring Value Oct 2018-Oct 2019
Fecal Coliform	≤200/100 mL mo. mean	51.14/100 mL
Total Nitrogen (TN)	Monitor Only	21.82 mg/l
Total Phosphorus (TP)	72 lbs/day mo. ave. 1 mg/l mo. ave	2.45 mg/l
Total Suspended Solids (TSS)	864 lbs/day mo. ave. 12 mg/l mo. ave	6.02 mg/l

4.2 Pollutant Loading Analysis

The USEPA modeling tool called STEPL (Spreadsheet Tool to Estimate Pollutant Loads) was used to estimate the existing nonpoint source load of nutrients (nitrogen & phosphorus) and sediment from Upper South Branch Kishwaukee River watershed as a whole and by individual Subwatershed Management Unit (SMU). The model uses land use/cover category types, precipitation, soils information, existing best management practices, and other existing conditions data information. The model outputs average annual pollutant load for each of the land use/cover types. The results of this analysis combined with known outfall information from the wastewater treatment plant (WWTP) was used to estimate the total watershed load for nitrogen, phosphorus, and sediment and to identify and map pollutant load "Hot Spot" SMUs. It is important to note that STEPL is not a calibrated model, although every effort was taken to include all current and available data.

Kishwaukee Water Reclamation District (KWRD) contributes the highest estimated nutrient (nitrogen

and phosphorus) loading to Upper South Branch Kishwaukee River watershed (Table 36 & Table 37). Annual nitrogen and phosphorus loading from Kishwaukee Water Reclamation District is estimated at 469,281 lbs/yr and 52,692 lbs/yr respectively. This accounts for about 57% of the total annual load for nitrogen and 42% of the total annual load for phosphorus. The annual load for total suspended solids/sediment (TSS) from the treatment plant is low compared to other sources. **It is important to note that KWRD is a permitted point source and does an excellent job of staying within its permitted discharge limits.**

The results of the STEPL model run at the watershed scale combined with estimated point source WWTP loading indicate that Upper South Branch Kishwaukee River watershed produces approximately 825,666 lbs/yr of nitrogen, 125,941 lbs/yr of phosphorus, and 33,775 tons/yr of sediment (Table 37; Figure 55).

Excluding the wastewater contributions to pollutant loading, cropland contributes the highest loads of nitrogen (231,584 lbs/yr: 28%), phosphorus (47,159 lbs/yr:

37%), and of sediment (17,813 t/yr: 53%). Cropland is expected to be a significant pollutant contributor since it makes up more roughly 80% of the watershed. Urban land uses contribute the second highest nutrient loads after cropland areas, with 98,634 lbs/yr (12%) of nitrogen and 15,964 lbs/yr (13%) of phosphorus per year, as well as the third highest sediment load (2,334 t/yr or 7%). Streambank erosion contributes the second highest sediment load (13,538 tons/yr: 40%) to Upper South Branch Kishwaukee River and also contributes significantly to nitrogen (18,411 lbs/yr: 2%) and phosphorus (7,088 lbs/yr: 6%) loading. Septic systems in the watershed also contribute to nutrient loading in the watershed, estimated at 7,660 lbs/yr (1%) of nitrogen loading and 3,000 lbs/yr (2%) of phosphorus loading. As expected, the STEPL model suggests that very few pollutants originate from wetland areas. Complete STEPL Model results and assumptions can be found in Appendix D.

Table 36. Estimated average annual pollutant load from KWRD.

Average Flow MGD	Average Concentration (mg/l)			Annual Pollutant Load*		
	TN (mg/l)	TP (mg/l)	TSS (mg/l)	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS (t/yr)
7.07	21.82	2.45	6.02	469,281	52,692	64.7

*Average daily flow (MGD) × average concentration (mg/l) × 3,042 (L-d-lb/gal-y-mg) = average annual load (lb-t/y)

Table 37. Estimated existing (2019) annual pollutant load by source at the watershed scale.

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%

*Not included in STEPL model, calculated based on permit reporting.

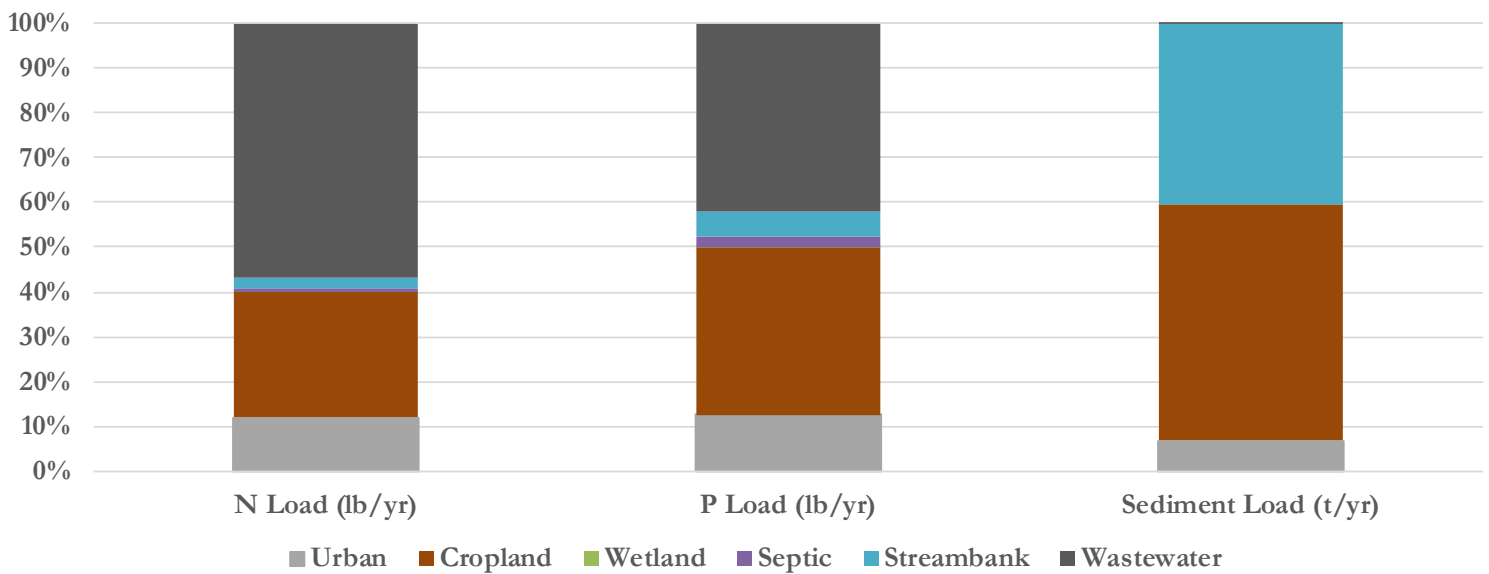


Figure 55. Estimated percent contributions to existing (2019) pollutant load by source.

The results of the STEPL model were also analyzed for nonpoint source pollutant loads at the Subwatershed Management Unit (SMU) scale. **This analysis does not incorporate the point source pollutant estimates from KWRD.** This allows for a more refined breakdown of nonpoint pollutant sources and leads to the identification of pollutant load “Hot Spots”. Hot Spot SMUs were selected by examining pollutant load concentration (load/acre) for each pollutant. Next, pollutant concentrations exceeding the 75% quartile and 50% quartile were calculated resulting in “High

Concentration” and “Moderate Concentration” nonpoint source pollutant load Hot Spot SMUs and an aggregate pollutant contribution number was calculated based on each SMUs total load per acre (the sum of the load/acre of nitrogen, phosphorus, and sediment). SMUs with a total load concentration of 8.0 or higher were categorized as “High Concentration” pollutant load hot spots, while SMUs scoring a total load concentration between 7.0 and 7.9 were determined to be “Moderate Concentration pollutant load hot spots. Any SMU exhibiting pollutant load concentrations below the 50% quartile contribute a “Low

Concentration” of pollutants relative to other SMUs. Table 38 and Figure 56 depict and summarize the results of the SMU scale pollutant loading analysis. Nine of the 34 SMUs comprising Upper South Branch Kishwaukee River watershed are considered “High Concentration” pollutant load Hot Spots for nitrogen, phosphorus, and sediment based on STEPL modeling. Another six SMUs are considered “Moderate Concentration” pollutant load Hot Spots for various combinations of nitrogen, phosphorus, and sediment. The remaining seven SMUs contribute “Low Concentrations” based on modeling.

Table 38. Pollutant load “Hot Spot” SMUs.

Hot Spot SMU	Size (acres)	N Load (lbs/yr)	N Load (lbs/yr) /ac	P Load (lbs/yr)	P Load (lbs/yr) /ac	TSS Load (t/yr)	TSS Load (t/yr) /ac	Aggregate Load Concentration
High Concentration Hot Spot SMUs								
SMU 34	1,252.7	9,292.1	7.4	2,386.3	1.9	2,100.4	1.7	11.0
SMU 22	1,543.0	10,279.4	6.7	2,647.0	1.7	2,694.7	1.7	10.1
SMU 29	3,610.0	26,939.3	7.5	5,222.6	1.4	2,722.5	0.8	9.7
SMU 32	2,158.3	16,877.7	7.8	2,953.8	1.4	982.2	0.5	9.6
SMU 28	2,628.3	17,051.4	6.5	3,969.3	1.5	1,282.9	0.5	8.5
SMU 16	1,623.6	10,105.7	6.2	2,138.6	1.3	1,121.4	0.7	8.2
SMU 26	901.0	5,731.3	6.4	1,105.6	1.2	543.7	0.6	8.2
SMU 13	1,943.5	12,014.0	6.2	2,433.5	1.3	1,135.6	0.6	8.0
SMU 24	1,693.5	10,980.4	6.5	1,973.3	1.2	603.7	0.4	8.0
Moderate Concentration Hot Spot SMUs								
SMU 17	4,124.3	25,239.9	6.1	5,066.6	1.2	2,118.2	0.5	7.9
SMU 27	1,103.4	7,041.7	6.4	1,169.5	1.1	172.3	0.2	7.6
SMU 12	1,612.1	9,133.2	5.7	1,778.2	1.1	572.2	0.4	7.1
SMU 19	1,764.9	9,623.0	5.5	1,996.2	1.1	886.5	0.5	7.1
SMU 6	1,139.8	5,949.1	5.2	1,307.4	1.1	794.9	0.7	7.1
SMU 33	1,226.6	6,434.0	5.2	1,411.6	1.2	732.7	0.6	7.0

A brief summary of “High Concentration” pollutant loading Hot Spots follows:

- SMUs 13, 16, 22, and 34 are generally dominated by agricultural land uses, from which stems the bulk of their pollutant concentration.
- For SMUs 24, 26, 28, 29, and 32, pollutant concentrations are generally driven by urban land uses in combination with agricultural areas.
- All of the “High Concentration” SMUs contain either a significant amount of stream length or streambanks with higher levels of erosion than is typically found elsewhere in the watershed (severely eroded banks, for example).

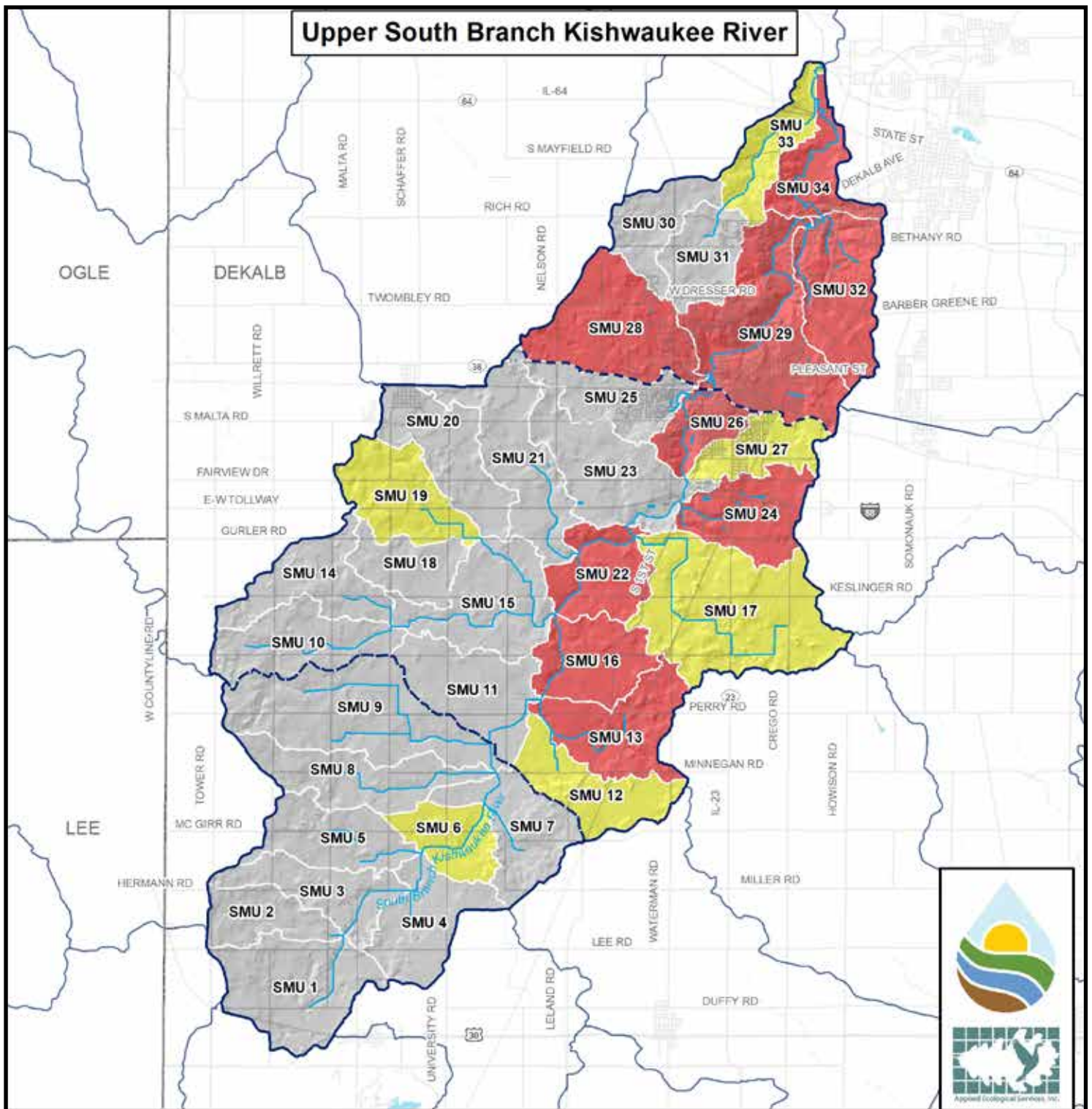


Figure 56: Nonpoint Source Pollutant Loading Hot Spot SMU's

0 1 2 4 Miles

Locator Map

Legend

- Roads
- Railroads
- Streams
- Open Water
- Kishwaukee River Watershed
- Kishwaukee River Subwatersheds (HUC12)
- Adjacent Watersheds

Pollutant Load Hot Spot SMUs

- High Concentration Pollutant Loading
- Medium Concentration Pollutant Loading
- Low Concentration Pollutant Loading

AES Project #: 16-1003

Coordinate System: NAD 83 IL State Plane East

Data Sources: DeKalb County